GOVERNMENT OF MAHARASHTRA

सत्यमेव जयते

Maharashtra State Irrigation Commission

REPORT

1962

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1962

PERSONNEL OF THE COMMISSION

1. Shri S. G. Barve, Minister for Finance, Government of Maharashtra.	*Chairman.*
2. Shri D. R. Gadgil, Director, Gokhale Institute of Politics and Economics, Poona.	*Member.*
3. Shri M. L. Champhekar, M.E., M.I.E., I.S.E. (Retd.), formerly Chief Engineer, Government of Bombay.	*Member.*
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10. Shri S. P. Mohite, I.A.S., Agriculture Commissioner, Maharashtra State.	*Member.*
11. Shri G. N. Pandit, B.Sc. (Lond.), M.I.E., I.S.E., Chief Engineer (Irrigation Projects), Maharashtra State.	*Member.*
12. Shri D. A. Gadkary, B.E., M.S.E. (I) (Retd.), formerly Director of Minor Irrigation, Maharashtra State.	*Member and Associate Secretary.*
13. Shri S. K. Bedekar, I.A.S.	*Secretary,*

STAFF

1. Shri P. R. Joglekar, Assistant Secretary.
2. Shri A. R. Kaulgud, B.E., M.S.E. (I), Executive Engineer.
3. Shri S. P. Gothoskar, M.Sc., Research Officer.
4. Shri B. G. Jambhle, D.C.E., M.S.E. (II), Deputy Engineer.
5. Shri K. S. Upalavikar, B.E., M.S.E. (II), Deputy Engineer.

EXPENDITURE INCURRED ON THE MAHARASHTRA STATE IRRIGATION COMMISSION

		Rs.	
1.	Pay and allowances of staff ..	1,16,500,	(Approx.)
2.	Travelling allowances of members, staff and witnesses	28,500,	(Approx.)
	Total ..	1,45,000,	(Approx.)

ERRATA

PAGE		
26	Line 23 ..	*Read* full stop after "area is irrigated".
34	Line 26 ..	*Delete* comma after "was available".
38	Column 11 ..	*For* "Irrigated areas)" *read* "Irrigated area".
49	Marginal heading of para 2. 6. 3.	*For* "complimentary" *read* "complementary".
94	Line 20 ..	*For* full stop after 1953 *read* comma.
112	Line 13 ..	*For* "3. 7 6." *read* "3. 7. 6".
114	Line 37 ..	*For* "dada" *read* "data".
142	Line 42 ..	*For* "volumatrice" *read* "volumetric".
152	Marginal heading of para 6. 2. 2.	*For* "on-utilisation" *read* "non-utilisation".
159	Marginal heading of para 6. 5. 1.	*For* "integrate" *read* "integrated".
171	Line 31 ..	*For* "convinient" *read* "convenient".
263	Column (11) against "Total-State".	*For* "(4)" *read* "(—)".
291	Column (3) against "Total-State".	*For* "4,41,49" *read* "4,41,40,1".
320	Line 3 ..	*For* "acreage" *read* "average".
336	Column (8) against "Ground-nut".	*Read* "6" in the blank space.
344	Column (2) ..	*For* "Ekrur" *read* "Ekruk".
349	Column (11) against "Gram".	*For* "117" *read* "11. 7".
362	Column (2) line 3 ..	*For* "51,551" *read* "51,555".

(G.C.P.) MO-B Va 930 (1,500—7-62)

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INTRODUCTION

OUR PREDECESSORS

IN INDIA, the Irrigation Commission 1901-03 held the first comprehensive and countrywide inquiry into questions of irrigation policy and practice. Subsequent all-India committees and commissions on other subjects have no doubt considered this subject, but only with reference to some of its facets, *e.g.*, the Royal Commission on Agriculture, 1928, dealt with irrigation in relation to agricultural production and the Taxation Inquiry Committee, 1953-54, has dealt with water rates and betterment levy. The report of the Irrigation Commission of 1901 still remains the only document dealing with irrigation problems of the country as a whole. The lapse of about sixty years since then has changed almost entirely the context in which that Commission deliberated.

In respect of territories which comprise the present Maharashtra State there have been some inquiries in the past, but none of a comprehensive nature since that of the Bombay Irrigation Inquiry Committee of 1938, presided over by the late Shri M. Visvesvaraya. In Bombay a committee appointed under the chairmanship of Mr. Pratt studied the problem of irrigation in the then Bombay Presidency and reported in 1921. Mr. Bristow was specially appointed by the Bombay Government in 1928 to study and report on the problems of the Deccan Canals. The Deccan Canals Financial Improvements Committee, under the chairmanship of Shri B. S. Kamat, reported in 1932. The Bombay Government appointed a sub-committee of the Cabinet in 1947 to study and report on the financial aspect of irrigation works. The C. P. and Berar Irrigation Enquiry Committee reported in 1927. No inquiry in respect of the Marathwada area has come to our notice.

Several inquiry committees and commissions at the State level, which were entrusted with the study of problems relating to agriculture, food production, famine relief, taxation, *etc.*, have, from time to time, reported on the problems of irrigation in so far as they pertained to the main subjects under their study. A large number of reports on studies of specific or local problems of irrigation conducted by official agencies, non-official organisations and individual research workers have also been published especially in recent years. To our knowledge none of the State Governments in India have had their irrigation policies and problems comprehensively investigated since the beginning of the Second World War. Our Commission thus stepped into a field largely untreaded at least for more than two decades.

Appointment of the Commission

2. The Maharashtra Government Resolution of the 7th December 1960 by which our Commission was appointed and the addendum of the 17th January 1961 are printed in Appendix 'A' to this Report.

Our terms of reference

3. Our terms of reference were as below:—

"(i) To assess the water resources of the State of Maharashtra and consider their utilisation for all purposes, namely hydro-power, irrigation, industrial and domestic use, and in particular to examine and report on the potentialities of irrigation by different means, *i.e.*, major, medium and minor irrigation works, wells, tanks, bandharas, *etc.*, in the territories of the State of Maharashtra.

(ii) After assessing the extent of irrigation facilities available from works already constructed or in progress, to consider and formulate, as far as may be, a specific plan of action for carrying out various types of irrigation works, with a view to affording protection to scarcity-affected areas as well as securing an optimum utilisation of the water resources available in the territories of the State of Maharashtra. In this connection the Commission will in particular consider the pros and cons of utilising some of the available water resources for power, alternatively to their utilisation for irrigation.

(iii) To consider problems of crop patterns and crop-planning in irrigation commands including the problems of localisation in new commands; water-logging and drainage; policy relating to supply of water from Government irrigation works to various consumers including sugar factories, industrial undertakings as well as individual farm-holdings, large and small; water-rates, including compulsory irrigation cess, full utilisation of irrigation potentialities—present and prospective; simplification of procedures as well as other problems of irrigation management, including measurement and distribution of water, repairs and maintenance of head works and the distribution system, *etc.*

(iv) To examine the financial return on existing irrigation works; to consider the question of 'betterment levy' in all its aspects; and recommend the means of ensuring, as far as may be, an adequate financial return from the various types of irrigation works, *i.e.*, productive, protective, major, minor, *etc.*

(v) To consider generally all connected and ancillary matters relating to economic development and general prosperity in the irrigated areas of the State."

A 'memorandum of instructions' was also appended to the Government Resolution dated the 7th December 1960 which can be found in Appendix 'A' of our Report.

In Maharashtra it is difficult to substantially increase agricultural production by any means other than irrigation. Prosperity of the rural areas is, therefore, dependent mainly on the extension of irrigation facilities. Unless agricultural production increases, thereby making available larger quantities of raw materials for agro-industries, industrial development also cannot be pushed very much further.

Full exploitation of the irrigation resources of the State would mean a large investment of capital. And this investment of capital must be made to yield adequate revenue to Government. Some problems like difficulties in the assessment of betterment levy, localisation of crops, continuance of certain irrigation management practices which farmers do not like and are protesting against, were also awaiting solution. It was against this background that our Commission was appointed.

It appeared to us from some of the discussions we had at the district headquarters in the State that a number of persons expected us to examine individual irrigation projects already prepared, arrange to get such projects prepared where they had not been, consider their suggestions regarding individual projects and give our verdict on their suitability and priority individually. Similarly, some expected the Commission to cover such subjects as agricultural research and extension, land reform measures, establishment of subsidiary and ancillary industries, rural credit, urban water supply, *etc.*, beyond their strictly limited relevance to irrigation problems.

We have eschewed the consideration of individual projects and have limited our discussion of the cognate subjects mentioned above only to the extent that they are relevant to irrigation problems. Mainly, we have dealt with matters of irrigation policy in all its aspects. The scope of our work can be seen from the questionnaire which was issued in January 1961 ; it is reprinted as Appendix 'B'.

Procedure of work

4. The office of the Commission started working on the 9th December 1960 and the Commission held its first meeting in Bombay on the 6th January 1961. Immediately after holding our first meeting we issued our questionnaire both in English and in Marathi. We sent the questionnaire to a large number of non-official persons connected with irrigation, associations of irrigators and other bodies expected to be interested in the problem, as well as to several officials connected with irrigation, agriculture, co-operation, *etc.* We also publicised through newspapers that any one wishing to assist the Commission by sending replies to the questionnaire was welcome to do so. In all we received 197 replies and the list of the persons and associations who have sent their replies forms Appendix 'C'.

We decided to tour the entire State and meet persons interested in the subject of our inquiry and hold informal discussions with them. We held these informal meetings in each district of the State, mostly at the district headquarters. The itinerary of our tours will be found in Appendix 'D'. During these tours we also acquainted ourselves with various local problems pertaining to irrigation.

The Commission also decided to make a comparative study, particularly of irrigation management practices, in a few States, some in the north and others in the south. Accordingly, we visited the Punjab, Uttar Pradesh, Mysore and Kerala. We could observe in these States irrigation management practices and procedures, some of which were radically different to those prevailing in Maharashtra. We feel that these visits helped us in examining objectively the merits of the procedures adopted in Maharashtra. The itinerary of our tours outside the State will also be found in Appendix 'D'.

After completing our tours, both inside and outside the State, we divided ourselves into four Panels, each for one of the following subjects:—

(i) Financial aspect of irrigation works.
(ii) Planning and execution of irrigation works.
(iii) Irrigation management.
(iv) Utilisation of the irrigation potential.

At our request Government agreed to the association of Shri Ramakrishna Ayyar, Financial Advisor, with the work of Panel I, of Shri V. B. Manerikar, Additional Chief Engineer (Irrigation Projects), with that of Panel II and of Shri L. N. Bongirwar, Registrar of Co-operative Societies and Dr. M. B. Ghatge, Director of Agriculture, with the work of Panel IV.

After the Panels completed their deliberations and formulated concrete proposals for the consideration of the Commission, we proceeded to record oral evidence of persons, of whom a list is given in Appendix 'E'. We recorded evidence at each of the four Divisional Headquarters in the State. At Bombay we also had the opportunity of having a discussion with Shri Y. B. Chavan, Chief Minister, Maharashtra State.

We met during the second week of December to finalise our conclusions and formulate our recommendations. The general elections which intervened kept some of us busy till the end of February and it was only in March that we could meet to consider the draft of our Report. Though we have taken six months more than originally intended by Government we feel that there has not been any avoidable delay and that the work has been completed as rapidly as circumstances permitted.

Layout of the Report

5. The Report is divided into eight chapters followed by seven appendices and an index. The first chapter on the 'Economic Geography of Maharashtra with reference to Irrigation' is intended to present the physical background to the problems discussed in later chapters. As such, only those aspects of the economic geography of the State are described which have a bearing on the problems of irrigation. Chapter II deals with the first part of our terms of reference, *viz.*, water resources and their utilisation. In chapter III we have dealt with the fourth

part of our terms of reference, *viz.*, an examination of the financial aspects of irrigation. Chapter IV is devoted to the formulation of irrigation projects and their execution. Chapter V deals with irrigation management and mainly covers item (iii) of the terms of reference. Chapter VI covers the fifth part of our terms of reference and deals with utilisation of irrigation facilities and development of irrigated areas. Chapter VII is devoted to research, statistics and the organisation for the reviewing of irrigation policy. The deficiencies which we have pointed out in the present method of collection and compilation of agricultural and irrigation statistics and accounting data, are, in the main, those which we came across in procuring and using those data for our purposes ; we have not attempted to examine that field exhaustively. Chapter VIII is a summary of our Report. An index has been appended separately.

We have not numbered the paragraphs in the report in a single serial order. Instead we have adopted the decimal system, in which the first digit stands for the number of the chapter, the second for the serial number of the section within the chapter and the third for the serial number of the paragraph within the section. Sub-paragraphs have not been numbered. The serial numbers of Tables mentioned in the text of the Report are those given to the statistical tables in Appendix 'F'. The maps are kept in the separate folder which forms part of the Report. We thought that maps of a smaller size, which could have been bound with the Report, would have resulted in the details getting blurred in the process of reduction of size.

Acknowledgements

6. We would like to thank those persons and organisations who sent to us their replies to the questionnaire. We realise that much time and effort must have gone into the preparation of those replies and we put on record our gratitude for the help that these replies have given to us in the formulation of our recommendations. We invited some of those who had sent replies to our questionnaire, as well as some others, to give oral evidence before the Commission. The invitations had a fairly good response and as many as 102 persons gave evidence before us. We also had a group discussion with the Chairman

and members of the Deccan Agricultural Association of Poona. The response to our invitations to farmers, social workers, *etc.*, to meet us at the various district places was enthusiastic. A large number of persons, both officials and non-officials, came all the way to attend these informal discussions, no doubt at considerable expense and inconvenience to themselves. We are very grateful to these persons for helping us in assessing the situation, particularly with reference to local conditions.

We have the most agreeable memories of our stay at the different places in the State and would like to record our thanks to all the officers and others, who made our tours so comfortable and fruitful.

We would particularly like to thank the Governments of Punjab, Uttar Pradesh, Mysore and Kerala for the excellent arrangements made by them for our tours in those States. The officers of those States with whom we had long discussions gave us the fullest help and co-operation.

Several Departments and organisations of the Maharashtra Government sent us information, both statistical and other, regarding the various aspects with which we have dealt. Mention must be made particularly of the Water Resources Investigation Circle, the Deccan Irrigation Circle (I), the Bureau of Economics and Statistics and the Statictical Section of the Agriculture Department; they furnished to us voluminous data and we realise that this must have involved arduous work. With the kind courtesy of the Director of the Gokhale Institute of Politics and Economics, Poona, we made extensive use of the Institute's library.

We are grateful to the Gokhale Institute of Politics and Economics, Poona, for doing the very laborious work of translation of the Report into Marathi.

We desire, not as a mere formality, to record our appreciation of the sincere and hard work of the entire staff of the Commission, both during our deliberations and in the preparation of this Report.

To our Secretary, Shri S. K. Bedekar, we are very grateful for the excellent arrangements he made for the tours and for the meetings of the Commission. His experience of the Agriculture and Revenue Departments and his wide knowledge of agricultural conditions in Maharashtra were of great value to the Commission. He brought to bear on his work zeal, enthusiasm and a discriminating judgment. The Associate Secretary and Member of the Commission, Shri D. A. Gadkary, has also helped immensely in the Commission's labours. Shri Gadkary, who has just retired as Director of Minor Irrigation after a long and distinguished service in the Public Works and Agriculture Departments, made available to us all the resources of his wide experience and ingenuity which were of great help in finding solutions to many of the complex issues that faced us. The Commission is deeply obliged to both these our colleagues for their valuable assistance. Shri A. R. Kaulgud, assisted by Sarwashri B. G. Jambhale and K. S. Upalavikar, handled the engineering section of the Commission's office. Shri Kaulgud's experience of irrigation management at the field level and his analytical perception of the matters in issue helped us substantially in evolving workable solutions to many of the technical problems of irrigation management. The statistical material, which forms the factual basis of our inquiry, was compiled and analysed by our Research Officer Shri S. P. Gothoskar, whose knowledge of the sources of statistical material, meticulousness in checking its validity and scientific approach to its analysis, helped us in making our examination of the data objective. Shri P. R. Joglekar, our Assistant Secretary, 'kept house' for the Commission. He had the responsibility to look after our tours, provide all secretarial and ministerial assistance and do all those things which comprise running an office, which he did very efficiently indeed. For all these services we are sincerely grateful.

7. The Report, we present, is a unanimous one. It means that we are agreed on all major points of principle and if individual opinions and preferences have been modified for the sake of presentation of the best collective view of the Commission as a whole, that has had to be done on a few matters of minor detail only.

CHAPTER ONE

Economic Geography of Maharashtra with reference to Irrigation

1.1. Physical features

GEOGRAPHICAL POSITION

1.1.1. The Maharashtra State, with an area of about 1,19,000 sq. miles (or 762 lakh acres), lies between 16.4 and 22.1 degrees north latitude. The longitudinal position is of no significance from the point of view of climate. The State is situated entirely within the tropics, but because of the high altitude the major portion of the State does not have a tropical climate associated with low annual variation in temperature and humidity. Because of its tropical position the winter in Maharashtra is comparatively mild. The State is flanked on the west by the Arabian sea and on account of this proximity to the sea, the western and southern portions of the State have a milder summer as compared to the eastern and northern portions.

NATURAL REGIONS AND TOPOGRAPHY

1.1.2. The State may be divided into three natural regions, *viz.*, (i) the Konkan coastal strip, (ii) the Godavari and Krishna basins and (iii) the Tapi basin.

(i) Except for the hilly portion near the Sahyadri range the altitude of the Konkan coastal strip varies between about 300 feet above mean sea-level to almost sea-level. The altitude is thus not high enough to affect temperatures to an appreciable extent; the result is that the winter is very mild. This area is interspersed with numerous low spurs of the main Sahyadri range, which have made it very hilly and undulated. It is more hilly in the Ratnagiri district than in the two northern districts. The large number of valleys formed between these off-shoots are narrow and are drained by short gushing streams running from east to west and meeting the Arabian Sea. The narrowness of the valleys, the sharp slope towards the sea and the heavy rainfall have combined to make the soils in the upper reaches shallow; comparatively deeper soils exist only in small patches at the bottoms of the valleys.

(ii) The coastal strip is separated from the other two regions by the Sahyadri range which, correctly described, is the precipitous edge of the Deccan plateau. The altitude of that portion of the plateau which lies in the Godavari and Krishna basins varies from about 2,000 feet in the west to about 500 feet near the eastern boundary of the State. Some hills in the Sahyadri range rise to more than 5,000 feet but the area which has an altitude higher than 2,000 feet is very small. The high altitude in the western portion of the Godavari and Krishna basins makes for lower temperatures in the summer.

The Godavari basin comprises the Godavari basin-proper and the Wainganga sub-basin. The Godavari basin-proper lies between the Satmala range and the Balaghat range. The Wainganga sub-basin lies between the highland separating it from the Tapi basin and the Balaghat (not the Balaghat range to the south of the Godavari basin-proper) hills on the eastern borders of the State. The Wainganga sub-basin is also relatively flat except in the upper reaches, which lie on the northern border of the State. The Godavari basin-proper is narrow and hilly in its upper reaches in the west and gradually becomes broader and flatter eastwards.

The Krishna basin is divided into the Krishna basin-proper and the Bhima sub-basin. The Bhima sub-basin lies between the Balaghat range and the Mahadeo range. The Krishna basin-proper extends from the Mahadeo range to the southern border of the State. The Bhima sub-basin, like the Godavari basin-proper, is hilly in the west and broader and flatter in the east. The broader parts of the Krishna basin-proper mostly lie outside the State, the portion within the State being more hilly and undulating in comparison to the Bhima sub-basin and the Godavari basin-proper in the north.

(iii) The Third region comprising the Tapi basin slopes from east to west and the altitude ranges from 2,000 to 500 feet. This region has a comparatively more extreme climate. The Tapi valley lies between the Satpura range in the north and the Satmala range in the south. The Tapi flows from east to west, its tributaries on the right bank running north to south and those on the left bank from south to north. Only one large tributary, the Purna, runs east to west to the south of the Tapi. On the east, the Tapi valley is separated from the Wainganga valley by a highland running north to south. Comparatively there are fewer off-shoots of the Satpura and Satmala ranges and the Tapi valley is, therefore, more flat with large stretches of deep soil areas.

Broadly speaking, the western portion of the State from the sea to about forty miles to the east of the Sahyadri range is hilly and highly undulating. In the rest of the State the degree of undulation is less and depends on the proximity of an area to one of the watersheds separating the several basins and sub-basins from each other. The location of the river basins and sub-basins described above can be seen in Map 2. The area of each basin and sub-basin is given in Table No. 15.

1.2. Climate

1.2.1. Climate is mainly determined by the combined effect of temperature, rainfall and humidity. SEASONS

Climatically there are three seasons in Maharashtra, *viz.*, the 'summer' from the beginning of March to the middle of June, the 'rainy season' from the middle of June to the middle of October and the 'winter' from the middle of October to the end of February. The summer is also called 'hot weather' or 'early *kharif*', the rainy season 'monsoon' '*kharif*' or 'late *kharif*' and winter '*rabi*'.

In Maharashtra, rain is brought by two currents, *viz.*, the south-west monsoon and the north-east monsoon. The south-west monsoon current brings between June and October about 98 per cent. of the total annual rainfall in the Ratnagiri district and about 85 per cent. in the Sholapur district. The remaining districts are in between these two limits. Thus the main precipitation all over the State is in the rainy season; winter rains brought by the north-east monsoon are of small magnitude. The south-west monsoon rains begin by about the 6th June in south Ratnagiri and rapidly extend in the north-easterly direction; by the 1st July rain has begun almost all over the State.

TEMPERATURES AND CROPS

1.2.2. The Maharashtra State can be roughly divided into four regions on the basis of temperature. The regions are shown in Table No. 1. The first region comprises the coastal districts of Konkan which have a low annual variation, very mild winters and high humidity. Here the temperatures would permit the growing of tropical crops like rice and cotton even in the *rabi* season. Crops of the temperate region like wheat cannot be grown satisfactorily in this region even in the winter.

The second region, with a high altitude and situated not too far away from the sea, covers the western portions of Nasik, Ahmednagar, Poona, Satara, Sangli and Kolhapur districts. Here temperatures during the rainy season are low permitting winter crops like potatoes and onions to be grown in that season. Winter temperatures are also low enough to enable the growing of *rabi* crops like wheat. Fruits and annual tropical crops like sugarcane can be grown very successfully. In fact, this region permits the growing of a very wide range of crops in all seasons, as far as the temperature is concerned. Humidity is low excepting during the rainy season.

The third and the fourth regions, comprising the rest of the State, differ only in degree as far as temperature is concerned; the temperatures in the fourth region are more extreme than those in the third region. In both these regions summer temperatures are high. Winter temperatures are low and humidity is high only during the rainy season. Tropical crops grow well in the rainy season and temperate crops in the winter. In these regions interchange between crops and seasons is not possible, unlike the case of summer crops which can be grown in winter in the Konkan and winter crops grown in the rainy season in the second region. For perennial tropical crops like sugarcane the summer is a little too hot and winter a little too cold. However, rarely there is frost and although there is some risk in growing crops sensitive to cold, it is not such as to warrant abandoning their cultivation altogether.

TEMPERATURE AND RAINFALL EFFECTIVENESS

1.2.3. From the point of view of plant growth the effectiveness of rainfall is governed to a large extent by the temperature obtaining in the area at the time. For instance, the beneficial effects of a satisfactorily high and assured rainfall, such as that obtaining in western Vidarbha, may be considerably offset by the prevailing high atmospheric temperatures. A comparatively light shower in the rainy season after a hot dry spell would give little benefit, if at all, to the standing crop, whereas the same amount of rain in December or January may give renewed vigour to a standing crop of *rabi* jowar.

TEMPERATURE AND ROTATION PERIODS

1.2.4. Just as effectiveness of rainfall is affected by temperatures so is the effectiveness of watering by irrigation. This is the reason for the necessity of varying the periods of rotation of watering in the three seasons. Apart from the retentive capacity of the soil, the amount of irrigation water required by a crop and the frequency of its application is mainly determined by temperature. For example, while sugarcane can stand an interval in watering of about twelve days in the rainy season and of fourteen days in the winter, it is desirable to give it a watering every ten days in the summer.

TEMPERATURE AND EVAPORATION FROM RESERVOIRS

1.2.5. Losses due to evaporation from reservoirs are governed by temperature, humidity and wind velocity. It has been estimated that losses per unit area of water-surface during March to June are about twice those sustained during the previous four months of the winter season. However, the losses in terms of absolute quantities of water lost by evaporation are about equal during the two periods, owing to a smaller area of water surface being exposed to the atmosphere during the summer months, when the reservoir level has gone down owing to draw-off for irrigation during the *rabi* season. But if the draw-off commences only at the beginning of the summer, as would happen in an area where there is no *rabi* irrigation, the total losses due to evaporation in the summer would be considerably larger.

TEMPERATURE AND CROP YIELDS

1.2.6. Crop yields, *inter alia*, depend on the level of temperature as well as on the duration of the growing period. In Maharashtra winters are mild with the result that the growing period for *kharif* crops like rice, groundnut and *kharif* jowar is ample. As far as temperature is concerned the potentiality for producing high yields of these crops is, therefore, large. The *rabi* variety of jowar which does not favour a severe winter also grows well in Maharashtra. Sugarcane is a tropical crop and favours a temperate climate, high humidity and plenty of soil moisture. The optimum temperature for its development is between 85°F (30°C) and 65°F (18° C) while temperatures in excess of 105° F (40° C) are deleterious to normal growth and those less than 50° F (10° C) arrest growth. Temperatures higher or lower than the above limits occur only occasionally over most parts of Maharashtra, with the result that sugarcane thrives well, particularly in the western and the southern portions of the Godavari, Bhima and Krishna basins.

RAINFALL 1.2.7. Map 3 shows isohyets. As stated earlier 85 to 98 per cent. of the total annual rainfall is received between June and October. Winter rains are of little value except in the low rainfall belt where about 5 to 8 per cent. of the annual precipitation is received in the winter. Here non-irrigated *rabi* crops benefit considerably even with the one or two good showers which are received in December and January. The few but heavy showers in the latter part of May and early June are also very helpful for early sowing of crops, particularly paddy, which thereby get a longer growing period. These showers are received occasionally throughout the State except in the Konkan, but with enough regularity to plan sowing of crops on that basis only in the southernmost portion of the State.

The monsoon is the heaviest on the Sahyadri edge and its neighbouring area (called Maval) to the east up to a distance of ten to fifteen miles from the edge. At the edge itself the rainfall is over 250 inches at places like Mahableshwar. It decreases rapidly as one moves west towards the sea—a distance of about 30 to 40 miles—to about 125 inches on the seacoast in the south and to about 75 inches on the seacoast in the north. The rate of decrease is still more rapid towards the east of the Sahyadri range. The rainfall at places about 10 miles to the east of the range is only about 50 inches per year. To the east of Maval is the 20 to 30 miles broad strip, running parallel to the Sahyadri range, known as the 'transition tract'. To the east of this tract lies the 'low rainfall belt', with rainfall averaging less than 25 inches, and at places even less than 20 inches. Beyond this low rainfall belt precipitation gradually increases towards the east until we have in the easternmost districts of the State rainfall averaging over 50 inches.

AREAS OF UNCERTAIN RAINFALL AND LOW PRODUCTIVITY 1.2.8. A large part of the State suffers, every now and then, from crop failures, partial or even complete. This is due to the vagaries of the monsoon. In some years the total precipitation may be considerably short of the normal and in others, while the total may be equal to the normal, it may be badly distributed, *i.e.,* there may be too many or too long dry spells, adversely affecting crop growth or even resulting in complete withering away of the crops. The lower the margin between bare adequacy in relation to the usual crops of the area and the normal rainfall of the area, the more pronounced is the effect of variation in the total rainfall on the crops grown. For drilled rice a rainfall of 45 inches is just adequate. For *kharif* jowar and bajri the limits of adequacy are about 25 and 20 inches, respectively. In areas where the normal rainfall is just at these levels, even a comparatively small shortfall may affect the crops very considerably. Similarly a longish break in the rains may affect the crops severely, particularly so if the soil on which they are grown is not retentive of moisture. Thus both the areas, *i.e.*, with 45 inches and 20—25 inches normal rainfalls, are areas of 'uncertain rainfall' with reference to the crops grown in those areas. Areas receiving high aggregate rainfall with reference to the requirements of the crops normally grown therein, are also not entirely free from crop failures—particularly partial failures—but the incidence of such failures is less frequent, principally because there is a larger cushion or margin between adequacy and normal precipitation to absorb the fluctuations caused by the vagaries of the monsoon. The low rainfall belt normally grows crops like jowar and bajri. The normal yields of these crops per unit of area are low and considering the frequency of partial or complete crop failures the average yields per acre over a period of years is undoubtedly poor; this belt is the 'low productivity area'.

Variations in the length of the rainy season

1.2.9. The normal date of the onset of the monsoon and the date of its weakening or disappearance, are important in determining the dates of sowing, the length of the growing season and the dates of harvesting. Map 4 shows the rainfall pattern in respect of each district. In areas where the onset of the monsoon is late, as is the case in the eastern portion of western Maharashtra, semi-*rabi* crops are commonly grown because the *kharif* season remaining after the onset of vigorous monsoon is too short for adequate growth of purely *kharif* crops. Where the monsoon ends early, as in the Konkan and Chanda-Bhandara area, late maturing fine rices cannot be grown on rainfall alone, except in deep soils which retain moisture for long periods or under irrigation.

Rainy days

1.2.10. The number of rainy days in the rainy season is also of importance in determining crop prospects. In a particular year there may be adequacy of the total rainfall but it may be received in a few sharp showers which would not permit the rain water to slowly sink into the soil. In the low rainfall belt less than the normal number of rainy days may leave too many days at a stretch without any rainfall whatsoever, resulting in unsatisfactory crop growth. The normal average number of rainy days in each isohyetic belt is shown in Table No. 3.

CHARACTER OF THE RAINY SEASON

1.2.11. Variations in the aggregate precipitation, in the dates of onset and cessation of the rainy season, in the number of rainy days and in the frequency and duration of dry spells determine the 'character' of the rainy season for the year. Farming practices are adjusted to the normal character of the rainy season and expectations are built on the basis of the normal character. It is the departure from the normal in a particular year which brings hardship to the farmers, the degree of hardship depending on the extent of the departure.

RAINFALL AND LIABILITY TO CROP FAILURES

1.2.12. Declaration of scarcity and famine depends on the severity and extent of the crop failure in relation to the normal crop condition of the area concerned. Thus in the low productivity area a poor yield in relation to yields elsewhere does not lead to declaration of scarcity. Here a poor crop may still represent an anna valuation of the crop which, according to the standards laid down, does not warrant the declaration of scarcity conditions. Data about declaration of scarcity and famine, therefore, do not bring out the true nature, in the absolute, of the conditions in the low productivity area. They indicate only the frequency and the severity of departure from the normal.

In its report the Fact-Finding Committee, 1960, has included a map showing the areas liable to scarcity conditions which is based mainly on data pertaining to declaration of scarcity conditions. We have reproduced it as Map 5. Its reproduction does not imply our acceptance of the inferences underlying the demarcation of scarcity areas by the Committee. It will be seen that the region in which scarcity conditions frequently prevail does not get demarcated by any of the isohyets. No direct correlation between low normal rainfall and the frequency and degree of departure of the crop season from its normal character is indicated.

1.3. Soils

GEOLOGICAL BACKGROUND

1.3.1 Soils are derived by the disintegration of rocks obtaining in the tract in question, excepting in the case of alluvial soils where the parent rock may lie in the upper reaches of the river. The major portion of the State is occupied by basalt or the Deccan trap an igneous rock. In the east, only in the eastern talukas of Nagpur district and in the Chanda and Bhandara districts and in the south at the tip of the Ratnagiri district, one finds other rock formations such as granites, schists and gneisses. On the hill tops in the Sahyadri range and in parts of Chanda, action of heavy rainfall and vegetation has transformed trap and granite into red and yellow laterite. Map 2 may be seen in this connection.

Factors affecting development of soils

1.3.2. The five important factors which take part in the development of soils are the climate, organic matter, relief, parent material and time. Parent material has been described in the preceding paragraph; in this respect there is very little variation over the major part of the State. The influence of climate, *i.e.*, temperature and rainfall, is also more or less uniform in the major portion of the State, on account of the comparatively equable temperatures and a low level of precipitation, respectively. The status of organic matter is also low over a major part of the State. Almost throughout that part of the State which has the Deccan trap base, the influence of parent material, climate and organic matter is thus more or less uniform and the soils consequently exhibit similar chemical composition, which is characterised by high base saturation, presence of free calcium carbonate, low organic matter, *etc.*

The main differences in soils are, therefore, confined to their physical characteristics, *viz.*, their texture, structure and depth. These differences are brought about by the fourth factor, *viz.*, relief or topography and the action of moving water through time—the fifth and the last factor affecting the development of soils.

Topography and soils

1.3.3. The hill ranges in Maharashtra are all remnants of large table lands, out of which valleys and low lands have been carved out by the action of water. The soil in a valley is formed of material slowly transported down the ridge by moving water. During this travel down the ridge a natural grading of the particles transported takes place. The coarser soil particles begin to be dropped earlier as the velocity of the water flow gets reduced on approaching the flatter portions of the valley. Flatter the slope finer the soil particles which get deposited in the process of soil formation. Thus soils along the cross slope of a valley range from the coarsest to the finest as one goes from the ridge to the drainage line. By reason of the same process the soil cover becomes deeper towards the drainage line. We, therefore, observe coarse and shallow soils near the ridge lines, loamy soils of medium depth in intermediate positions and deep black soils of clay-loam to clayey texture near the drainage lines. Thus over most of the State topography plays a dominant role in determining the differentiation in the physical characteristics of soils. A typical cross-section of a valley in the Deccan trap area is shown on the opposite page. The entire Deccan area is traversed by rivers and their innumerable big and small tributary rivers, nalas and streams. In each individual catchment area the variations in the physical characters described above are obtained. The result is that shallow and coarse soils exist in close proximity to fine and deep soils, with all the intervening gradations of texture and depth in between. Map 2 shows the distribution of parent material in the State and the manner in which topography affects the physical character of the soil. So far, a Statewide detailed survey of soil types has not been undertaken. The breadths of the strips of shallow and deep soils shown in the Map are based on general information collected from local officers by the Water Resources Investigation Circle of the Irrigation and Power Department. Since the Map is not based on an actual soil survey it should be taken more as a pictorial representation of the geological background and the effect of topograph described above, rather than, as accurate mapping of the actual soil conditions.

The proportion of the three types of soils mentioned above differs widely between one valley and another, depending on its breadth and slope. The Bombay Irrigation Enquiry Committee, 1938, estimated the proportions of the three types in three irrigated tracts of Western Maharashtra as below:—

Kind of soil	Nira Left Bank Canal tract	Nira Right Bank Canal tract	Pravara and Godavari Canal tract
(1)	(2)	(3)	(4)
	Per cent.	Per cent.	Per cent.
1. Light (18 inches and less in depth).	40	60	20
2. Medium (more than 18 inches but less than 4 feet in depth).	30	25	30
3. Heavy (4 feet or more in depth)	30	15	50
Total ..	100	100	100

This lack of uniformity in physical characters is significant from the point of view of the variety of crops grown and their growing seasons. For example, the more retentive soils can grow non-irrigated *rabi* crops while the shallower ones are used for *kharif* crops. The heavier soils are suitable for deep-rooted crops like cotton while the lighter ones, which are more friable, are suitable for crops like groundnut.

Physical characters also determine the suitability of a soil for irrigation and also the kind of irrigation—perennial or seasonal—for which it is suitable. Shallow soils are too easily drained and are, therefore, unsuitable for irrigation. Deep soils, particularly those with a sub-stratum of low permeability, are unsuitable for perennial irrigation.

The area of alluvial soils is comparatively small but not insignificant. These soils are developed through water transporting fine soil particles or silt over long distances and ultimately depositing them where the velocity is checked. The depth of such soils depends on the time factor. Alluvial soils are formed on the banks of most of the larger rivers, their width of coverage becoming larger in the broader and flatter valleys. Large stretches of land in the Tapi valley and in the valley of its tributary, the Purna, are of alluvial origin; the unusual breadth and depth of alluvium in these two valleys is attributed to some peculiar geological phenomenon.

MOISTURE RETENTION AND DRAINAGE CAPACITY

1.3.4. Coarser the grain and shallower the soil greater the porosity and consequently lesser the retentive capacity for moisture. The converse is the case with finer and deeper soils. Over most parts of Maharashtra the lands on the banks of rivers are undulating with a fairly acute slope towards the river bed. Therefore, although alluvial soils are generally fine-grained and fairly deep, they are generally found to be well drained over most parts of Maharashtra, on account of their lie and proximity to the natural drainage lines. Shallow soils can grow only *kharif* crops while the deeper soils can grow both *kharif* and *rabi* crops. The ability of deep soils to grow *kharif* crops is, however, limited by their capacity for drainage. If not well drained they tend to retain excessive moisture in the *kharif* season which is detrimental to plant growth.

Draining capacity is determined not only by the character of the soil but also by the character of the sub-soil. Where soils have been developed *in situ* the sub-soil usually consists of weathered and partially disintegrated rock called *Murum*. *Murum* provides easy and quick drainage. Other sub-soils are mainly *Man, Shadu* and *Chopan;* the first is fairly pervious to water while the latter two are almost impervious.

The moisture holding capacity and the draining capacity of the soil (the latter considered together with that of its sub-soil) largely determine its suitability for irrigation, as also for the type of irrigated crops it can successfully grow. If a soil is very porous, it will require too frequent waterings. On the other hand, if it is too retentive of moisture, it is liable to get puddled. Therefore, too light or too heavy soils are not suitable for irrigation. Drainage will be hampered if the sub-soil is impervious, *e.g.*, *Chopan.* The presence of *Murum* or *Kankar* at a moderate depth is, therefore, essential. Soils with a comparatively impermeable sub-strata can be irrigated only if the crops grown require light and infrequent waterings and the land is left without irrigation for a part of the year. It is, therefore, that normally only lands with a soil depth between 18 inches and 8 feet, are accepted as suitable for growing crops like sugarcane, which require heavy irrigation.

In respect of the culturable command of each major irrigation work the draining quality of the sub-soil is previously determined by taking pits and examining its condition. Maps showing lines connecting points with equal depth at which *Murum* is found are then drawn. These lines are called *Murum* Isobaths (M. I. Bs.). Another precaution taken for preventing waterlogging in irrigated areas is the fixing, in respect of each sub-catchment, of the maximum limit of acreage which may be given heavy irrigation. These are called 'X' limits. These limits are determined after studying the depth of *Murum* Isobaths, the total area of the sub-catchment and the capacity for natural drainage.

Another type of soil which is suitable only for light irrigation is the one with a saline sub-soil. Patches of such area are found to exist in several places. A large stretch of such land extending over one hundred miles exists in the Tapi-Purna valley. The width of this patch along the Purna river is about eighteen miles. Slightly saline soils or underground water lifted from such soils are, however, tolerated by some crops like cotton and by those varieties of rice which are grown in the *Khar* or saline lands on the seacoast. Growing of irrigated cotton, which requires light irrigation, can be attempted in these lands.

Lateritic soils are coarse and not retentive. They cannot, therefore, support non-irrigated *rabi* crops. Being mostly situated in hilly areas flow irrigation cannot be extended on a large scale to these soils. On account of their high porosity they also tend to consume excessive quantities of water.

Soils in the Chanda and Bhandara districts are formed *in situ* from the granites, gneisses and schists. They are sandy in nature and not retentive of moisture. They are also less fertile and are slightly acidic. Being well drained they may prove suitable for fruit crops. So far no large scale attempts have been made to ascertain their suitability for crops other than rice, which grows fairly well in these areas, particularly when aided by irrigation.

SOIL-CLIMATE COMPLEX

1.3.5. The farmer's choice of crops to be grown, the seasons in which to grow them, the yields he expects from the crops grown, the improvements in agricultural practices which can be brought about, all these are very largely determined by the nature of the climate and soil of the area concerned. This choice is influenced by factors related to climatic and soil conditions as a whole and not independently of each other. These factors coalesce to make a 'complex,' which is not only an aggregate of the individual influences of these factors, but also comprise influences produced by their interactions. This is termed the 'soil-climate complex'. Two regions which have congruent soil-climate complexes are expected to have similar crop patterns, similar problems of agricultural research and improvement, similar irrigation requirements and practices and, therefore, similar problems of irrigation management. It is, therefore, necessary to demarcate the State into regions having uniform soil-climate complexes and treat each of the regions as an entity, when dealing with problems pertaining to irrigation practice.

These soil-climatic regions potentially have a uniform crop-pattern under non-irrigated conditions; such variations as may exist between the different areas in a region are due to such extraneous factors as nearness to a market, local knowledge of the methods of growing particular crops, *etc.* Potentially each of the regions would also have a uniform crop pattern on the introduction of irrigation, provided the 'quality of service' rendered, *i.e.*, the frequency and magnitude of waterings provided, is also uniform. With a uniform quality of service such variations within a region as may be found in practice would be due to the same factors which are responsible for variations under non-irrigated conditions. The above concept would be of great value in assessing the possibilities of improvement in yields, introduction of new varieties, making changes in cultivation and manurial practices, *etc.* It would be reasonable to consider as possible the attainment of conditions obtaining in the best area within a region by the other areas within that region. Such a division into soil-climatic regions would also help in locating experimental stations for agricultural research which must evolve improved varieties and techniques suitable to each soil-climate complex. While irrigation management practices should be as uniform as possible thoughout the State variations therein may have to be made to suit local conditions but no suggestion for making a variation need be countenanced within the same soil-climatic region.

1.4. Land-use pattern

LAND UTILISATION PATTERN BY ADMINISTRATIVE DIVISIONS

1.4.1. The total geographical area of the Maharashtra State is about 762 lakh acres (according to village papers the geographical area is about 765 lakh acres). The State is divided into four divisions and twenty-six districts. The distribution of the area is shown in Table No. 4.

The total area can first be divided into two broad categories, *viz.,* (A) area not available for cultivation and (B) area available for cultivation.

Details of the area under category (A) are available under the following items:—

(*i*) Forest.
(*ii*) Barren and unculturable land.
(*iii*) Land put to non-agricultural use.
(*iv*) Permanent pasture and other grazing land.

Category (B) can be sub-divided into the following:—

(*i*) Net area sown.
(*ii*) Current fallow.
(*iii*) Culturable waste.
(*iv*) Land under tree crops and groves.
(*v*) Other fallow land.

Distribution of the geographical area between the two broad categories and further between the sub-classes of each category is given regionwise in Table No. 4. The totals for the State are reproduced below:—

	Lakh acres	Per cent. of total
(*A*) Not available for cultivation—		
(*i*) Forest	134	17
(*ii*) Land put to non-agricultural use	18	2
(*iii*) Pasture and grazing land	37	5
(*iv*) Barren and unculturable	47	6
Total (*A*) ..	236	30
	Lakh acres	Per cent. of total
(*B*) Available for cultivation—		
(*i*) Net area sown	441	57
(*ii*) Current fallow	27	4
(*iii*) Culturable waste	22	3
(*iv*) Land under tree crops and groves ..	5	1
(*v*) Other fallow land	34	5
Total (*B*) ..	529	70
Grand total ..	765	100

LAND UTILISATION PATTERN BY RIVER BASIN

1.4.2. The main basins and sub-basins into which the State has got divided have been mentioned in paragraph 1.1.2. The boundaries of these basins and sub-basins cut across the boundaries of administrative divisions such as Division and District but rarely of the Taluka. Detailed land utilisation statistics is available only by administrative divisions and not by basins and sub-basins. Estimates of total area and area available for cultivation in each basin and sub-basin have been prepared by suitably allocating talukas between them and these are shown in Table No. 15.

CROPS GROWN

1.4.3. Out of the net sown area 21 lakh acres grow more than one crop in a year. The total or gross cropped area is, therefore, 462 lakh acres. The distribution of the gross cropped area between the major crops is shown in Table No. 5, for each district in the State. Foodgrain crops, *i.e.*, cereals and pulses, occupy the major portion, *viz.*, 68 per cent, of the cropped area. Among these the four major crops are jowar, bajri, rice and wheat in that order of acreage and between them account for 76 per cent. of the area under foodgrain crops. Among the non-foodgrain crops the important ones are cotton, groundnut and sugarcane, the last named more on account of its cash value rather than because of the area occupied by it.

The importance of these crops in the different districts is, however, very far from uniform as will be seen from Table No. 5. The distribution of each crop in the State has been pictorically represented in Map. 6. Rice predominates in the Konkan and Chanda and Bhandara districts. Cotton predominates in the Nagpur and Aurangabad divisions and in the districts of Dhulia and Jalgaon. The remaining crops, *viz.*, wheat, jowar, bajri and groundnut, are dispersed almost all over the State, outside the Konkan. Sugarcane is more or less confined to the irrigated patches in the State.

The shares of Maharashtra and other States out of the total acreage under these crops in India are shown in Table No. 6. Maharashtra has the largest acreage under jowar and cotton and contributes one-third and one-fourth of the total production of those crops in the country, respectively.

CROP YIELDS

1.4.4. The yields per acre of the principal crops in the State are shown in Table No. 21. It will be seen therefrom that yields vary widely from district to district according to their soil-climate complexes. These yield figures are composite, *i.e.*, averaged over the non-irrigated as well as the irrigated area under each crop. Yield figures and consequently production estimates are not available for the two categories separately.

1.5. Present extent and pattern of irrigation

SOME DEFINITIONS

1.5.1. Before proceeding to examine the present extent and pattern of irrigation in the State, connotations of certain terms used are given below:

Net irrigated area is the area of land to which irrigation water is actually applied during a part or the whole of the year and on which one or more crops are grown during the year.

Gross irrigated area is the area of crops grown under irrigation during the year; thus an area of land which has grown two irrigated crops during the year is counted twice.

Basic cane area is the area under sugarcane allowed to be planted or retained as ratoon, during the year.

Cane overlap area is that area under sugarcane at any one time during the year, which is in excess of the basic cane area.

Total sugarcane area is the total of basic cane area and cane overlap area.

Area assessed but not irrigated is the area in respect of which the cultivator has been required to pay water charges but for which irrigation water, though made available, was not used owing to non-requirement, *e.g.*, due to sufficiency of rains, the land being actually without a crop, *etc.*

Gross command of an irrigation work is the total area to which, by virtue of the local topography, water could be supplied by gravity; this area would also include area not available for cultivation but to which, topographically, water could be led. In practice it is roughly the total area between the canal on one side and the river on the other.

Culturable command of an irrigation work is the gross commanded area *minus* the area not available for cultivation.

Irrigable command of an irrigation work is that area out of the culturable command for which water available from the irrigation work in a normal year would, with a given crop pattern, suffice.

DEVELOPMENT OF IRRIGATION

1.5.2. Irrigation means supplying water to crops artificially. In this sense the practice of irrigation has been in existence since times immemorial. Wells and small surface tanks have been used for irrigation since many centuries past. Lifting or diverting water from rivers and small streams, the latter by putting temporary bunds across them, is also an ancient practice. In Maharashtra, the small flow in the rivers, excepting in the monsoon, and the difficult terrain, prevented the development of large scale irrigation works in the pre-British period. During the same period favourable terrain and the existence of large perennial rivers helped the development of irrigation in the Indo-Gangetic plain and the delta areas on the east coast, *e.g.*, the 'Grand Anicut' across the Coleroon in Madras, perhaps constructed in the second century A. D. and the numerous inundation canals from the Indus, Ravi, Yamuna, *etc.*, situated in the Punjab and U. P. which were constructed by Muslim and Sikh rulers.

The first large scale irrigation work in Maharashtra was the Krishna Canal which was opened in 1870. The canal takes off from a diversion weir across the river and the irrigated area fluctuates with the available flow. It was clear that irrigation in Maharashtra could not be stable unless it was based on storage. The first canals fed from storage were the Mutha canals taking off from the Khadakwasla reservoir. This work dates from 1875. This was followed by the opening of the Nira Left Bank Canal fed by the Bhatghar reservoir, in 1885, Girna Canals fed from the Chankapur reservoir, in 1910, the Godavari Canals fed by the Darna reservoir, in 1911, the Pravara Canals fed from the Bhandardara reservoir, in 1920 and the Nira Right Bank Canal deriving its supply from the enlarged Bhatghar reservoir, in 1930. In the Vidarbha area irrigation on the Ramtek, Ghorajheri, Asola-Mendha and Naleshwar tanks was started in 1909, 1910, 1911 and 1919, respectively. In Marathwada no fair sized work was completed till 1954. Thus since 1930 and until the completion of the Gangapur reservoir in 1954, *i.e.*, for about twenty-five years, no new major work was commissioned in the State.

PRESENT EXTENT OF IRRIGATION

1.5.3. Out of the total gross cropped area of 462 lakh acres the gross irrigated area is only about 27 lakh acres, or about 6 per cent. On the net sown area the percentage of net irrigated area is 5.2 which is the lowest amongst all the sixteen major States in India. Comparative figures are given in Table No. 9. The distribution of the total irrigated area between the districts and the percentages of the irrigated area to the gross sown area in each district are shown in Table No. 7. It brings out the fact that the percentage of irrigated area to the gross cropped area is significant only in a few districts, *e.g.*, Bhandara (25), Chanda (16), Satara (12), Sholapur (10) and Ahmednagar (10).

CROPS IRRIGATED

1.5.4. The distribution of irrigation by principal crops is indicated in Table No. 7. Of the irrigated area 81 per cent. is under food crops other than sugarcane, 10 per cent. under sugarcane and non-food crops account for the remaining 9 per cent. It will be seen from Table No. 12 that the percentage of the area of a crop which is irrigated varies widely from one district to another. For example, out of the major rice growing districts, Chanda, Bhandara and Nagpur have about 50 per cent. of the rice area under irrigation while the corresponding percentage in Ratnagiri is 3.4 and in Kolaba and Thana it is less than one per cent.

From the point of view of percentage of the cropped area under irrigation Bhandara and Chanda are the first two districts in the State. This is an area which receives about 45 inches of rain, which often ceases, or at least becomes uncertain, by the middle of September. Growing of late maturing varieties of rice is possible only if irrigation water is available during the period from about the middle of September to the end of October or middle of November. This is provided by the large number of small village tanks in the two districts.

Wheat is grown as a dry *rabi* crop throughout the State, except in the Konkan districts. In deep retentive soils it does not need the assistance of irrigation. However, where the soil is not so retentive or when wheat is a second crop after a *kharif* crop, irrigation is inescapable. And yet in the State as a whole only about 15 per cent. of the wheat area is irrigated *Rabi* jowar is irrigated in circumstances somewhat similar to those of wheat. Most of the irrigated jowar is in Poona and Aurangabad divisions. Amongst the non-foodgrain crops the only important crop is sugarcane. Sugarcane cannot be grown without irrigation and, therefore, the entire sugarcane area is under irrigation. The important sugarcane growing districts are Ahmednagar, Kolhapur, Poona, Nasik and Sholapur which together account for about 70 per cent. of the sugarcane area in the State.

Table No. 8 shows the distribution of the gross irrigated area by crops in other States in India. It will be seen therefrom that rice is the predominant irrigated crop in Andhra Pradesh, Assam, Bihar, Jammu and Kashmir, Kerala, Madhya Pradesh, Madras, Orissa and West Bengal while wheat is the predominant irrigated crop in Gujarat, Punjab, Rajasthan and Uttar Pradesh. Of the remaining crops sugarcane is important in U. P. and cotton in the Punjab.

SOURCES OF IRRIGATION

1.5.5. The main types of irrigation works are (i) large storage reservoirs, (ii) diversion bandharas, (iii) medium and small tanks and (iv) wells. There are also miscellaneous sources such as lifts from rivers, temporary diversions on small streams, *etc*. The distribution of the irrigated area by sources is shown in Table No. 10. Government canals emanate from large reservoirs, diversion bandharas and large tanks constructed by Government. During 1956-57 to 1958-59 on an average Government canals irrigated only about 1.2 per cent. of the net cropped area and about 22 per cent. of the net irrigated area in the State. Table No. 10 also shows the percentage shares of each source of irrigation in each district of the State. Government canals are an important source of irrigation only in Western Maharashtra and Vidarbha where they account for 31 and 15 per cent. of the total irrigated area, respectively. In the remaining regions, *i.e.*, in Konkan and Marathwada, Government canals irrigate only about two per cent. of the total irrigated area. 'Private canals' are mostly from temporary diversions on small streams. The area under private canals lies entirely in the Konkan and Western Maharashtra, since small streams rising in the hills and having a post-monsoon flow largely exist only in these regions. Ratnagiri and Satara districts account for 73 per cent. of the total area in the State under private canals. 'Tank' irrigation accounts for 19 per cent. of the total irrigated area of the State and ninety-one per cent. of the area under tank irrigation is in the Chanda and Bhandara districts. Wells account for more than one-half of the total irrigated area in the State. It is only in Vidarbha that their share out of the total irrigation is only 15 per cent. In Konkan and Western Maharashtra wells contribute 55 and 60 per cent. of the total irrigated area, respectively, while in Marathwada as much as 94 per cent. of the total irrigation is by wells. 'Other sources' are the miscellaneous artifices for irrigation, *e.g.*, lifts from rivers, which do not contribute materially to the total irrigated area except in the Kolhapur district where other sources account for 58 per cent. of the irrigated area.

Table No. 11 shows the importance of the different sources of irrigation in other States in India. It will be seen that wells are the most important source of irrigation in Gujarat, Rajasthan and Uttar Pradesh. Tanks are important in Andhra Pradesh, Madras, Mysore, West Bengal and Orissa. Government canals contribute a large share in Andhra Pradesh, Kerala, Madhya Pradesh and the Punjab and private canals are the most important contributors to the total irrigated area in Assam and Jammu and Kashmir.

1.6. Effect of irrigation.

EFFECT ON THE SOIL-CLIMATE COMPLEX

1.6.1. The fact that the yields of crops in Maharashtra are low as compared to those in other States in India may be seen from Table No. 22. Under non-irrigated conditions the soil-climate complex chiefly determines the level of yields. We have a fairly large proportion of light shallow soils which do not give good yields but our medium and deep soils are fairly fertile and given enough moisture yield well. Rainfall is the principal factor affecting yields of non-irrigated crops and in this respect the major portion of Maharashtra is at a considerable disadvantage. Excepting in the Konkan and the eastern districts of Vidarbha and Marathwada rainfall is inadequate for the optimum growth of crops. This is the main reason for the low crop yields in Maharashtra as a whole. Although we can grow a wide variety of crops and some of them in more seasons than one, we have to grow almost all of them under comparatively less favourable rainfall conditions.

This situation is, however, almost entirely changed when irrigation is available. Irrigation removes the deficiency of moisture. Moreover, when moisture is freely available, manuring can be heavy and with large doses of manure even comparatively poor soils can give high yields. Similarly the inferiority of light soils in respect of retentivity is almost completely removed by irrigation. What cannot be corrected by irrigation is only the temperature; the limits set by temperature continue to affect yields in spite of irrigation.

EFFECT ON GROSS CROPPED AREA

1.6.2. In Maharashtra the scope for increasing the area under cultivation is severely limited. But irrigation makes possible the use of the available land resources more intensively, by keeping land under crops for a longer period in the year, than is possible merely with soil moisture derived from natural precipitation. For example, with irrigation we can grow late maturing varieties of rice in shallow soils, long staple cotton which is a ten month crop and sugarcane which is a perennial crop. Secondly, we can grow more than one crop in a year, *e.g.*, a *rabi* crop following a *kharif* crop in the same land or a summer crop following a *rabi* crop. The extent of increase in the cropped area due to irrigation can be gauged from the following. The total sown area in the State is 441 lakh acres out of which 21 lakh acres, or only about 5 per cent., are double cropped. The net area under irrigation is 23.2 lakh acres out of which 3.5 lakh acres, or about 15 per cent., are irrigated more than once.

INTRODUCTION OF NEW CROPS AND NEW VARIETIES OF EXISTING CROPS

1.6.3. Irrigation makes possible the introduction of those crops which cannot be grown except under irrigation in the soil-climate complex of the area concerned. Sugarcane and most fruits cannot be grown without irrigation anywhere in Maharashtra. The introduction of certain varieties of crops is also possible only under irrigation, either because the growing seasons of those varieties must begin before the monsoon breaks out or last beyond the cessation of the monsoon.

INCREASE IN YIELDS DUE TO IRRIGATION

1.6.4. Comparison of yields under irrigated and non-irrigated conditions is rendered difficult on account of the absence of reliable data concerning them. 'Standard normal yield' figures are available for irrigated and non-irrigated crops separately. But these standard normal yields have been fixed on the basis of opinions of local officers of the Revenue and Agriculture Departments. These data are, therefore, of little value in assessing the increase in yield due to irrigation. Crop-cutting experiments annually conducted on the principal crops are not designed to obtain average yields of irrigated and non-irrigated crops separately. During the tours of the Commission and in the evidence of witnesses many progressive cultivators and others gave their estimates of average yields of irrigated crops obtained in the canal irrigated areas with which they were familiar. We have summarised their opinions into average figures of yield for each principal irrigated crop. These figures are given in column 3 of Table No. 38. The average figures of yields under all types of irrigation together would no doubt be of a lower order than those in Table No. 38 which pertain only to areas irrigated by Government canals. As shown in the following paragraph yields under well irrigation are considerably lower than those under canal irrigation.

VARIATIONS IN THE INCREASE IN YIELD ACCORDING TO SOURCES OF IRRIGATION

1.6.5. The magnitude and the period of availability of irrigation water varies between one source and another. This has a considerable effect on the yields of some crops. In the case of seasonal crops the differences in yields are not large, since more or less enough irrigation water becomes available even from sources which have a supply only for a limited period. It is in the case of perennial crops like sugarcane and fruits that the difference becomes appreciable. Data regarding yields of crops irrigated from different types of irrigation, *e.g.*, perennial canals, seasonal canals, wells, tanks, *etc.*, are not available.

However, a rough comparison between the yields of sugarcane under canals, lift irrigation and wells is possible. In 1953-54 a crop cutting survey on sugarcane was carried out by the Agriculture Department in the canal zone of the Ahmednagar district. It showed that the average yield of sugarcane was 42.8 tons per acre for plant (*Suru*) and ratoon crops and 62.8 tons per acre for the *Adsali* crop. Considering that about 50 per cent. of the sugarcane area under major canals grows *Adsali*, the average yield per acre would work out to 52.8 tons, with an average overlap of 33 per cent. The yield per acre per year would, therefore, be about 40 tons in the area in which this crop cutting survey was carried out. The total sugarcane area under major canals is 66,000 acres and if the yield in this area is taken at 40 tons per acre per year the total production of this area would be about 26.4 lakh tons. Deducting this quantity from the total sugarcane production in the State the estimated production in the sugarcane area irrigated by sources other than major canals, which are principally wells, would work out to about 20 tons per acre. Another survey carried out by the Agriculture Department in the Kolhapur district, with its large area of sugarcane under lift irrigation, showed that the average yield for plant cane was about 32 tons per acre, *i.e.*, about 27 tons per acre per year. The above figures cannot be considered as accurate estimates of yields of sugarcane under the three sources of irrigation, *viz.*, canals, lift irrigation and wells, but should be taken merely as indicative of the fact that large variations in irrigated yields exist according to the sources of irrigation used.

Another example is that of irrigated long staple cotton. In 1959-60, this crop was grown on about 25,000 acres in the northern talukas of Ahmednagar district, out of which only about 2,000 acres were on the Godavari and Pravara Canals. the rest being under wells. As stated in the preceding paragraph the consensus of opinion among progressive cultivators was that in the canal irrigated areas the yield was about 20 maunds. Against this, the average yield on the 25,000 acres under the crop in 1959-60, worked out from records of production maintained by the District Agricultural Officer, was only 12.6 maunds per acre. The difference in yields is clearly due to that in the sources of irrigation.

The lesser yields under irrigation from sources with a less copious supply of water are primarily due to less soil moisture and secondarily to smaller doses of manure, since larger doses can be applied only with a plentiful water supply.

EFFECT ON THE CROP PATTERN

1.6.6. Irrigation affects the crop pattern. Table No. 17 compares the acreages under different crops in two sets of neighbouring talukas, one of them having a large percentage of the area under irrigation and the other with very little irrigation.

The differences between the percentages which the different crops occupy in the respective totals show how the crop pattern changes with the introduction of perennial irrigation in an area which has had until then only the other forms of irrigation. The share of perennial crops increases appreciably and those of *rabi* crops and rice show some increase. The crop pattern under irrigation brings a much larger income per acre of the holding to the farmer, due both to the larger yields per acre and to more valuable crops having a larger proportion in the crop pattern.

CHANGES IN CROP PATTERN ACCORDING TO SOURCES OF IRRIGATION

1.6.7. The change in the crop pattern due to irrigation also varies according to the source of irrigation. This is because the different sources of irrigation have varying magnitudes and periods of availability of water. Accordingly the types of crops irrigated by them vary materially. Large storage reservoirs can supply irrigation water throughout the year and to the full measure required. The availability of water in wells varies from area to area and even from well to well in the same area. Some wells retain enough water throughout the year while others dry up by the beginning of the summer. Diversion bandharas can provide water only for *kharif* crops and sometimes to *rabi* crops but only up to the end of December or January. Tanks, like wells, may or may not retain enough water till the end of summer. Temporary diversion bandharas on small streams are mostly meant for taking water in the *rabi* season. It would have been useful to make a comparative study of the crop patterns on the different sources of irrigation and to see how they vary from each other. But data regarding areas of crops irrigated according to sources of irrigation are not being compiled, although they exist in the basic village registers. However, Table No. 16 shows the percentage shares of different crops grown under 'commercial' irrigation works in Western Maharashtra for which cropwise data are available and, by deduction from totals, those under 'other sources' of irrigation; wells account for most of the area irrigated by this residual category. The figures bring out the fact that cash crops increase considerably under Government canals.

The crop pattern on new wells was the subject of a special study conducted recently by the Agriculture Department. The results of the study are given in Table No. 18. The crop pattern under wells in the four regions of the State would show how even on the same source the crop pattern varies according to the soil-climate complex and external factors such as nearness to the market and prices.

CHANGES IN THE CROP PATTERN BY SEASONS

1.6.8. Availability of irrigation also changes the crop pattern in respect of seasons. For example, if perennial irrigation is available groundnut may be grown in the summer instead of in the rainy season or a vegetable crop may be grown in the *rabi* or summer instead of in the rainy season.

Sometimes a vegetable crop may be grown as a *kharif* crop but sown earlier or harvested later than usual, to take advantage of better market rates. The facility of growing a vegetable crop in *kharif* being more general, the farmer growing it in another season realizes a better return on account of higher prices. In the case of groundnut the irrigated summer crop gives a very much higher yield than as an irrigated monsoon crop.

Irrigation and Economic Development

1.6.9. Irrigation results in an enlargement of the gross income of the farmer which not only brings stability to agriculture but creates surpluses in the economy. In a predominantly agricultural country with a high density of population such as India, initially at least, irrigation alone can generate surpluses in the economy, without which further economic development cannot be brought about. Thus irrigation is not only important for stabilising agriculture but is the *sine qua non* for the all-round economic development of Maharashtra.

CHAPTER TWO

Water Resources and their Utilisation

2.1. Estimation of surface water resources

METHODS OF MEASUREMENT OF SURFACE WATER FLOW

2.1.1. The main resources of water in a region are (i) surface water that flows through the natural drainage channels and (ii) underground water. After a portion of the precipitation is lost by evaporation and transpiration through plants, the remainder is found either as a surface flow in the natural drainage channels or as underground water. The annual surface flow is directly dependent on the nature, duration and quantity of rainfall received in that year. Hydrologists have established a fairly accurate, though empirical, relationship between the rainfall and the total yield in the different regions of India. Some of the well-known formulæ are (a) Ingles' formula, (b) Strange's formula and (c) Binny's formula. All these formulæ are used in the Maharashtra State, though the former two are more common.

However, the most reliable method of ascertaining the run-off in a particular valley is by actually measuring it at suitable sites, preferably nearabout the sites of proposed irrigation projects. If actual observations of run-off for some years and of rainfall data for a series of years are available, the surface flow at the gauge sites, for all the years for which rainfall data are available, can be fairly accurately computed. It is, therefore, important that a sufficient number of raingauges are established in the different basins and sub-basins in the State. The data from these raingauges must be supplemented by those of actual run-off at suitable points and for as long a period as possible.

DEPENDABILITY OF SUPPLY

2.1.2. The magnitude of surface flow available in streams and rivers varies from year to year. It is, therefore, necessary to know the range and manner of variation during a period of years of the quantity of flow available in a stream. It is the knowledge of the character of this variation which enables one to forecast, with a fair degree of accuracy, the extent to which one can depend on obtaining a specified quantity of water from the flow, from year to year. This is termed the degree of dependability. Tables Nos. 24 and 25 give the annual run-off in the Nira river gauged at Vir over a period of 69 years and that in the Mutha river gauged at Khadakwasla over a period of 49 years, respectively. The Tables show the run-offs in these valleys arranged in a chronological order, as well as in the descending order of magnitude. It can be seen from these Tables that a run-off of 80,228 MCft. was available, at Vir for 50 per cent. of the years for which the data are given. Similarly, a run-off of 48,350 MCft. was available at Khadakwasla for 50 per cent. of the years. Such quantities are known as 50 per cent. dependable supplies. Similarly, the run-offs of 61,730 MCft. and 37,271 MCft., which were available at Vir and Khadakwasla, respectively, for 75 per cent. of the years are said to be 75 per cent. dependable supplies. On this basis, flows of different dependabilities of the Nira and Mutha rivers could be stated as under:—

Percentage dependability (1)		Nira (2)	Mutha (3)
50	..	80,228	48,350
60	..	73,579	45,795
65	..	70,792	42,757
75	..	61,730	37,271
80	..	56,737	36,058
90	..	39,541	32,518

In designing an irrigation project the size of the storage depends on the volume of water available with a given degree of dependability. The degree of dependability also determines the cropping pattern or rather the limits up to which crops requiring more dependable supply than others, can be grown. As such, dependability of the stored supply is of vital importance in an irrigation project.

AVAILABILITY OF SUPPLY IN THE DIFFERENT BASINS AND SUB-BASINS

2.1.3. As stated in paragraph 1.2.2 the Maharashtra State is divided into four main basins as below:—

(i) The Krishna basin with its large sub-basin of the Bhima.

(ii) The Godavari basin with its large sub-basin of the Wainganga.

(iii) The Tapi basin.

(iv) The Konkan area comprising the several small basins of west-flowing rivers.

The Krishna Basin

(a) *The Krishna basin proper* (*i.e.,* exclusive of the Bhima sub-basin).—The total water resources available in this basin, at 75 per cent. dependability, are 769 thousand million cubic feet (TMCft.). The basin covers an area of approximately 8,446 sq. miles or 54.03 lakh acres, having 39.92 lakh acres of culturable land. On account of the undulating nature of the area of the basin and consequent difficulties in having flow irrigation the area that can be brought under irrigation would be only about 25 per cent. of the culturable area. The water in this basin can be used for hydro-power generation by its westward diversion.

(b) *The Bhima sub-basin.*—This sub-basin covers an area of approximately 18,647 sq. miles (119.33 lakh acres) with 97.39 lakh acres of culturable land. An area of nearly 13,000 sq. miles (83.2 lakh acres) out of this sub-basin lies in the low rainfall zone and experiences scarcity conditions fairly frequently. The total water resources in this sub-basin, with 75 per cent. dependability, are hardly 310 TMCft. Even if the entire water resources were to be used for irrigation, they will not provide irrigation for more than 20 per cent. of the culturable area in the basin. If more water were available larger areas could be irrigated.

The Godavari Basin

(a) *The Godavari basin-proper* (*i.e.,* exclusive of the Wainganga sub-basin).—This basin covers an area of approximately 27,052 sq. miles (172.35 lakh acres) with about 147.40 lakh acres of culturable land. The total water resources available, at 75 per cent. dependability, are approximately 403 TMCft. Even if the entire water resources were used for irrigation, they would provide irrigation for only about 16 per cent. of the culturable area.

(b) *The Wainganga sub-basin.*—This sub-basin covers an area of approximately 32,630 sq. miles (208.61 lakh acres) with 114 lakh acres of culturable land. The total water resources available, at 75 per cent. dependability, are approximately 720 TMCft. These water resources are sufficient to provide irrigation to nearly 40 per cent. of the culturable area. The area which can be irrigated by the possible irrigation works would be only about 26 per cent. of the culturable area.

The Tapi Basin—This basin covers an area of nearly 19.975 sq. miles (133 lakh acres) with 83 lakh acres of culturable land. The total water resources available, at 75 per cent. dependability, are approximately 229 TMCft. They can provide irrigation for about 13 lakh acres, *i.e.*, about 16 per cent. of the culturable area.

The Konkan area—This area covers nearly 12,000 sq. miles (77 lakh acres) with approximately 43 lakh acres of culturable land. The total resources are approximately 1,500 TMCft. In spite of this very huge water potential, the irrigation possibilities are very limited on account of the difficult terrain.

The above estimates, which have been prepared by the Water Resources Investigation Circle during the course of preparation of Master Plans are based on the available run-off and raingauge data, which are not adequate for very accurate estimating. The present estimates of yield are, therefore, very approximate and liable to correction when further gauge data become available. The estimates are summarised below:—

Serial No.	Name of basin or sub-basin	Culturable area of basin (Lakh acres)	Irrigable command (Lakh acres)	Percentage of (4) to (3)
(1)	(2)	(3)	(4)	(5)
1	Krishna (proper)	39·92	10·26	25·5
2	Bhima	97·39	18·62	19·1
3	Godavari (proper)	147·40	23·67	16·0
4	Wainganga (including Penganga and Wardha).	114·00	30·14	26·1
5	Tapi	82·83	12·93	15·6
6	West-flowing rivers in Konkan	43·13	N.A.	N.A.
	Total ..	524·67	95·62	..

Note.—(i) N. A. means not available.
(ii) Culturable area excludes land under tree crops and groves.

2.1.4. An important observation needs to be made here. The total reliable flow, of a particular dependability, of the entire river basin is not merely a sum of utilisable flows (of the same dependability) at the different points of utilisation, *i.e.,* at the dam or pick-up-weir sites in the river basin. Tables Nos. 26 and 27 give the discharges at 11 and 8 different gauge sites in the Bhima and Godavari basins, respectively. If the two valleys are assumed to be formed of these 11 and 8 sub-basins, respectively, then 75 per cent. dependable flows for the entire valleys are not the sums of 75 per cent. dependable flows at the different gauge sites but more, as is evident from those Tables. The position disclosed by the two Tables is summarised below:— METHOD OF DETERMINING RELIABLE FLOW

	Bhima Basin (TMCft.)	Godavari Basin (TMCft.)
(*i*) Sum of 75 per cent. reliable flows at different gauge stations.	172·5	112·00
(*ii*) 75 per cent. reliable flows for the river basin, on the basis of sum at annual flows at different gauge stations.	196·7	128·5

The utilisable potential at the lower points in a valley should, therefore, not be based on a simple summation of potentials at the various points in the upper reaches, but on the total dependable flow for the entire valley.

2.2. Utilisation of surface water resources

2.2.1. The total available surface resources of the different river valleys and the maximum possibilities according to the present estimation are mentioned in the preceding paragraph. Utilisation prior to planned development, *i.e.,* prior to 1951, formed an insignificant portion of the maximum potential as will be seen from the Table on page 38. UTILISATION PRIOR TO 1951

The total utilisation in the State was about 200 TMCft. Of this the major portion of the utilisation was in the Bhima sub-basin where nearly 90 TMCft. were put to use, about 50 TMCft. for irrigation and 40 TMCft. for hydro-power generation by westward diversion. About 70 TMCft. were utilised in the Godavari basin including its sub-basin of the Wainganga. The rest of the quantity was utilised in the Krishna and Tapi basins. The total irrigated area was about 10.6 lakh acres, while the installed capacity for hydro-power generation was 240 M.W.

UTILISATION OF SURFACE WATER RESOURCES IN THE DIFFERENT RIVER BASINS IN THE STATE

Serial No.	Name of the river basin or sub-basin	Utilisation prior to 1951 (Approx.)			Utilisation proposed under schemes taken up in the 1st and 2nd Five Year Plans			Utilisation proposed under new schemes in the 3rd Five Year Plan		
		For irrigation TMCft.	For power TMCft.	Irrigated area (Lakh acres)	For irrigation TMCft.	For power TMCft.	Irrigated area (Lakh acres)	For irrigation TMCft.	For power TMCft.	Irrigated areas) (Lakh acres)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Krishna	15.0	..	0.8	24.5	43	1.3	32.7	37.1	1.5
2	Bhima	48.5	40.8	2.5	57.1	..	3.5	47.1	..	3.4
3	Godavari	30.0	..	1.5	110.2	..	5.5	42.6	..	2.5
4	Wainganga	40.0	..	5.0	30.3	..	2.7	37.9	12.5	2.5
5	Tapi	14.0	..	0.7	41.4	..	3.3	40.5	..	2.7
6	West-flowing rivers in Konkan.	13.0*	..	0.1	2.0	..	0.2	5.0	8.0	0.3
	Total ..	160.5	40.8	10.6	265.5	43	16.5	210.8	57.6	13.0

*Inclusive of drinking water supply requirements.

Totals for irrigation schemes in the 1st, 2nd and 3rd Five Year Plans.

(1) Total cost of irrigation schemes including minor irrigation .. .. 230 Crore Rs. (Actual expenditure till end of 1960-61 Rs. 50 crores approximately)

(2) Total utilisation—

(*a*) Irrigation	476.3	TMCft.
(*b*) Power	100.6	TMCft.
Total ..	576.9	TMCft.

(3) Area to be irrigated .. .. 29.5 lakh acres.

Of the total area of 10.6 lakh acres irrigated by surface sources prior to 1951, nearly 70 per cent. was under Government canals. The remaining 30 per cent. was mainly under katcha bandharas (in the Ratnagiri and Satara districts) under private tanks (in the Bhandara and Chanda districts) and under private lift irrigation works (in the Kolhapur district).

UTILISATION PROPOSED IN THE FIRST THREE FIVE YEAR PLANS

2.2.2. As compared to the utilisation prior to 1951, that proposed through the different irrigation and power schemes in the first three Five Year Plans is large. There are hardly any private efforts to exploit surface flows for irrigation, except co-operative lift irrigation schemes. When all the schemes of the three Five Year Plans are developed fully the utilisation will rise from 200 TMCft. to nearly 800 TMCft., *i.e.,* an increase of 300 per cent. Of this, about 100 TMCft. will initially be used for generation of hydro-power, with an installed capacity of about 750 M.W. The capital cost of the power projects concerned is about Rs. 70 crores. There is a possibility of re-utilising this water at a later stage for irrigation and for domestic and industrial use. The balance, *viz.,* 500 TMCft., will be utilised for irrigating about 30 lakh acres in the different basins. This additional utilisation of 600 TMCft. is expected to entail a capital outlay of about Rs. 300 crores, including about Rs. 70 crores on power projects.

CO-OPERATIVE LIFT IRRIGATION

2.2.3. About 132 co-operative lift irrigation societies have been registered in Maharashtra, 95 prior to 1956 and the rest thereafter. Of these, 127 societies with a membership of about 5,700 are working at present. (Proposals for registering 65 more co-operative lift irrigation societies have been received by the Co-operative Department.) Government has given them about Rs. 20.94 lakhs by way of loans during the Second Five Year Plan period. In areas where other forms of irrigation are not possible, except at a very high cost, and water is available in perennial streams, there is generally a keen demand for organising co-operative lift irrigation societies. In paragraphs 3.7.6 and 4.3.6 we have examined the financial aspect and the constructional aspect of these schemes, respectively.

2.3. Utilisation of underground water resources.

IMPORTANCE OF UNDERGROUND WATER RESOURCES

2.3.1. In the preceding paragraph we have dealt with surface water resources. The other important source is underground water. The importance of this source can be well judged from the fact that more than 50 per cent. of the total area irrigated in the State at present is under wells, which get their supply of water from underground sources. The areas irrigated by wells and other sources during the eight years from 1951-52 to 1958-59 were as below:—

Area irrigated by wells and other sources in the Maharashtra State

[hundred acres]

Area irrigated by (1)	1951-52 (2)	1952-53 (3)	1953-54 (4)	1954-55 (5)	1955-56 (6)	1956-57 (7)	1957-58 (8)	1958-59 (9)
Wells ..	10,00,1	9,88,4	10,27,3	10,84,2	11,36,6	11,71,6	11,81,7	12,88,4
Other sources	11,03,0	9,92,3	10,45,2	10,66,1	10,39,9	10,90,6	11,37,7	10,96,0
Total area irrigated.	21,03,1	19,80,7	20,72,5	21,50,3	21,76,5	22,62,2	23,19,4	23,84,4

The magnitude of underground water sources depends to a large extent on the rainfall in the region, but the annual variation in the available supply does not seem to be definitely correlated to the annual rainfall. In fact, the relationship between the total underground supply or its annual variation and annual rainfall has not so far been definitely established.

The underground water source is of particular significance to the Maharashtra State, because the surface source is limited and may provide irrigation to only about 26 per cent. of the ultimate cultivated area. The rest of the area will, therefore, have to get as much water as possible from the underground water source. As mentioned earlier 12 lakh acres or about 50 per cent. of the total area under irrigation is under wells. Of this area nearly 3 lakh acres are under perennial crops such as sugarcane, plantains and other fruit trees and the rest is under seasonal crops. The water requirements of the area which is irrigated by wells work out, at the rate of 8 feet delta for perennials and one foot delta for other crops, to about 140 TMCft. per year. This much quantity of water may, therefore, be considered to be lifted from below the ground for irrigation purposes every year.

WELL CONSTRUCTION PROGRAMME

2.3.2. The above figures show the importance of the underground source. Government have undertaken a large programme of helping farmers in digging new wells and repairing old wells, in order to increase the area under well irrigation. The wells scheme was started in the former Bombay State in 1947-48. Under the scheme tagai loans were given to the full extent of the estimated cost of construction or repairs, at a concessional rate of interest of 3.25 per cent. per annum against the normal rate of 5.5 per cent. charged on tagai loans. Subsidy was paid to the extent of 25 per cent. of the cost of construction, subject to the maximum of Rs. 500 in respect of a new well and Rs. 250 in respect of repairs to an old well. The element of subsidy was discontinued from 1951-52. An integrated scheme for the former bilingual Bombay State was introduced with effect from November 1957 which is at present operating in the Maharashtra State. Under this scheme loans up to Rs. 2,500 for the construction of a new well and Rs. 1,000 for repairs to an old well are given through co-operative land mortgage banks. A subsidy equivalent to 25 per cent. of the actual cost of construction, subject to the maximum of Rs. 500, is given for the construction of a new well. No subsidy is given for repairs to existing wells. Government bears the difference between the normal lending rate of co-operative land mortgage banks which is 7.5 per cent. per annum and the concessional rate of 4.5 per cent., and also the entire cost of subsidy.

Since the introduction of the old scheme in 1947-48 Government has helped farmers to dig about 80,000 new wells and repair about 35,000 old wells. The area under well irrigation has increased from about 10 lakh acres in 1951-52 to over 12 lakh acres in a period of eight years. In fact, between 1951-52 and 1958-59 almost the entire increase in the total irrigated area in the State was by wells alone.

In the Third Five Year Plan it is proposed to finance the construction of about 64,000 new wells, mainly in the areas already covered by or to be taken up for contour bunding. It is also proposed to provide for the repairing of 32,000 existing wells in the State. The Third Five Year Plan provides for this scheme about Rs. 480 lakhs for subsidies and for paying the differential in interest charges, while the co-operative land mortgage banks will loan about Rs. 14,50 lakhs under the scheme.

Investigation of Underground Water Resources

2.3.3. Unlike the deep alluvial soils of north India and parts of Gujarat, the soils in Maharashtra have a sub-stratum of homogeneous rock of great depth. This makes the striking of a dependable source of underground water very much a matter of chance. A sample survey conducted by the Agriculture Department in 1957-58 showed that out of the new wells constructed during the period from 1947-48 to 1957-58 over 11 per cent. had failed either on account of lack of water or inadequacy of water or unsuitability of the water available. There are areas, *e.g.*, the Loni area under the Pravara Canals and the Varud area in the Amravati district, where an excessive number of wells seems to have been dug, on the experience of existing wells which indicated good prospects of striking underground water. In these areas the digging of new wells seems to have depleted the underground storage so fast that the already established old wells are suffering from shortage of water. It is, therefore, very necessary that a scientific survey of underground water resources should be undertaken immediately. The programme of digging new wells should be adjusted to the results of the survey as they become available. Since it will take a considerable time before enough data are available from such a survey, it would be desirable in the meantime to shape the present programme of well construction on the basis of data regarding existing wells which are not being used and new wells which have failed. It would not be difficult to obtain comprehensive data regarding new wells which have failed. Locations of successful and unsuccessful wells would be a good guide to show in which areas new wells can be dug with a reasonable prospect of getting enough water. A study of unused wells would also reveal areas where prospects for new wells are not very bright. We would advocate an element of circumspection lest we end up by excavating a high proportion of useless wells, burdening the programme and the land-holders with infructuous and uneconomical expenditure in the wells programme.

Out of a total of 5,85,000 irrigation wells in the State, 1,04,000 or about 18 per cent., were out of use in 1957-58. It has been mentioned in paragraph 2.3.2 that since 1947-48 Government has helped farmers to repair about 35,000 old wells and that during the Third Five Year Plan it is proposed to finance the repairing of another 32,000 existing wells, most of which are probably out of use. Even then the irrigation potential which is being wasted at present is considerable and would be so even at the end of the Third Five Year Plan. The reasons why existing wells are out of use are numerous and differ in their importance from area to area. It is, therefore, necessary to undertake local surveys of unused irrigation wells in order to ascertain the reasons for their non-use and to adopt measures to overcome the difficulties to the extent possible. A survey of unused wells would be useful not only in revealing areas where prospects for new wells would not be very bright but also for utilising these sources of irrigation to the extent possible.

Surveys of underground resources in a geological formation such as the one obtained in Maharashtra are not in existence. It is, therefore, necessary to evolve a scientific method of assessing underground sources and establishing their relationship with the annual rainfall. We, therefore, recommend that a pilot survey should be immediately undertaken in a few representative small catchments, where a detailed investigation of the underground resources should be made to enable a fairly correct and workable method to be evolved for carrying out a Statewide survey of underground water resources. To the undertaking and eventual completion of such a comprehensive underground water survey we attach the highest importance considering the significance that well irrigation will always enjoy in Maharashtra.

2.4. Uses of water

DOMESTIC AND INDUSTRIAL REQUIREMENTS

2.4.1. The water resources of the State are mainly required for the following purposes:—

(i) Domestic water supply.
(ii) Industrial water supply.
(iii) Irrigation.
(iv) Power generation.

There cannot be two opinions that the needs of domestic water supply should receive the highest priority. Requirements on this account should be calculated not only on the basis of present day consumption but on the basis of likely consumption after about 25 years, to be estimated after considering all the relevant factors such as increase in population, tendency towards urbanisation and larger water requirements per person with the expected higher standards of living and better public health measures such as an underground sewerage system. An estimate of the water requirements for domestic supply in the entire State is given below. It indicates that a comparatively small portion of the total water resources available in the State would be required for this purpose.

Category of area	Population (Lakhs) 1961	Rate of requirement (gallons per head per day)	Requirement of the population per day (million gallons)	Annual requirements (MCft.)
(1)	(2)	(3)	(4)	(5)
Municipal corporations ..	53·86	50	270	15,800
Other urban areas	56·39	30	170	9,950
Rural areas	284·80	15	427	25,000
			Total ..	50,750
			Say, ..	50,000

Even with a 100 per cent. increase in demand in the next 25 years, total requirements may be only about 100 TMCft.

The next priority would normally be for the requirements of industries. The present day consumption on this account is only 5 TMCft. It is difficult to forecast the requirements of industries at the end of the next 25 years, but it is certain that they cannot be large in comparison to the total water reasources as a whole. Nevertheless it is necessary to make an estimate for each basin of the ultimate requirements of industry, however rough it may be, and provide for it in the Master Plan concerned. It is possible, however, that in some limited areas, *e.g.*, the Bombay-Thana, Poona and Nagpur areas, the ultimate requirements may compete with the demands for irrigation for the limited water resources locally available. As a precaution against the thwarting of industrial development in such potential zones, development of irrigation in such areas should be made on a non-permanent basis so that the required resources could be diverted to industry as and when the need develops. As a general rule, where choice is required to be made between irrigation and the needs of industry priority should be given to the latter, having in view the very much greater income and employment potential of an equal quantity of water. However, supplies to agriculture should be curtailed to meet the needs of industry only after considering the possibilities of choosing an alternative location for the industry where the demand for water would not conflict with irrigation.

Inter se PRIORITY BETWEEN IRRIGATION AND POWER GENERATION

2.4.2. Between irrigation and power generation, priority should normally be accorded to that alternative which gives the greater benefit per unit of water utilised. In comparing the benefits from the use of water for any primary purpose, its subsequent uses, if any, should also be taken into account. For instance, water utilised first for power generation may be available subsequently for irrigation, industries or for domestic use. Similarly, water which is primarily to be utilised for irrigation purposes can also be utilised for power generation on its way from the storage to the pick-up-weir or at canal falls. The Commission considers that in making a comparison of the benefits accruable from irrigation and power generation, on general grounds some weightage may have to be given to irrigation over power generation, considering that irrigation is possible only by the use of water, whereas power can be generated from alternative sources such as coal, oil and, in future, even atomic energy.

On the other hand proposals for westward diversion of waters from the Krishna basin for generation of power need, however, to be considered in the light of the fact that these areas are far removed from coal fields and the cost of thermal generation would be comparatively high. The high and dependable precipitation in the Western Ghats alongside of possibilities of exceptionally high heads for power generation and the presence of suitable sites for impounding storages, make the situation in the Western Ghats an exceptionally favourable conjuncture for hydro-power generation. Large quantities of power could be generated close to consuming centres at unusually cheap rates, using small volumes of water at high heads of 1,500 to 1,700 ft.

As a general rule power should be produced at every possible stage in an irrigation system; the disadvantage of seasonal fluctuations can be overcome by its link-up with the grid system.

The above priorities deal with the surface water resources. There will hardly be any competitive claims on underground sources, which are available locally and in small quantities.

2.5. General policy regarding the use of surface water resources for irrigation.

USE OF WATER RESOURCES OF LOWER DEPENDABILITY

2.5.1. As already pointed out earlier, water resources over a large part of the State are very limited as compared to the needs of irrigation. It should be noted that greater the dependability lesser is the quantity of water available for utilisation. At present irrigation projects are being designed to utilise flows with 75 per cent. dependability. This level of dependability has put a severe limitation on the total area that could be supplied with irrigation water. Considering the paramount importance of irrigation in economic development and the severely limited scope for coverage in the Maharashtra region, the Commission considers that it would be desirable to harness for irrigation additional quantities of water of lesser dependability. Table No. 30 indicates that about 33 per cent. additional water would become available, if the dependability is lowered from 75 per cent. to 50 per cent. The Commission, therefore, recommends that in the planning of irrigation projects in future the aim should be to utilise 50 per cent. dependable flows, especially in the basins of the Bhima, the Godavari (excluding Wainganga) and the Tapi, where water resources of 75 per cent. dependability are extremely inadequate; even 50 per cent. dependable flows would still be short to meet the demands of irrigation in these valleys. It is true that with a lower dependability the average annual utilisation over a period of years would be less in comparison to the projected utilisation and that this would increase the cost, but this increase would be counterbalanced by economies inherent in large scale construction and operation of irrigation schemes. In any case the need for more water makes the harnessing of larger supplies imperative.

EASTWARD DIVERSION OF WEST-FLOWING RIVER

2.5.2. Were it possible to do so, we would have recommended the eastward diversion into the Godavari and Bhima basins of west-flowing rivers, but the topography in the immediate western and eastern sides of the continental divide makes such diversion impracticable.

DISPERSAL OF IRRIGATION FACILITIES

2.5.3. It is clear that even after the full development of the available surface resources, the irrigated area would form only about 26 per cent. of the ultimate cultivated area. Nevertheless the bulk of the cultivable area of Maharashtra is destined to remain under dry-farming conditions, relieved in the main only by small areas of well irrigation wherever underground resources permit of this. Not only that, the farmers located in the irrigated areas, particularly where perennial cash crops can be grown, become far more prosperous than those outside such areas, but the canal irrigated areas and their environs virtually become pockets of all-round prosperity. The Commission, therefore, recommends that in each river basin irrigation facilities should be spread over as large a region as possible thereby permitting the development of pockets of prosperity all along the river course.

The acreage under cash crops which can be sanctioned in the light of the quantity of water allocated and the availability of suitable land in the area, should be distributed equitably amongst the farmers in the area. Whenever the demand for blocks, especially cash crop blocks, on a distributary exceeds the total area to be sanctioned on that distributary, sanctions should be given by a slab system. If, for example, 800 applicants have applied for 1,500 acres of cane and only 1,000 acres can be sanctioned, one-half acre should be given to each of the 800 applicants in the first slab, then another one-half acre each to all those who have asked for one acre or more, and so on, until, the limit of 1,000 acres is reached.

If such dispersal of irrigation facilities is not deliberately and properly planned in advance and the plan adhered to, lopsided development, such as the one witnessed on the existing canals, will result on the new irrigation works also. For example, even though the Pravara canals were designed to cover a culturable area of 1,57,000 acres, the area actually irrigated covers only 60,000 acres and that too only in the upper reaches of the canals. Similarly the Nira Left Bank Canal covers a culturable area of 1,43,000 acres while assured irrigation is mainly spread over 73,000 acres in the upper reaches of the canal, leaving the remaining area at the tail end with comparatively little benefit of irrigation. On the Nira Right Bank Canal assured irrigation is spread over 2,13,000 acres, leaving the tail end with 1,06,000 acres, practically without any irrigation. The Commission considers that such lopsided development should not take place, not only on individual canal systems but also along the entire river basin. Table No. 14 shows the large differences between the various talukas in respect of irrigation facilities generally, and also separately in respect of irrigation from surface sources.

The above recommendation regarding dispersal of irrigation benefits over the widest possible area of each river basin, however, requires to be modified in the case of sugarcane supply zones of established sugar factories. Sugar factories give the best and a comparatively steady return on sugarcane and are thus an important factor in the stabilisation of irrigated agriculture in Maharashtra. Sugar factories need to get their supply of cane from within a reasonable distance so as to make their working economic.

In some places cane supply zones of neighbouring sugar factories are interspersed. They should be rationalised to the extent possible. The minimum cane area required within the supply zone of each sugar factory (rationalised where necessary) should be carefully worked out and the deficiency, if any, be made up immediately. This can be effected by redistribution, lining of canals or by other measures such as introduction of the lift-*cum*-flow system of irrigation. The making up of deficiency would be subject to there being room within the 'X' limits of the several catchments in the zone concerned for allowing additional cane area. Distribution of this additional cane area should be made according to the slab system recommended by us. Revision of 'X' limits within the supply zones of sugar factories should be so timed as to make available additional 'X' limit area, if any, at the time of sanctioning additional cane area therein.

Conversion of a portion of the sugarcane area dependent on wells and situated within the supply zone of a sugar factory into that on canals (or under the lift-*cum*-flow system when that system is introduced) should also be given priority consideration while allotting additional cane area in the supply zone concerned, for the reason that sugar factories depending for a large proportion of their cane supply from areas irrigated by wells are in a comparatively disadvantageous position.

While working out the minimum cane area required within the supply zone of a sugar factory only its existing crushing capacity and sanctioned expansion, if any, for which firm commitments have already been made, should be taken into account. Merely projected or licensed expansion, not accompanied by actual investment of capital or the making of an irrevocable commitment regarding purchase of machinery, *etc.*, should not be taken into consideration.

Sanctioning additional cane areas in the manner described above would only be at corresponding expense of the principle of wide dispersal of irrigation benefits. Hence, in the future, proposals regarding location of new sugar factories or regarding expansion of existing factories should be very carefully scrutinised with a view to limiting to the minimum such infringement of the policy of wide dispersal of irrigation benefits.

As a corollary of the principle of wide dispersal of irrigation benefits, both areawise and personwise, we have recommended that individual blocks of perennial crops should be reduced in size to the extent necessary to accommodate fresh applicants. However, we feel that there should be a minimum limit below which the area under perennial crops allowed to an individual should not go. We suggest that this minimum limit should be two acres. The provisions of the Land Ceilings Act prescribe the maximum area of six acres under perennial irrigation for one individual. If a person holding more than this maximum of perennially irrigated area has to surrender a part of his non-irrigated holding by virtue of the ceiling laid down in the Act and subsequently gets his area under perennial irrigation reduced to two acres, he would have a just cause for grievance. We feel that Government should consider the implications of this recommendation and amend the Act, if necessary, to avoid unintended hardship.

2.6. General policy regarding use of other water resources for irrigation

UNDERGROUND WATER RESOURCES

2.6.1. The dispersal of irrigation facilities under other sources of irrigation, namely, underground water supply, is comparatively an easy problem and should not present any difficulty. Barring the physical limitations indicating scanty or practically no underground supply, wells can be located throughout the State to effect suitable distribution. This source of irrigation is, as has already been pointed out, important since the irrigation schemes for utilising the surface flow can hardly irrigate about 26 per cent. of the cultivated area of the State.

Use of surface and underground water resources in combination with each other

2.6.2. So far we have considered the utilisation of the two water sources separately. It is, however, possible to increase the utility of each of these sources by combining them. Experience on the old canals indicates that underground water resources get considerably increased in the command areas of canals. In the Pravara Canal system, about 10,000 acres of cane is grown on wells in the canal command, against the perennial irrigation of about 12,000 acres under flow from the canals. Similarly, on the Nira Left Bank Canal, wells irrigate about 4,500 acres of cane when the total perennial irrigation under canal flow is about 7,000 acres only. This indicates that the underground water source gets considerably enriched in the commands of canals. Experience on these canals further points out that, this underground source frequently proves inadequate in the summer months, endangering the entire crop irrigated by wells. Comparatively a small quantity of supplementary water from surface storage is enough to stabilise this area under wells. The surface flow from canals can thus be suitably combined with sub-soil water in the command areas to bring larger areas under assured irrigation. Similarly, water flowing through the nalas and drains in the canal command can also be suitably combined with canal water for increasing the area under assured irrigation.

Works which are complimentary to well irrigation

2.6.3. Experience has shown that the underground water table is considerably enriched in areas where percolation tanks, contour bunding, nala bunding, *etc.*, have been done. The scope for a well programme is considerably increased by such works apart from their utility by themselves.

Use of Sewage

2.6.4. Another way of augmenting the water supply for irrigation is the use of sewage from towns. Sewage from Poona City is being used for irrigation in this manner. It is recommended that the possibilities of combining sewage and canal water for irrigation should be explored and provided for in the irrigation projects, wherever canals run near cities and towns with a sewage system. Even if the towns in question do not have such a system at the time of construction of an irrigation work, future possibilities in this respect should be borne in mind and canals should be so designed that an adjustment later on, for taking advantage of the sewerage, can be made without difficulty.

2.7. Formulation of Master Plan

The inadequate water resources of the State make it all the more imperative that the programme of their exploitation follows a well prepared Master Plan. The Master Plan must be comprehensive and sub-divided for each river basin. It should take into consideration not only the surface resources but also the underground water resources (as increased after the introduction of irrigation). Both these sources should be considered separately and also in combination with each other. The Master Plan should provide not only for the requirements of irrigation but for domestic and industrial requirements as well, and for power generation. The possibility of increasing the command by lifting water from rivers fed from storages, even up to a head of 100 feet, should not be overlooked. Master Plans for each river basin should be publicised in the draft stage and explained to the potential beneficiaries and others. They should be finalised only after the suggestions received from the beneficiaries and others are carefully considered and, where suitable, incorporated.

The Commission recommends that the following steps should be taken while preparing Master Plans for the different basins:—

(a) In a valley all possible sites for storages and possible canal alignments should be marked out.

(b) Water should be apportioned to all such possible commands in the valley, from the source to the border of the State, in an equitable manner. While doing so the claim of an area which is a part of an administrative unit (say taluka or district) should not be denied merely on the ground that elsewhere in the administrative unit concerned, there has been sufficient development of irrigation already. While making the apportionment scarcity areas should be given weightage.

(c) Intensity at any point of distribution in a basin may be allowed to be increased above the normal, only if there is no other area lower down in that basin which can use the available water.

(d) Full lining should be resorted to particularly in respect of those sections of the canals where transit losses are likely to be heavy. Transit losses for unlined canals are normally assumed at 8 cusecs per million sq. feet area of canal section up to full supply depth. For lined canals transit losses are seen to vary from 0.5 to 1.5 cusec per MSft. of area. Assuming an average loss of 1 cusec per MSft. the saving in transit losses on account of lining of canals will be about 7 cusecs per MSft. of area. If these 7 cusecs are continuously available for the whole year, the total annual saving would be a little over 220 MCft.. Canals, however, do not run continuously at the maximum capacity. The average annual discharge is about 50 to 60 per cent. of the maximum, and the canal section below the water level for such discharge is about 80 per cent. of that for the maximum discharge. The annual saving expected by lining of one million sq. ft. area will, therefore, be approximately 175 MCft.. The cost of lining one MSft. area of the canal would, at the rate of Rs. 100 per 100 s.ft., be Rs. 10 lakhs, *i.e.*, the cost per MCft. of water saved would be Rs. 5,700.

If the old canals are lined, additional water will immediately become available at distributary head at a cost of Rs. 5,700 per MCft. while the cost of additional water through fresh storages would be about Rs. 7,550 (the sum-at-charge). Lining of old canals is, therefore, clearly profitable. In the case of new canals capital cost on lining, *viz.*, Rs. 5,700 should be compared with the capital cost of fresh storages, *viz.*, Rs. 6,000 per MCft.; it will be seen that lining of new canals is also economical.

Apart from these factors, lining of canals will make about 25 per cent. more water available at the distributary head, which otherwise would be lost during transit in the canals. This is a very important factor for consideration, especially when there is shortage of water resources in certain river basins. Lining of canals becomes justifiable on this count alone in areas of water shortage. The increase in the irrigable area due to lining of canals can be modestly placed at about 15 lakh acres. Lining of canals would also considerably reduce the proportion of damaged land. It might be possible in many cases to undertake such lining on old canal systems along with the construction of additional storages in the particular irrigation system in pursuance of the policy of optimum utilisation of water resources in each valley. The additional storage would anyhow need additional canal capacity and if the opportunity is availed of for lining the canal a part, at any rate, of the larger capacity needed for the larger storage would be available as a result of lining, and only the balance will have to be secured by widening the section.

The effect of lining would be that seepage from the canal will be reduced very considerably and this may affect supplies in a number of wells in the command. Till such time that the lift-*cum*-flow system is introduced on canals and all irrigators are brought on par with each other, the saving effected through lining (or any additional storage made available) may in the first instance be allowed to irrigators on wells whose supplies are adversely affected by lining.

Lining of canals would also remove the common objection, namely transit losses, raised against leading storage water to a considerable distance from the pick-up-weir. Lining of canals would thus help subserve the dispersal of irrigation benefits as well.

(e) In stretches along the river valley where canals are not feasible, lifts for using a portion of the river-flow including stored water should be allowed up to practicable limits. Stretches between the reservoir and the pick-up weir as well as areas adjacent to but beyond the practicable limits of flow irrigation should also be allowed to lift storage water for irrigation. Similarly areas upstream of the storage lakes should also be allowed certain quantities for lift irrigation. Even the areas on the upstream of canals up to 50 ft. head of lift should be apportioned certain water for lift irrigation.

We have made these recommendations in pursuance of the general policy of 'dispersal of benefits'. There is no justification, we feel, for denying wholly to these areas within the irrigation system or in close proximity to irrigation commands, the benefit of such irrigation as they can avail themselves of.

While giving the above concessions in order to achieve dispersal of irrigation, care will have to be taken not to adversely affect the existing irrigation unduly.

On non-notified rivers permission should be given for lifting water for irrigating both food crops and cash crops on payment of royalty charges.

(f) Major storage schemes can cover only a narrow strip of land on both the banks of the main river and its tributaries. The areas outside this zone should, therefore, be covered by medium and minor storage schemes wherever it is physically possible to do so.

(g) With 26 per cent. of the ultimate cultivated area under irrigation and an overall intensity of irrigation of 66 per cent., the area of the culturable commands of all major, medium and minor schemes will cover about 40 per cent. of the ultimate cultivated area. The remaining 60 per cent. of the area will ultimately be left uncovered by flow irrigation works. This area must, therefore, get whatever irrigation is possible from wells. Works such as percolation tanks, *nala* plugging, *etc.,* which benefit wells, should be located in this large area.

2.8. Programming for full development of irrigation resources

ESTIMATE OF MAXIMUM AREA UNDER IRRIGATION

2.8.1. It will be seen from paragraph 2.1.3 that the total area in the State which can be brought under irrigation from surface sources, excluding that in the Konkan districts, would be about 96 lakh acres. The Master Plan for the Konkan districts has not yet been completed. If about 4 lakh acres can be brought under irrigation in the Konkan, the total area under irrigation from surface sources would be about 100 lakh acres, including the area to be irrigated by lift within the culturable command. This is an estimate based on investigations carried out for harnessing 75 per cent. dependable flows, whereas we have recommended that 50 per cent. dependable flows should be made use of. However, short of carrying out a fresh series of investigations, it is not possible to indicate precisely the increase in the total potential on account of this change. As a rough estimate the increase may be put down at about 15 lakh acres. Another 15 lakh acres would be added due to less wastage of water on account of lining of canals.

The total area of the State, which is available for cultivation, is 525 lakh acres. Excluding the area which must remain without a crop as current fallow, the ultimate cultivated area would be of the order of 500 lakh acres. The area irrigated from surface sources would, therefore, be about 26 per cent. of the cultivable area.

RATE OF PROGRESS TOWARDS FULL EXPLOITATION OF RESOURCES

2.8.2. The area irrigated from surface sources which was 2.1 per cent. in 1950, will increase to about 5.4 per cent. when all the schemes started in the First and Second Five Year Plans are implemented and to 8 per cent. when the schemes in the Third Five Year Plan have been implemented. It is expected that all the schemes started in the first two Plans will be completed by 1965, which means that we will have added every year during the period from 1951 to 1965 about 0.2 per cent. of the cultivated area to the area under irrigation. If we have to proceed at this rate of progress we will be taking about 88 years after 1965 to achieve full exploitation of the surface water resources. We consider that it is both imperative and practicable to achieve the stage of full exploitation of the resources by 1980, *i.e.,* at the end of the sixth Five Year Plan period, instead of by 2053 A.D.

It may be pointed out that in respect of irrigation development India as a whole has progressed much faster than Maharashtra during the first three Five Year Plan periods. In 1951, the irrigated area in India was 17 per cent. of the net sown area while the percentage will have increased to 30 when the schemes of the first two Plans are executed. If this happens by 1965, as is assumed in the case of Maharashtra, the rate of progress will be 0.87 per cent. per annum. It may be seen from Table No. 28 that the rate of increase in irrigation, when all the schemes taken up till the end of 1960-61 are completed, is the lowest for Maharashtra amongst all the major States in India.

COST OF FULL EXPLOITATION OF SURFACE RESOURCES

2.8.3. The total utilisable surface water resources of 75 per cent. dependability have been assessed, on the basis of the surveys already made, at about 2,000 TMCft. We have suggested utilising supplies of a lower dependability up to 50 per cent. in certain basins. This may add to the annual utilisable supply about 300 TMCft. Out of this total of 2,300 TMCft. about 300 TMCft. may primarily be used for power generation. The total utilisable supply for flow irrigation would, therefore, be about 2,000 TMCft. Out of this quantity about 160 TMCft. have been harnessed for flow irrigation purposes prior to 1951. The quantity to be harnessed between 1951 and 1980 (which is the target year we are proposing for the full utilisation of the water resources) would be 1,840 TMCft.

The present capital cost of storages is about Rs. 6,000 per MCft. equivalent to about Rs. 4,700 per MCft. of annual utilisation, taking annual utilisation as equivalent to 1.28 times the live storage. As cheaper schemes get completed costlier schemes would have to be undertaken. Assuming that the average cost of all future schemes together would be 15 per cent. higher than the present capital cost, the capital cost per MCft. of annual utilisation would work out to about Rs. 5,400 and for 1,840 TMCft. of annual utilisation the total capital cost would be Rs. 994 crores or roughly Rs. 1,000 crores. About Rs. 50 crores have already been spent between 1951 and 1960 on irrigation schemes. Deducting this outlay already made, the outlay between 1961 and 1980 would have to be of the order of Rs. 950 crores. All the canals are to be lined as recommended by us. Lining will save about 15 per cent. of the water flowing through canals, *viz.*, 2,000 TMCft. The saving will, therefore, be about 300 TMCft. At Rs. 6,000 per MCft. the additional outlay required for lining would be about Rs. 180 crores. Thus the total outlay required would be Rs. 1,130 crores.

It is hardly necessary for us to add that by the very nature of things these cost calculations are extremely rough. The data available about water resources are only approximate, the assumptions regarding costs of irrigation per MCft. of water stored are based merely on generalised experience without reference to estimated costs of particular schemes; over the several years over which the programme would be spread out costs are liable to vary considerably for obvious reasons. We have attempted these cost calculations at all, only to give an idea of the order of size of financial outlay involved.

COST OF DEVELOPING OTHER WATER RESOURCES

2.8.4. The programme of exploiting surface resources should not be considered independently of schemes intended to conserve and utilise underground water resources. Amongst these the main schemes are construction of wells, contour bunding and terracing.

The total culturable command of irrigation works irrigating 130 lakh acres would be about 200 lakh acres. It is expected that out of the 130 lakh acres about 15 lakh acres would be irrigated from wells getting their water supply mainly from seepage from canals and irrigated fields. The new wells which will have to be dug for irrigating these 15 lakh acres would not cost more than about Rs. 1,000 per acre irrigated. Thus this cost has already been included in the estimate of Rs. 1,130 crores made above.

It is difficult to estimate the intensity of well irrigation in the area of 325 lakh acres which would be outside the culturable commands of irrigation projects. Their present intensity is perhaps about 3 per cent. Map 8 will show that the intensity of well irrigation varies widely from area to area. It indicates, on comparison with Map 3 showing isohyets, that the intensity of wells does not depend on the total precipitation, which largely determines the magnitude of underground supplies. The existing intensity seems to have been determined more by the need of well irrigation to ensure the success of crops in the precarious rainfall areas and also by the opportunities for growing cash crops. The intensity achieved even at present in some talukas is as high as 10 per cent. It might be reasonable to assume that the State can ultimately achieve an overall intensity of 10 per cent. in respect of well irrigation and of 7 per cent. by 1980. The total area under well irrigation outside the culturable commands would, therefore, be about 23 lakh acres. In this area, perhaps about 8 lakh acres are already under well irrigation. For bringing the remaining 15 lakh acres under well irrigation, about five lakh wells would be required and at the rate of Rs. 3,000 per well, the total cost would be

Rs. 150 crores. The entire cost of the well scheme need not, however, be provided in the State Plan since most of the amount is expected to come from the land mortgage banks. The State Plan has to provide for subsidy and the difference between the normal and concessional rates of interest. This is not expected to go beyond Rs. 50 crores.

In the 325 lakh acres of culturable area outside the canal commands, about 43 lakh acres lie in the heavy rainfall zone of the Konkan. This area would not be suitable for contour bunding. About 22 lakh acres of area has already been bunded in the State. The total area yet to be bunded in the State would thus be about 260 lakh acres and at the rate of Rs. 50 per acre the total cost would be Rs. 130 crores. It is expected that about five lakh acres can be terraced at a cost of Rs. 500 per acre. The total cost on this item would be Rs. 25 crores.

There are other items like repairs to *ex*-Malguzari tanks, repairs to old wells, drainage schemes in the canal commands, percolation tanks, *nala* bunding, *etc.*, which have to be provided for in the overall plan of development of irrigation resources. Though it is difficult to estimate the costs involved in these items, for want of a detailed survey, the outlay required is not expected to go beyond Rs. 60 crores.

TOTAL COST OF DEVELOPMENT OF WATER RESOURCES

2.8.5. The total cost of schemes for conservation and utilisation of water resources during the period from 1961 to 1980 would, therefore, be as under:—

		Rs. in crores
1.	Flow irrigation works including wells in the culturable commands.	1,130
2.	Wells outside command areas	50
3.	Contour bunding	130
4.	Terracing	25
5.	Other items	60
	Total ..	1,395 or say Rs. 1,400 crores.

Out of the total of Rs. 1,400 crores about Rs. 100 crores would be loans for contour bunding.

PLAN PROVISIONS

2.8.6. In our opinion it is absolutely necessary to complete the work of fully exploiting the irrigation potential of the State, by 1980. As stated earlier irrigation is the *sine qua non* of the economic development of Maharashtra and it is, therefore, necessary to complete the programme of irrigation development by 1980, by according to it the highest possible priority. We have noted that the provision for all the works mentioned above in the Third Five Year Plan is only Rs. 105 crores which, while it is a substantial advance on the outlays provided so far, is wholly inadequate in relation to the enormous leeway we have to make up. All efforts should, therefore, be made to increase this Plan provision to the maximum extent possible. The Plan provisions in each of the three Five Year Plan periods between 1965 and 1980 would have to be of the order of Rs. 300 to 500 crores, if the irrigation development programme outlined by us is to be completed by 1980.

सत्यमेव जयते

CHAPTER THREE

Financial Aspects of Irrigation

3.1. Financial scrutiny of irrigation projects

HISTORICAL

3.1.1. In the pre-British period no large-sized irrigation works were constructed in Maharashtra. However, a fair number of small irrigation works, *e.g.*, small village tanks and weirs on perennial streams, were constructed by landlords such as Malguzars and Khots and sometimes by the farmers themselves acting jointly. The need for irrigation, the availability of capital resources and labour and of knowledge of the technique of construction largely governed the decision of the landlord or the villagers, as the case may be, in regard to the feasibility of undertaking such an irrigation work. The benefit from the work to the landlord was his increased share in the produce and sometimes his ability to attract settlers to cultivate the land.

The modern history of irrigation projects begins with the advent of the British. Previous to 1854, however, public works of all description were carried on by the engineer department of the Army under the superintendence of a Military Board in each of the three Presidencies. All expenditure incurred under this system was treated as ordinary expenditure and charged against the revenue of the year. In 1854, the Military Boards were abolished and Public Works Departments created in their stead. Also, the policy of undertaking construction and extension of works of public utility with money raised on loan was adopted. With the adoption of this policy it became necessary to evolve criteria for deciding whether a work should be constructed with borrowed money or not. The first full consideration of this problem was made by a Select Committee of the House of Commons appointed in 1879. The basic recommendation of this committee was that "the construction of new works from borrowed money for the future be limited to those schemes alone which, upon the responsibility of the Government are estimated to be productive, by yielding an annual income equal to the interest on the capital expended on their construction, including in such capital, interest during construction". A couple of years before this committee reported, the Government of India had instituted, on the recommendation of the Famine Commission, a Famine Insurance Fund which would be utilised, among other objects, for construction of works likely to avert famine and obviate famine expenditure. The position as regards the classification and financing of irrigation works at the beginning of the 20th century is described in the following extract from the report of the Indian Irrigation Commission, 1901-03:—

> "Irrigation works may be primarily divided into two great classes: those which have been constructed wholly or mainly from loan funds; and those of which the cost has been charged against general revenue, in the same way as the cost of a trunk road or civil building. The former are now called 'productive' and the latter 'minor' works. An intermediate class called 'protective' was, however, formed sometime after the establishment of the Famine Fund. It had been decided that a portion of the amount credited annually to that fund should, when not required for purposes of famine relief, be devoted to the construction of famine protective railways and irrigation works, the balance being applied to the reduction or avoidance of debt. As the Famine Fund is formed out of current taxation, the cost of protective works is really met, like that of minor works, from general revenues; but there is this difference, that the cost of protective works is met from a grant which has been earmarked for purposes of famine relief, protection, or insurance; and if these works were not constructed, the money would be applied to the reduction or avoidance

of debt, or, in other words, be held in reserve for meeting the cost of future famines. An irrigation work is classed as 'productive' and sanctioned against loan funds, when it has been shown to the satisfaction of the Secretary of State that it is likely to fulfil the conditions of productive public work, that is, to yield a net revenue, ten years after completion, sufficient to cover interest charges on the sum-at-charge at that date. By the 'sum-at-charge' is meant the total direct and indirect capital cost *plus* the excess, if any, of interest charges to date over net revenue".

An aspect, other than source of finance and the application of the productivity test, in relation to which protective works differed from productive works, was the management of the works in relation to distribution of water for growing crops. The difference made was by reference to the protective intent of the work. Because of this intent, the area under sugarcane and other high class crops or perennials was restricted in the beginning of the year so that the demand for water for dry food crops may fully be met if the rainfall proved deficient later in any year. As a result of this bias in administration, the area under high class crops, under normal rainfall, was much less than it would otherwise have been. The Irrigation Commission was disposed to doubt whether this system of administration had any real advantage even from a protective point of view. The Commission noted: "The mere extension of the area under food crops in a year of famine is, in the Deccan, no longer a matter of the first importance as it was in 1877-78. There is no longer any difficulty in getting foodgrains into the provinces in the year of drought. What is really wanted is remunerative agricultural employment for the people; and as long as this can be found for them by means of irrigation works, it is a matter of little importance whether they are employed in the cultivation of food crops or of such a crop as cotton or sugarcane." (Part II, para. 164). The Irrigation Commission also suggested the abolition of the distinction regarding source of finance as between productive and protective works. They held that in case the construction of a protective work was well justifiable on other accounts, it should not have to wait for obtaining allocation from the Famine Fund and recommended that all major works should be financed from loan funds. When in 1928, the States were empowered to raise loans with the consent of the Government of India, for the execution of irrigation works, the distinction between productive and protective works in the source of capital came to an end. However, the policy of administration continued to be coloured by the distinction between productive and protective intent. It was in this context that the Bombay Irrigation Enquiry Committee of 1938 recorded the view that the best protection a canal can give is afforded when the supply is used from year to year, to obtain crops of the maximum value and advocated redistribution of canal facilities to secure this important advantage.

PRESENT METHOD OF FINANCIAL SCRUTINY

3.1.2. The current Bombay P. W. D. Manual also prescribes the 'productivity test'. However, the wording in the Manual regarding the calculation of the 'sum-at-charge' subsequent to the expiry of the ten year period is somewhat ambiguous. As a result of this ambiguity, the accounts of irrigation works are examined and the productivity test applied by the Accountant General on the basis of the sum-at-charge which includes the arrears of interest up to the end of the year, previous to the one for which the accounts are prepared, instead of including only those up to the end of the tenth year. Interest is calculated every year according to the rates prescribed for the purpose by Government from time to time. The rates prescribed for determining productivity are somewhat different from those prescribed for calculating interest charges. The rates for determining productivity have been varied from time to time. Until 1937, the rates prescribed by the Government of India were also adopted by the Bombay Government. After that date the rates prescribed by the Bombay Government were slightly different from the rates prescribed by the Government of India. The productivity rates prescribed from time to time have been as below:—

Period during which work was sanctioned (1)	Government of India rates (2)	Bombay Government rates (3)
(i) Before 1919	4%	4%
(ii) Between 1919 and 1921	5%	5%
(iii) Between 1921 and 1937	6%	6%
(iv) Between 1937 and 1949	6%	4%
(v) Between 1949 and 1954	3·75%	4%
(vi) Between 1954 and 1955	4·5%	4%
(vii) Between 1955 and 1960	4·5%	4·5%
(viii) After 1960	5%	5%

The rates of interest in force at present are as below:—

For capital outlay incurred during period (1)	Interest rate per cent. per annum (2)
(i) Up to the end of 1916-17	3·3252
(ii) Between 1917-18 and 1936-37	4·9
(iii) Between 1937-38 and 1960-61	4·5
(iv) Since 1961-62	4·75

The present practice is to test the financial soundness of a project according to the maximum limits of capital outlay per acre (called yardsticks or norms) fixed from time to time, separately for (*a*) major and medium schemes and (*b*) minor schemes. These limits are fixed per acre of the irrigable command, on an *ad hoc* basis, after taking into consideration current average capital cost. Any project, the cost per acre of which is beyond these limits is considered 'non-feasible' and rejected, unless the high cost is justified on other grounds such as a local need, *etc*. These limits may also be raised from time to time, (i) generally, if the costs of materials and labour show a substantial and general rise or (ii) for specific areas, if the average cost per acre in that area is noticed to have gone up.

3.2. Financial position of existing irrigation schemes

DEFINITIONS OF TERMS USED

3.2.1. For the sake of clarity we may at the outset define some of the terms used in the following discussion of the financial position of existing irrigation works.

(1) *The sum-at-charge* for a project is the total sum of (i) the capital expenditure incurred on the project *plus* (ii) the net losses incurred during such period as may be prescribed as the expected period required for full development of irrigation after the commencement of irrigation. Thus the 'sum-at-charge' for a project would be a fixed sum after the period of development is over, except for additions made to it on account of capital expenditure incurred for 'improvements and extensions'. For working out the net loss in a year during the period of development, interest is calculated on the intermediate sum-at-charge up to the end of the previous year. Once the final

sum-at-charge at the end of the development period gets fixed the annual *pro forma* accounts are to be made up by calculating only simple interest, the losses and gains being automatically debited and credited, respectively, to the general revenues.

(2) *Recurring expenses* during a year are the total sum of (i) charges for maintenance and repairs and (ii) the cost of the establishment entertained for the management of irrigation.

(3) *Interest charges* are calculated on the 'sum-at-charge' at the rates of interest prescribed from time to time. These rates are related to the average borrowing rate for long term Government loans.

(4) *Annual cost* would be the total of 'recurring expenses' and 'interest charges'.

(5) *Annual income* from a project is the total sum of charges levied for water supplied for irrigation, domestic supply, industrial supply, *etc.*, and for all other supplies and services rendered, for which capital costs have not been allocated. The charges may not necessarily be recovered during the year.

ANALYSIS OF ACCOUNTS OF CAPITAL COMMERCIAL SCHEMES

3.2.2. For purposes of maintaining accounts of expenditure and receipts irrigation works are classified into 'capital works' and 'non-capital works'. Capital works are further sub-divided into 'commercial works' and 'non-commercial works'. Separate capital and revenue accounts are kept on a quasi-commercial basis only for 'capital-commercial works' It is in respect of these works alone that an analysis of their existing financial position can be made.

Figures regarding expenditure and receipts in respect of each capital-commercial work are compiled by the Accountant General on the basis of returns sent to him by the Divisional Executive Engineers concerned. The returns are scrutinised by the Accountant General and the data compiled in the prescribed form, which are presented to the State Government as the 'Annual Finance Schedule of Irrigation Works'. In spite of the errors in reporting and compilation which seem to creep into this return due to lack of care, this is the best source of information in this respect. Hence data for making an analysis of the existing financial position of irrigation works were extracted from the Annual Finance Schedules of Irrigation Works prepared by the Accountant General, Maharashtra.

The latest year for which the Schedule has been presented to the State Government is 1959-60. Data in respect of individual 'capital-commercial works' in the Vidarbha and

Marathwada areas are not available in the Schedules presented by the Accountant General, Maharashtra, for the continuous period of three years (1957-58 to 1959-60) for which the present analysis is made. Out of the total area of 5.1 lakh acres irrigated by Government canals, 4.1 lakh acres or 80 per cent. are in Western Maharashtra. The twenty-four schemes in respect of which we have carried out the financial analysis cover 3.25 lakh acres or 80 per cent. of the area under Government canals in Western Maharashtra. The conclusions drawn from the analysis of these twenty-four schemes may, by and large, be considered as applicable to Government irrigation works in the entire State.

The position regarding receipts and expenditure on the twenty-four schemes was studied for a period of three years from 1957-58 to 1959-60. The schemes have been grouped into three broad categories, *viz.*, (i) large storage schemes, *i.e.*, those with a live storage exceeding 500 MCft., (ii) small storage schemes with a live storage of less than 500 MCft. and (iii) diversion or weir schemes which have no storage. The results are shown in Table No. 33. All these schemes are in existence since before the Second World War and could be taken as those on which such development of irrigation as was possible with the present policy, has already taken place.

The total receipts shown in Table No. 33 are actual receipts (and not charges assessed) for (i) water rates, (ii) sale of water and (iii) other receipts. The expenditure on (i) maintenance and repairs, (ii) establishment charges and (iii) other expenditure is shown separately. Expenditure on 'extensions and improvements' has been excluded from 'other expenditure' shown in this Table. Capital outlay on each of the schemes up to the end of 1950-51 is also shown in the Table. The live storage in MCft. of each of the schemes is shown in respect of the storage schemes. Table No. 34 summarises the position in respect of the twenty-four schemes. The summary Table shows that there was a profit only on large storage schemes. It may be pertinent to point out that the capital cost of these large storage schemes was about Rs. 976 lakhs, *i.e.*, about Rs. 1,797 per MCft. of live storage, whereas at the present rates of construction the capital cost would be about Rs. 6,000 per MCft. The smaller storage schemes show a loss even at their own level of capital cost, mainly because of low receipts due primarily to a crop pattern with a low proportion of cash crops. Weir schemes show a loss of about 26 per cent on the total expenditure.

Profit and loss on non-commercial schemes could not be worked out in the absence of data regarding their capital cost, which are not maintained.

For a comparison of the capital cost of storage schemes constructed before the Second World War with that of schemes being constructed now, it is necessary to see Table No. 32. It shows the estimated capital outlay, the live storage and the cost per MCft. of live storage on works which have been taken up after 1950-51. The average capital cost per MCft. of major and medium storage schemes works out to Rs. 5,937 or roughly Rs. 6,000. It will be seen from Table No. 35 that the sum-at-charge corresponding to this cost would be Rs. 7,550 per MCft.

The receipts shown in Table No. 33 are the average receipts for the years 1957-58 to 1959-60. Government has revised the rates of water charges and irrigation cess with effect from February 1961. The revised rates are as below:—

[In Rs. per acre]

Name of crop (1)	Water rate (2)	Irrigation cess (3)	Total (4)
(i) Sugarcane (annual)	160	30	190
(ii) Other perennials (annual) ..	100	15	115
(iii) *Kharif* seasonals	6	3	9
(iv) *Rabi* seasonals	9	3	12
(v) Hot weather crops	18	3	21

Table No. 31 shows the average percentages of areas under different crops irrigated during the years 1955-56 to 1957-58 under the twenty-four schemes, in respect of which the financial position has been studied in Table No. 33. The expected annual receipts for the three groups of schemes at the rates in force since February 1961 and for the crop pattern shown in Table No. 31 would be as below:—

	Expected receipts (lakh Rs.)	Expected receipts per MCft. (Rs.)
1. Large storage schemes ..	150·71	277
2. Small storage schemes ..	0·88	67
3. Weir schemes	4·24	..

At the present rates of capital cost the annual cost per MCft. works out to Rs. 410.

3.3. Acceptance and fixing of *inter se* priority of irrigation projects

BENEFIT-COST RATIO

3.3.1. As stated earlier in paragraph 3.1.2 the 'productivity test' is still applied, *albeit* loosely, with a view to judging the financial soundness of a project, or in other words, to see whether or not its expected annual income would be enough to meet the annual cost. The annual income, however, in practice accrues on the basis of water rates which are more or less *ad hoc*. Thus, the productivity test is no more than an accounting criterion or a calculation which relates expected direct revenue receipts of Government at current rates to the estimated cost of works.

The principal direct effect of irrigation in relation to production is the increase in agricultural produce brought about through more intensive use of land. The extent of this increase in production can be estimated by finding out the value of produce of land with irrigation which is in excess of the produce of the same land without irrigation. To the extent that the whole of this excess can be attributed to irrigation, it may be said to represent direct gross benefit due to irrigation. By allowing for the increase in costs needed for increased production under irrigation it would be possible to estimate the net direct increase, obtained through increased agricultural production, attributable to irrigation. Thinking in terms of the community as a whole, it may be held worthwhile to undertake any capital work the annual cost of which is less than the annual direct benefit accruing as a result of its construction, as calculated above. In those instances in which the organization or persons incurring risk and expenditure of construction of work and the beneficiaries from such construction are identical, it is possible to work on the basis of the full increment of the value of direct productive benefit. Where, however, the expenditure, *etc*. are undertaken by a public authority and the advantage accrues to others, through their separate operations, the problem of other less comprehensive tests arises. In such a context, it becomes necessary to see what part of the benefits accruing to separate individual operators could be recovered by the public authority without removing the incentive needed for continued effort on the part of the individual operator. It is often pointed out that even conceding the need for Government to think in terms of the return obtained by itself, the present financial test is too narrowly conceived. Financial returns are obtained by Government from irrigation not only in the form of direct revenues from water charges but also through increases in other receipts such as those from excise, income tax, sales tax, railways, *etc.*, and no allowance is made for such receipts in the existing system.

INDIRECT BENEFITS

3.3.2. It is possible to argue that a Government which is operating a plan of economic development should in planning construction of capital works be guided by the total incremental effects accruing to the community as a whole rather than by narrow calculations of financial receipts, whether direct or indirect, obtained by itself. However, while there may be a case for adopting a broad social benefits view in judging of the relative merits of capital works, it still remains true that Governments, which have the responsibility of financing development expenditure at a steadily increasing tempo, must also take into consideration the possibility of recovering for their own use a substantial portion of benefits originating in the construction of capital works. It will be observed that these considerations play an important part in the recommendations made by us in relation to water rates, *etc.*

3.4. Water rates

EXISTING WATER RATES

3.4.1. The present water rates seem to have been fixed on an *ad hoc* basis. Until 1905 the 'crop rates' system was in vogue. It was then replaced by the seasonal rates system, *i.e.*, the system in which all crops grown in the same season are charged uniform rates. An exception has been made in the case of sugarcane and other perennials on account of the high return they give to the irrigator. Some distinction was formerly made between crops grown in the same season, on the basis of their comparative water requirements, *e.g.*, 'heavy seasonals' and 'light seasonals'. This distinction was abolished on the recommendation of the Bombay Irrigation Enquiry Committee, 1938. As a result of the recommendation of the Cabinet Sub-Committee, 1947, a separate irrigation cess is being charged since 1954; the cess was intended to meet the cost of maintenance and was to be charged over the entire culturable command. At present, however, the cess is being charged on lands actually irrigated in a year and thus acts as a surcharge on the water rates. Water rates are not uniform all over the State; those in Vidarbha and Marathwada are related to the systems in vogue in those areas prior to 1956. The existing water rates in the different areas are shown in Table No. 40.

WATER RATE POLICY

3.4.2. Only 1.2 per cent. of the net cropped area in the State is at present irrigated by Government canals. Even after the fullest exploitation of the available irrigation resources the total area under irrigation from surface sources would not exceed about twenty-six per cent. of the ultimate cultivated area. Even though it is true that a large number of farmers taking advantage of irrigation from Government irrigation works are small holders and consequently not well-to-do, and indeed under the policy of dispersal of benefits that we advocate the acreages of individual holdings deriving benefits especially of perennial irrigation would become still smaller—they are nevertheless better off than those small farmers who have either to grow only non-irrigated crops or to depend on and incur expenditure in relation to other sources of irrigation such as water lifted from wells, rivers, *etc.* It is only fair that the general tax payer should not be made to pay for benefiting a small section of the population. Irrigation facility is a service and it is reasonable that it should be paid for by the persons who take advantage of it We are, therefore, of the view that irrigation works, as a whole, should give an annual income which is equivalent to the annual cost thereof. In other words, the burden of providing irrigation should not fall, even in part, on the general tax payer. If it is at all felt that any section of irrigation farmers deserve to be subsidised, such element of subsidy should not be incorporated in the water rates.

STRUCTURE OF WATER RATES

3.4.3. The objectives of a satisfactory structure of water rates should be as below:—

(i) The total recoveries on account of water rates should not be less than the annual cost incurred by the State for providing the service.

(ii) The water rate for a crop should be equitable, in the sense that it should be related to the ability of the crop to bear it.

(iii) Water rates should be so pitched as not to leave any irrigation potential unutilised on account of either the system of charging rates or the level of particular rates.

The upper limit to the ability of a crop to bear the water rate is indicated by the entire net benefit to the irrigator on account of irrigation. If this benefit is wholly appropriated by Government as water rate, the irrigator would not be worse off as compared to the farmer not using irrigation water. But this would leave no incentive to the farmer to make use of irrigation water. In order to provide such incentive it is necessary to appropriate as water rate only a portion of the net benefit.

The calculation of net value of additional agricultural production due to irrigation, which we consider as of basic importance, would require two types of data—those regarding the per acre volume of crops produced and those regarding per acre costs of production. Data regarding average production per acre for irrigated crops are available to some extent but those regarding the costs of production are very scanty and are not representative enough for calculating averages applicable over wide areas. In existing circumstances, it is thus not possible to compute the net value of additional agricultural production due to irrigation. However, it may be taken for granted that in normal years there exists a relationship between gross and net income. On this assumption, broad calculations could be made on the basis of estimates of only gross values of irrigated crops. These calculations are subject to two limitations. In the first instance, the proportion of expenditure to receipts varies from crop to crop and this variation would have to be taken into account in operating with figures of gross income. Secondly, calculations of values of gross income take for granted a certain stabilised level of future prices. If prices fall suddenly, a charge based in relation to the existing level of prices would prove highly inappropriate. We, however, proceed on the assumption that, in view of the announcements of Government policy, prices of agricultural products will be stabilised and that our calculations regarding gross and net increments of values will not prove substantially wrong.

While it is not possible to make generalisations regarding relations between gross and net incomes in various types of crops it is safe to state that the ability of the more valuable crops to bear the water rate is more than proportionately larger than the ability of the less valuable crops. The case for this can be argued on abstract grounds. Moreover, in actual practice it is observed that cultivators will bear very heavy costs to obtain and raise water supplies from alternate sources such as wells to grow highly valuable crops like sugarcane. The data regarding the costs of alternate sources of water supplies in the case of these valuable crops indicate the upper limit of the ability of these crops to bear water charges.

PRINCIPLES OF WATER RATE STRUCTURE

3.4.4. In the light of the foregoing discussion, we would indicate the following as the factors to be taken into consideration in formulating water rates for individual crops:—

(1) The cost of irrigation water required by the crop.

(2) The level of average gross income obtained from the crop under the usual conditions of fertility, supply of

manure, supply of water, level of efficiency of cultivation, prices, *etc*.

It follows from the higher ability to bear the water rate of the more valuable crops that the percentage of gross income charged as water rate should not be the same for all crops. This should vary as between crops, the main differentiation in rates being as between the more valuable and the less valuable crops. Any losses that have to be borne on account of fixation of water rates at levels below cost of water for the less valuable crops would in this case be balanced by the higher proportionate rate that the more valuable crops bear.

It will be observed that we propose to relate water rates to the ability of the crops to pay for the water. It has been contended that an irrigator with a small holding would be less able to bear a water rate than an irrigator with a large holding growing the same crop and that, therefore, the rate should vary according to the ability to pay of the individual irrigator. Acceptance of this contention would be tantamount to changing entirely the base of the imposition of the water rate. Like the land revenue, the water rate is based on calculation of productivity of given fields of land and is not based on incomes of particular persons. The principle of graduation which is thus appropriate or applicable in the case of personal direct taxation cannot be held applicable in this case. Furthermore, the water-supply for irrigation and for other purposes by a public system is in the nature of a public utility service. It is accepted that rates for particular types of supply from public utilities should be uniform for all users. Uniform imposition of water rates does not, of course, militate against any Government policy for assistance or subsidisation of particular classes of cultivators like farmers with small holdings. It is not, in our opinion, necessary or proper to introduce this factor in determining water rates.

WATER RATES TO BE BASED ON THE SUM-AT-CHARGE

3.4.5. From Table No. 32 it will be seen that the current capital cost of major and medium projects is about Rs. 6,000 per MCft. of storage. The period of construction of a project would not be less than three years after the completion of its preliminaries. At present, development of irrigation is supposed to spread over ten years from the commencement of irrigation. This period must be shortened to keep the sum-at-charge as low as possible. If the steps adumbrated in chapter VI are implemented, this period could be shortened to five years. With concessional rates being given for the first three years from the commencement of irrigation on a distributary, full water rates on the entire irrigable command would accrue after seven years. The total period which will elapse from the commencement of construction will, therefore, be about ten years.

Water rates must be based not on the bare capital outlay but on the sum-at-charge as on the date from which the return from water rates is expected to be derived in full. This date would be ten years from the commencement of construction of a project and seven years from the commencement of irrigation in a portion of the irrigable command. In Table No. 35 the sum-at-charge on a capital outlay of Rs. 6,000 per MCft. has been worked out at Rs. 7,550.

ANNUAL COST

3.4.6. On the sum-at-charge of Rs. 7,550 per MCft. of storage, interest charges at 4.75 per cent. per annum would work out to about Rs. 360 per annum. The recurring expenses on large storage schemes are of the order of Rs. 50 per MCft. Thus at the present rates of capital cost, interest charges and recurring expenses, Rs. 410 per MCft. will have to be recovered through water rates. According to the water requirements of the various crops and on the basis of the existing crop pattern on large storage schemes in Western Maharashtra, the area irrigated per MCft. of storage should be about 7.2 acres. Therefore, Government will have to recover about Rs. 57 per average acre.

UNIFORMITY OF WATER RATES

3.4.7. At present, water rates vary from area to area and from one type of scheme to another. This is mostly due to historical reasons and some times due to the fact that the rates are related to cost, dependability of supply, *etc.* The extent of variation in rates can be seen from Table No. 40. Since the entire water resources available are to be utilised to the fullest extent, some of the schemes which will be undertaken for attaining full utilisation of the water resources, would be costlier than other schemes. However, the service rendered to the farmers in the shape of supply of irrigation water and the increased productivity which would result thereby, would, by and large, be uniform within broad geographical regions demarcated by the yield status of the crops irrigated. We are, therefore, of the view that it would be equitable to have uniform water rates in such broad geographical regions of the State. They may, however, be different for the same crop within the geographical region if the 'quality of service' rendered is different. The quality of service would depend mainly on the nature of the supply, *i.e.,* the degree of dependability and the adequacy of water supplied. The quality of service would also depend on the water requirement of the crop in question. For example, the 'quality of service' would differ between (*a*) water supplied after lifting it from a river or a well and water supplied by flow irrigation, (*b*) water supplied from a dependable storage tank and that supplied from a less dependable storage tank, *e.g.*, one with its catchment in the scarcity area which completely fails once every four years, (*c*) supply of irrigation to paddy from a monsoon bandhara which enables the farmer to grow only drilled paddy and supply from a storage tank with which he can grow transplanted paddy or between (*d*) two or three waterings required by paddy in Chanda and Bhandara districts and eight to twelve waterings required by the same crop in Western Maharashtra.

Where the existing rates are much below the level at which they would have to be fixed according to the principle of uniformity recommended for adoption, irrigators would experience hardship if rates are suddenly raised to the new level. To avoid such hardship, we recommend that the new levels should be attained in suitable stages.

WORKING OUT WATER RATES

3.4.8. The result of applying the principles of water rate structure stated above to major storage schemes in Western Maharashtra is indicated in this paragraph merely to illustrate how water rates should be worked out for the different geographical regions and for the different qualities of service. Table No. 36 shows the quantity of irrigation water required in each of the three seasons and its cost per acre for fourteen principal crops. The periods of these seasons are those stated in paragraph 5.4.10. The fourteen crops given in the Table cover 93 per cent. of the area irrigated by the major storage schemes studied. The remaining crops, together covering 7 per cent. of the area, are of minor importance and are not dealt with individually. Columns 3 and 4 of the Table show the earliest date of watering and the latest date of watering, respectively. The dates have been fixed after taking into consideration the general demand for pre-seasonal irrigation for rice and long staple cotton. Column 5 of the Table gives the rotation periods in multiples of ten days. The Public Works Department Handbook mentions the rotation periods for different crops, which are not in multiples of ten days. In practice, however, rotation periods are fixed only in such multiples since canals cannot be opened or closed at different intervals to suit the different crops. The notes to Table No. 37 explain how the cost of water shown in column 16 has been worked out, starting from the annual cost of Rs. 410 per MCft. of live storage.

Table No. 38 shows the gross income per acre estimated to be derived from the different crops. As stated in paragraph 1.6.4 the figures of yields per acre shown in column 3 pertain to crops under canal irrigation only and are based on the information given to the Commission by progressive cultivators and others during its tours. A difficulty encountered in respect of harvest prices of the different crops shown in the Annual Season and Crop Report was that they varied greatly from district to district and also between one variety and another. We had, therefore, to prepare, on the basis of existing data, a set of figures (Table No. 38—Column 4) for general application.

As stated above the water rate per average acre has to be about Rs. 57. The gross income per average irrigated acre is Rs. 575. Therefore, about ten per cent. of the gross income must be appropriated as water rate in order that the annual income should be equal to the annual cost. On the basis of the crop pattern shown in column 6 of Table No. 38, we would recommend that the range of percentages of gross incomes from the different crops which should be charged as water rate may be fixed from 6 per cent. to 12 per cent. The range will have to be altered if substantial changes occur either in the crop pattern or in yields and prices. Ordinarily the discretion to vary the rate between 6 and 12 per cent. of the gross income should be exercised to fix the charge nearer the lower limit for the less valuable non-cash crops and nearer the higher limit for the more valuable cash crops.

	Non-cash crops	Cash crops	Total
(1)	(2)	(3)	(4)
(i) Percentage area in the crop pattern.	68	32	100
(ii) Total gross income from area in (i), (Rs.)	13,012	44,475	57,487
(iii) Gross income per acre [(ii) divided by (i)], (Rs.)	191	1,390	575
(iv) 6 per cent. of gross income in (iii), (Rs.)	11·5	83·4	34·5
(v) 12 per cent. of gross income in (iii),(Rs.)	23·00	166·8	69·0

It will be seen that losses and gains on account of fixing the rates for some crops below their cost of water and for others above the cost of water, respectively, can be balanced and an income of Rs. 57 per average acre or Rs. 410 per MCft. can be recovered by following the approach to the determination of water rates recommended by us.

3.4.9. At present water rates for crops are fixed in Western Maharashtra mainly on the basis of the season in which a crop is grown. Thus, water rates are fixed separately for 'hot weather crops', '*kharif* crops' and '*rabi* crops'. An exception is, however, made in respect of sugarcane and other perennials for which the water rate is more than that payable on the basis of the corresponding seasonal rates. While fixing rate for sugarcane and other perennials the incomes derived by the irrigator therefrom and their water requirements have been taken into account. **CROP RATES**

A large number of crops have to be planted and harvested beyond the prescribed seasonal periods, with the result that the irrigators have to apply for extra pre-seasonal and post-seasonal waterings and to pay additional charges for such waterings. Since irrigation is a public service which confers varying benefits according to season, use made, *etc.*, the principle of adopting the rate for each crop according to what the crop can bear is reasonable and equitable. It follows that crops grown in the same season but having different gross incomes should not pay the same water rate. Thus, because the periods between sowing and harvesting of all the crops classified as belonging to an irrigation season are not uniform and also because they differ widely in their gross incomes, the present seasonal rate system is unsuitable.

The cost of water in the different seasons differs on account of the fact that losses due to evaporation are greater for the summer supply than for the *rabi* supply. Value of water in the different seasons should, therefore, be one of the factors in determining the water rate for a crop.

It is obvious that the water rates should have a close relationship with the quantity of water supplied. Other things being equal, a crop requiring more water should pay more than a crop requiring less water.

In view of the above we recommend that crop rates be adopted as the basis of the system of water rates. However, as has been made clear, this would still allow for differentiation between rates for individual crops according to variations in seasons, the quality of service, special pre-seasonal or post-seasonal supply, *etc.* Such crop rates would also serve as the basis for fixing block rates referred to in paragraph 3.4.10.

The earliest date of watering and the latest date of watering for each crop grown to an appreciable extent should be so prescribed as to suit the large majority of the farmers growing that crop. Provision should be made for obtaining casual waterings either before the prescribed earliest date of watering or after the prescribed last date of watering, so as to accommodate those farmers who desire to depart from the normal dates of sowing and harvesting, in order to take advantage of seasonal rises in market rates or because they wish to grow a particularly late maturing variety of the crop. The rates for such casual waterings should be pitched at a somewhat higher level than the rate per watering calculated on the basis of the crop rate prescribed for the crop in question. We do not hereby advocate giving of casual waterings for crops which a farmer intends to grow on rain and then changes his mind at the eleventh hour when the rains fail. On the contrary we consider that it is desirable that as large a portion of the dependable water supply as possible should be contracted for on a long term basis.

BLOCK RATES

3.4.10. In the block system prevalent on the major canal systems in Western Maharashtra, a water rate per acre for the entire block area is worked out and charged. For facility of assessment and recovery of water rates, there would be no objection under the system of crop rates, to work out such an average water rate per acre of the block area, provided that crop rates form its basis, *i.e.*, while working out the area rate for the block, the rates prescribed for the crops in question are averaged according to the respective permissible areas under those crops in the block.

CALCULATING WATER RATE FOR SUGARCANE

3.4.11. The fixing of a crop rate for sugarcane requires special consideration. *Suru* (plant) crop remains on the land for about 14 months and is planted between November and January and harvested between February and April. The *Adsali* crop remains on the land for 16 to 18 months and is planted between July and September and harvested between November and February of the next irrigation year. Like *Suru* the *Khodwa* (ratoon) crop remains on the land for about 14 months. It is generally the *Adsali* crop which is retained as *Khodwa*. The planting and harvesting of sugarcane grown for supply to sugar factories have to be staggered to facilitate an even supply throughout the crushing season. The period for which a crop is allowed to remain on the land may also vary to some extent according to the requirements of the sugar factories and their crushing capacities. Even those who prepare gur may have to keep a crop on the land for a longer period than planned, on account of non-availability of crushers, *etc.*

Because of the fact that sugarcane is planted at various times of the year and stands in the field for 14 to 18 months, for each acre of sugarcane to be harvested in a year (basic area) the area under the crop during some months of the year has to be in excess of one acre. The extent to which the actual area under the crop in any month exceeds the basic area is called 'overlap'. Such overlap is permitted for the ten months between July and April. No overlap is permitted in May and June. The typical overlap from month to month is 25 per cent. in July, 50 per cent. for six months from August to January and 36 per cent., 24 per cent, and 12 per cent. during February, March and April, respectively. This is the position when overlap is permitted up to 50 per cent. of the basic area, which is the limit at present in force for individual irrigators*. The average overlap for the whole year works out to about 33 per cent. of the basic area. Therefore, with the limit of overlap at 50 per cent., the average annual area would be 33 per cent. more than the 'basic area'. Irrigation charges calculated at the 'annual water rate' may be recovered on this average annual area. When this is done no additional charge would be recoverable for 'overlap' area.

WATER RATES FROM MINOR CROPS

3.4.12. Crop rates should be fixed for all crops of which there is an appreciable acreage. Crop rates would thus cover about 93 per cent. of the entire area under irrigation. Very minor crops would remain for which crop rates need not be prescribed. These may be grouped under the three irrigation seasons stated in para. 5.4.10 and uniform *ad hoc* rates prescribed for them. These rates should be approximately equal to the crop rates for the principal foodgrain crop grown in the respective seasons. If and when a minor crop becomes appreciably important a separate crop rate may be prescribed for it.

WATER RATES FOR CROPS REQUIRING LARGE AMOUNTS OF WATER

3.4.13. It has been stated that water rates for the less valuable crops should be pitched at a lower percentage of their gross incomes. It is, however, necessary to see that such a treatment does not result in utilisation of water in a less desirable manner. A case in point is that of paddy grown in the low rainfall belt. Not only that paddy requires irrigation every ten days during the period of its growth, but it is necessary to give it pre-seasonal irrigation for getting good yields. The water used for pre-seasonal irrigation of paddy could be more beneficially used for pre-seasonal irrigation of long staple cotton or for hot weather groundnut. Both those crops are much more profitable than paddy, and can pay

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*Note.—We understand that joint stock sugar factories are permitted overlap area to the extent of 60 per cent. of the basic area. This discrimination should be removed as early as possible.

much higher water rates. We do not suggest that penal or prohibitive rates should be charged for paddy in these areas but the discretion to pitch the rate at the maximum percentage of the gross income should be exercised so as to permit only the most suitable lands being put under paddy in the low rainfall belt. During 1955-56 to 1957-58 the average paddy area on the major Deccan Canals was only about 9,000 acres.

CONCESSIONAL RATES FOR CERTAIN CROPS

3.4.14. Situations may arise when a rate lower than the minimum of the range is more appropriate for a crop. For example, it is necessary to encourage green manuring of crops to a large extent in view of the need and deficiency of bulky organic manures. Moreover, green manuring crops do not give a direct return to the farmer though they add to land fertility; in fact the farmer has often to lose a crop for the sake of green manuring. A concessional rate for green manuring crops with a view to encouraging their growth is, therefore, justifiable.

CONCESSIONAL RATES DURING DEVELOPMENT PERIOD

3.4.15. The present practice of giving concessional rates during the initial period of irrigation development is worth continuing. In the case of foodgrain and fodder crops, in the first year after a distributary is notified as open, water is given free and in the second and third years the water rate charged is one-third and two-thirds of the normal rate, respectively. From the fourth year onwards the full normal rate is charged. For other crops one-half of the normal rate is charged in the first year and full normal rate from the second year onwards. This concession is justifiable because the farmers take time to acquire adequate knowledge of irrigated farming, have to invest considerable amounts for levelling, *etc.*, in the initial years and in any case the fertility level of land does not get built up in less than about four years. It is reasonable that during these years, when the investment required to be made is high and the output is lower than the normal for the irrigated crop concerned, the burden of water rates should be light.

The cost of charging concessional rates instead of normal rates will add to the capital cost; in Table No. 35 the 'sum-at-charge' has been calculated after taking cognizance of this concession.

FIXATION OF WATER RATE FOR GOVERNMENT LIFT IRRIGATION SCHEMES

3.4.16. As stated in para. 3.4.7, supplying of water after pumping is a different 'quality of service' than supplying it by gravity. In the case of lift irrigation the actual cost of pumping *plus* the cost of the water pumped should be charged. There should be no pooling of these costs for a region or the State. Each system should be treated as an individual unit.

The Radhanagari Hydro-Electric Project is a combination of power generation and irrigation, the latter of the storage-*cum*-lift type. No part of the cost of the reservoir is charged to power generation. Further the charge levied for water in the river, and that recovered for water supplied for irrigation after pumping, have not been founded on a reasonable basis. If the entire scheme, that is inclusive of the pumping operation, is to yield an annual income equivalent to the annual cost it would mean subsidising the private pump owners at the cost of the irrigators growing sugarcane in the area irrigated by Government pumps. This is not justifiable. The cost of unlifted water will get reduced when a portion of the cost is allocated to power generation. This reduced cost should be charged to all irrigators alike and those who get water from Government pumps should pay in addition the actual cost of pumping incurred by Government.

RATES OF WATER LIFTED FOR IRRIGATION BY PRIVATE AGENCIES

3.4.17. Government normally charges a royalty for any water taken from a public source and used for irrigation. This charge is in token of the ownership of the water and brings in a justifiable income from a State's asset. Where the existence of the water is due to a work constructed by Government the user of the water should pay the annual cost of the work in question and not merely a royalty.

We have proposed that the benefits of irrigation should be widely dispersed and that the area between the reservoir and the pick-up-weir should be allowed to use a reasonable proportion of the storage by lifting water from the river. The charge for water so allowed to be lifted should be one-half of the corresponding rates for flow irrigation. The reduction is justified on the ground that the cost of the canal system, which is normally about 50 per cent. of the cost of a project, does not enter into the cost of the water in the river at this point. The irrigator must himself bear the cost of pumping.

Similarly, the area along a canal or a distributary, which is out of command should also be permitted to be irrigated, if the prospective irrigators are willing to lift the water at their own expense. In this case, however, the water must bear the entire annual cost and, therefore, the charge for such water should be the same as the normal water rates for flow irrigation.

The main river and its tributaries beyond the water-spread of the reservoir and tributaries above and beyond the water-spread of the pick-up-weir but below the reservoir, do not benefit from the storage work. It is unreasonable to charge anything except royalty for this water even though the river in question may have been notified for other purposes.

Water rate for sewage 3.4.18. Sewage is special water enriched with fertilising ingredients. When sewage is supplied mixed with flow irrigation water, it should be charged at flow irrigation rates *plus* a surcharge based on the fertilising value of the sewage, assessed on the basis of the cost of alternative fertilisers.

Remission of water rates 3.4.19. An irrigator may lose a crop or obtain low yield on account of two sets of reasons, *viz.*, (i) non-supply or irregular or inadequate supply of irrigation water and (ii) unfavourable weather, attack of pests and diseases, *etc.* When the loss to the farmer is due to the first set of reasons it is reasonable to remit the whole or a part of the water rates recoverable, depending on the extent of the damage caused. The procedure for granting such remissions should be speedy. The granting of such remissions should also be obligatory.

Relief for damage caused due to the second set of reasons should be available through the normal machinery for giving remissions and suspensions of land revenue.

Periodic revision of water rates 3.4.20. Water rates are to be fixed, *inter alia*, on the basis of the gross incomes of the crops concerned and by balancing losses and gains in a given crop pattern. The gross incomes would vary according to the fluctuations in the absolute and relative prices of crops and in yields per acre. Frequently changing rates would be both administratively unworkable and not conducive to proper crop planning by the farmers. Inelastic rates for long periods would, on the other hand, lead to loss to Government in periods of rising prices and uneconomic farming in periods of falling prices. We, therefore, suggest that ordinarily water rates should remain fixed for six-year periods. This length of the period would combine elasticity and stability in a suitable measure. The position should be reviewed during the fifth year and revised rates for the ensuing period announced one year in advance, *i.e.*, at the beginning of the sixth year of the previous period. This would give enough time for publicising the new rates and for farmers to work out their cropping plans for the next six-year period. The agency for the collection and analysis of the data required for such periodical review of rates should be established, which should compile the necessary data in time for the revision.

Where current water rates are low and are to be gradually brought up to the level of the region (*vide* paragraph 3.4.7) the period of duration for each such rise need not of course be six years which is recommended with reference to the revision of water rates.

While working out the annual costs of irrigation works, grouped according to the 'quality of service' they render, interest charges should be calculated on the total of sums-at-charge for each group, projected up to the middle of the ensuing six-year period, *i.e.*, in respect of which the revised water rates are to be prescribed.

The present rules made in this regard should be amended to allow such periodic review and revision of water rates.

3.5. Consolidated land revenue.

SITUATIONS IN WHICH CONSOLIDATED LAND REVENUE SYSTEM IS SUITABLE

3.5.1. On all second class irrigation works a uniform water charge is levied irrespective of the kind of crop grown. This charge is joined with land revenue to form the 'consolidated land revenue'. The consolidated land revenue system is not suitable where different categories of crops, *i.e.*, perennials, *rabi* seasonals, *kharif* seasonals, *etc.*, are grown. The system is suitable only where a single category of crop is grown, *i.e.*, where the benefit derived from irrigation does not vary to a large extent between one irrigator and another. The area irrigated from year to year should also be fairly constant and water should be actually available for the same fields over a number of years. In areas where each irrigator gets approximately the same average benefit per acre from year to year, owing to the crop pattern on all holdings being uniform over the rotation period, *e.g.*, in the Phad system of irrigation in Nasik and Dhulia districts, the consolidated land revenue system would be suitable, in spite of crops belonging to different categories being simultaneously irrigated.

In respect of those works for which the above conditions do not obtain and yet consolidated land revenue is charged, we recommend that the 'consolidated land revenue' system should be abolished, water rate element separated from land revenue and normal water rates charged according to the crops grown, subject to the exception indicated below.

CONSOLIDATED LAND REVENUE SYSTEM FOR SMALL WORKS

3.5.2. In view of the Maharashtra Zilla Parishads and Panchayat Samitis Act, 1961, each work irrigating 250 acres or less, is to be managed by the proposed Zilla Parishads. We have recommended in para. 7.3.2 that all such works should be classified as second class irrigation works. Conditions appropriate for the system of consolidated land revenue mentioned above, are generally obtained on such works. The separate water rate system involves the maintenance of detailed accounts, crop measurement and sanctioning of water applications. The cost of the minimum complement of operational staff, *e.g.*, Patkari, Measurer, *etc.*, will have to be met by the irrigation work. The total income from an irrigation work irrigating 250 acres or less would be so small that the maintenance of the operational staff would result in loss. Therefore, on the grounds of administrative convenience in facilitating the collection of irrigation charges the consolidated land revenue system may be followed in respect of all second class irrigation works, irrespective of the crop pattern.

SCALE OF CONSOLIDATED LAND REVENUE

3.5.3. The water rate element in the consolidated land revenue charged on a work should be equivalent to the average irrigation charges normally recovered for the crops grown under the work in question. Five per cent. of the irrigation charges recovered should be set apart and paid to the agency which is entrusted with the management of the work in question.

3.6. Giving financial sanction to irrigation projects.

NORMS OF CAPITAL COST

3.6.1. We have indicated in section 3.3 that in judging of the merits of particular works, it would be useful for the State to adopt the broad point of view of total social benefit rather than the narrow financial test at present in use. In section 3.4 we propose that the structure of water rates should be so devised and operated as to meet fully the annual costs of the irrigation system in the State as a whole. For the practical working out of individual crop rates, we have suggested that the best immediate basis would be gross incomes derived from particular irrigated crops. If the system of water rates is built up in this manner and the levels of rates determined as suggested, the receipts from current rates would fully meet the cost of irrigation in the State. Therefore, if in the case of any new or proposed irrigation project, receipts from water rates so prescribed fully meet the annual cost of the project, the project could be safely considered as feasible. This, of course, takes for granted that the crop pattern under the proposed project has been carefully worked out.

It would appear that in such a case no separate tests or 'norms' of feasibility of particular projects are necessary. However, there are two considerations which make it necessary to think of the formulation of norms. In the first instance, it may take sometime before our recommendations regarding structure and the level of water rates are adopted and fully worked out. Secondly and more importantly it is necessary to differentiate in this matter between types of works and between regions and situations. The structure of water rates would, on an average, yield income to cover the total annual cost of the irrigation system. As the cost of construction and operation of some types of works, for example minor works, are higher than those of others the receipts from the less costly would have to balance the lower level of incomes from the minor schemes. This means that the tests or norms for different types would have to be different, making due allowance for types of schemes, their costs and their objectives. In the same manner for particular areas or situations in which it is specially important to construct irrigation works a special set of norms would have to be adopted. We, therefore, recommend that norms of capital cost upto which the annual income from a project can be expected to equal the annual cost should be worked out and used as ready guides for according financial sanction to irrigation projects.

One of the major problems met with in the application of norms to particular projects at present relates to the crop pattern assumed. It is alleged that the crop pattern is often specially assumed to bring the capital cost per irrigated acre in consonance with the yardstick fixed. One way of avoiding this difficulty, in part, would be the adoption of the norm of capital cost as fixed per MCft. of annual utilisation. Even so it is important to forecast as accurately as possible the crop patten under the new projects. In areas where irrigation has already developed, this should not prove difficult. In new areas the crop pattern under the project will have to be based on the experience of other adjacent or similar areas.

SEPARATE NORMS FOR DIFFERENT REGIONS

3.6.2. Norms of capital cost per MCft. of water utilised should be fixed separately for the different broad geographical regions mentioned in para. 3.4.7 for which different sets of uniform water rates would be prescribed.

SEPARATE NORMS FOR DIFFERENT TYPES OF WORKS

3.6.3. Separate norms will also have to be fixed for the different types of irrigation works. For example, minor works are costlier in terms of capital cost per unit of water utilised. While fixing norms for such works the interest charges must be calculated at a sub-normal rate of interest. Since irrigation works as a whole must be self-sufficient the norms for larger or profitable types of works must be pitched on the basis of a higher or above normal rate of interest. In short, the bigger schemes must pay a surplus over the normal rate of interest to meet losses incurred on account of the sub-normal rate of interest being taken as the basis for fixing the norms for smaller schemes.

It is obvious that schemes of the type for which uneconomic norms, *i.e.*, norms based on sub-normal rates of interest, have been fixed should be undertaken only in those areas where the type of schemes for which economic norms have been fixed are not possible.

REVISION OF NORMS

3.6.4. The policy of exploiting the available water resources to the fullest extent would mean that the 'norms' of capital cost would have to be revised from time to time and always upwards. This would be so on account of the fact that cheaper schemes would be taken up earlier and as time elapses only the comparatively costlier schemes would be the ones to be considered and executed. The norms are to be based on returns from irrigation works in the State as a whole. Therefore, the circumstances which lead to a revision of the norms would also necessitate revision of the water rates to the extent required for making the irrigation works in the State as a whole, inclusive of those constructed according to the revised higher norms, self-supporting. There should, however, be a time lag between the revision of norms of capital cost and revision of water rates, since the costlier works at the new norms would start giving water for irrigation only after sometime—say about three years on an average. The revision of water rates on account of revision of norms of capital cost may, therefore, be conveniently made synchronous with the revision of water rates on account of variations in gross incomes.

3.7. Capital cost of irrigation works.

CONTRIBUTION TO CAPITAL COST BY PROSPECTIVE BENEFICIARIES

3.7.1. The resources available for Government irrigation works are limited while the need for increasing irrigation facilities is urgent. Government's resources could be augmented by the prospective beneficiaries agreeing to loan to Government a part of the estimated cost of a project. When such a loan is offered a project may be taken up early, but without changing the priority accorded to it in the succesive Five Year Plan periods. Thus a scheme included in the fourth Five Year Plan may be taken up early in that Plan period but not in an earlier Plan period, *e.g.*, the Third Plan period. We found that there was some readiness to contribute to such loans in areas where at present there is an inadequate supply of irrigation water and the demand for more area under irrigated cash crops is keen.

A project, the capital cost of which is below the current 'norm' would get accepted if its relative priority is sufficiently high, whereas a project the cost of which is above the current norm would definitely have to wait till the norm gets raised. However, the demand for the latter project may be keen on account of local circumstances. In such situations an offer from the prospective beneficiaries to bear the difference between the estimated cost and the cost according to the norm may be accepted and the disqualification of being above the norm removed. It should then be accorded such priority as would have been granted to it had its capital cost been equal to the norm.

Where the difference between the cost according to the current norm of capital cost and the estimated cost of a work is accepted by Government as a contribution from the beneficiaries, the actual amount payable should be worked out with reference to the estimated cost and not to the actual cost. Where the actual cost is higher than the estimated cost, the difference between the actual cost and the estimated cost should be borne by Government, in addition to the cost according to the 'norm'. The prospective irrigators would be unwilling, and rightly so, to agree to pay a contribution the exact magnitude of which is not known at the time of making the agreement. The prospective beneficiaries should be bound down by agreement to pay their respective shares of the contribution in instalments, if they are unable to pay in advance.

In the private sector Government have already tapped the field of co-operative finance for advancing loans for well construction by individual irrigators. We suggest that land mortgage banks may also be induced to advance loans to co-operative groups of farmers for undertaking the construction and repair of small village tanks, percolation tanks, small bandharas and such other small and local irrigation works. Government's resources thus saved could be diverted for bigger projects awaiting the provision of funds.

METHOD OF ALLOCATION OF COSTS OF MULTI-PURPOSE PROJECTS

3.7.2. Some irrigation projects serve more than one purpose, *e.g.*, power generation, flood control, domestic and industrial water supply, *etc.*, besides irrigation. Multi-purpose projects produce different services, the beneficiaries of which belong to different categories. Sometimes, as in the case of flood control, the beneficiary is the general public which means that the cost of flood control has to be borne by the general revenues. Multi-purpose projects result in savings and economies compared to single purpose projects. It is reasonable that the benefit of such savings and economies should be shared equitably by the users of the different services produced.

Two or more of the following functions may be performed by a multi-purpose project:—

(i) Irrigation.

(ii) Power generation.

(iii) Flood control.
(iv) Navigation.
(v) Domestic water supply.
(vi) Industrial water supply.
(vii) Pisciculture.
(viii) Wild life development.
(ix) Recreational development.

Multi-purpose projects in Maharashtra generally have only two important functions, *viz.*, (i) irrigation and (ii) power generation. Flood control and navigation do not figure prominently in our multi-purpose projects. Purposes mentioned at (v) to (ix) above are more or less incidental and comparatively of insignificant benefit. It is necessary that the total cost of a project should be equitably allocated between the important functions performed by it. It is not worthwhile allocating capital cost to functions which are minor and only incidental. The benefits derived from such minor functions can be charged reasonable prices unrelated to the capital costs incurred. The following methods are in vogue for allocating costs: (i) Benefit method, (ii) Alternative justifiable expenditure method, (iii) Separable cost remaining benefit method, (iv) Use of facilities method, (v) Separate projects method, (vi) Equal apportionment method, (vii) Priority of use method, (viii) Incremental method, (ix) Direct costs method, (x) Special costs method and (xi) Vendibility theory.

By judicious combination of two or more of the methods in vogue or by modifying one of them it is possible to evolve a method suitable to the circumstances of a project, the costs of which are required to be allocated.

In Maharashtra the problem of allocation of costs would come up only once in a while, since there would not be many multi-purpose projects to be undertaken in future, which are located entirely within the State and the benefits of which are also derived within the State's borders. As and when the problem of allocation arises a suitable method should be evolved. In respect of costs of a project in which other States are beneficiaries together with Maharashtra, an agreed method will have to be adopted which is suitable to the circumstances of the project in question.

ALLOCATION OF CAPITAL COSTS OF EXISTING HYDEL PROJECTS

3.7.3. Even where water is first used for power generation and then for irrigation, it is necessary to allocate the cost of the project concerned, since it would be unreasonable to burden either power or irrigation with the entire cost. At the Radhanagari dam in the Kolhapur district and the Bhatghar dam in the Poona district power is being generated but the costs have not been allocated and the full annual cost is being borne entirely by irrigation. It is not reasonable that consumers of power alone should benefit from the savings and enconomies accruing on account of the multi-purpose nature of these projects. We recommend that costs of multi-purpose projects should necessarily be allocated between the different functions performed, barring those functions which are very minor or for which recoveries are made on a uniform basis throughout the region or the State. Where costs have not so far been allocated it should be done forthwith.

WATER RATES FOR DOMESTIC AND INDUSTRIAL SUPPLY

3.7.4. We have suggested in paragraph 3.7.2. that where supply of water from an irrigation work for domestic or industrial use constitutes a minor function of the project, the capital costs thereof need not be allocated. Therefore, except in a solitary case where such allocation is done, the question of rates for water for domestic use taken from one project being cheaper than from another project would not arise. We recommend that a uniform rate should be fixed for the entire State for raw water supplied for domestic use from a reservoir or canal appurtenant to irrigation works. It should be fixed on an *ad hoc* basis at a reasonable level which can be borne by the population without hardship.

Industries may be grouped according to types on the basis of the extent to which the cost of water enters the final price of the products made by them. Water rates should be fixed for each group on the basis of what it can bear. These rates should be uniform for each group in each appropriate region.

ALLOCATION OF CAPITAL RESOURCES BETWEEN DIFFERENT TYPES OF WORKS

3.7.5. We have recommended elsewhere in this report that the available water resources in a basin or sub-basin should be equitably distributed between the different parts of the basin. We have also said that in areas where the extent of flow irrigation is likely to be small, other types of irrigation, particularly from underground water supplies, should be developed to the extent possible and necessary, to make up the leeway. These recommendations of ours would preclude any *a priori* decision on the allocation of the total available capital resources between the different types of irrigation works. It would not be desirable to earmark a specific proportion of the total capital resources for a specific type of projects, *e.g.*, for minor irrigation schemes. Such amounts as may be required for implementing the several types of schemes contained in a programme of extension of irrigation, framed on the basis of the principles recommended by us for adoption, should be allocated from time to time for the different types of works.

FINANCING OF CO-OPERATIVE LIFT IRRIGATION SCHEMES

3.7.6. We found that a number of co-operative lift irrigation schemes were unsuccessful mainly because many cultivators within the command area did not take water. This was so because a number of societies have put restrictions on the growing of the different crops, particularly cash crops. These restrictions were originally put by Government some years ago but it has since removed the restrictions. Notwithstanding this, some societies continue the restrictions, because if they did not do so the crop pattern obtained would be different from the one contained in the original project. The crop pattern included in the original project was obviously adjusted by them in order that the capital cost per acre should be within the 'yardstick of feasibility' fixed by Government. We suggest that the existing yardsticks of capital cost per acre irrigated should be done away with. Instead, standard annual recurring cost of irrigation per acre of each principal crop should be worked out for varying lifts. Only where the soil and climate of the area as well as the local level of cultivation efficiency justifies the expectation that the crops proposed to be grown by the prospective irrigators would be able to bear the standard annual recurring cost per acre relevant to the lift in question, should a co-operative lift irrigation scheme be considered as feasible. If this method of examination of the feasibility of co-operative lift irrigation schemes is adopted, we feel that lift irrigation will progress on sound lines. There would also be less infructuous investigating and organising of societies by the Irrigation and Co-operative Departments, respectively.

Land mortgage banks and central co-operative banks may be urged to take up the financing of co-operative lift irrigation schemes. This would augment the capital resources available for this type of irrigation besides making the managements of the co-operative lift irrigation societies more aware of their obligations in respect of repayment of the loans.

FINANCING OF WATER CONSERVATION AND STORAGE WORKS NOT DIRECTLY REMUNERATIVE.

3.7.7. Even after the full development of available surface water resources is achieved, a large part of the State would have to depend for irrigation on underground water supplies. Although the available resources in this field have not so far been surveyed it is clear that in many areas shortage of water in wells would be experienced, as this form of irrigation progresses. It is, therefore, necessary to consider ways and means of enriching the sub-soil water table. Amongst these measures are percolation tanks, *nala* bunding, trenching and afforestation of hill slopes and contour bunding of cultivated lands. The last item is being taken up on a large scale. Contour bunding work is financed by loans to the landowners concerned, which are recovered in suitable instalments. The case of the other measures of enrichment of the sub-soil water table mentioned above is different from that of contour bunding of cultivated fields. The benefit derived from these measures cannot be identified fieldwise, although it is well known that they result in positive addition to the available underground water supply. A large number of percolation tank schemes have been shelved for the reason that there is no direct financial return therefrom. Although these schemes are thus declared financially 'unsound' the fact remains that they are extremely useful, especially for areas where flow irrigation or lift irrigation is not possible.

When land revenue is settled an addition to the normal rate of assessment is made in respect of land which has facilities for growing irrigated crops from sources for which no water rates as such are payable, *e.g.*, wells. When measures for enriching the sub-soil water table are taken the area under well irrigation will increase, both on account of larger water supplies in the existing wells and on account of new wells. Larger supplies would also enable farmers to grow perennial or long term crops under irrigation where they could grow only short term seasonal crops before the water supplies got augmented in their wells. Under the Maharashtra Zilla Parishads and Panchayat Samitis Act, 1961, 70 per cent. of the land revenue has been assigned to the Zilla Parishads and 30 per cent. to the Gram Panchayats. Since a large number of wells have been dug recently, much of the area which grows irrigated crops on wells does not pay any addition to the normal rate of land revenue assessment. If the water facility assessment is separated and charged on irrigated lands as assessed from year to year a sizeable income should accrue. This income could be made over entirely to the Gram Panchayats in addition to the share of the land revenue which they are to receive. There may be cases in which an existing water facility assessment is not relatable to an existing source of irrigation. Separation of the water facility assessment and its computation from year to year would result in the removal of such anomalies. Zilla Parishads should make a recommendation to Government to separate the water facility assessment and allow it to be charged on land irrigated from wells and other sources for which no water rate is payable, in respect of those Gram Panchayats who agree to use the additional income for the construction of village tanks and percolation tanks and for *nala* bunding and trenching and afforestation of hill slopes, *etc.*, to the extent possible. Gram Panchayats can also be given loans against the security of this income either by the State Government or by the Reserve Bank of India. Even those Gram Panchayats, in whose jurisdiction there is little scope for carrying out such water conservation measures, should be allowed to benefit from the new system of charging water facility assessment, if they so desire. It may happen that in a catchment the works are required to be executed within the jurisdiction of one Gram Panchayat while the benefits accrue within the jurisdiction of another. Therefore, a system of apportioning the income from water facility assessment between Gram Panchayats situated within a single catchment will have to be devised.

The water facility assessment can also be graded for (i) perennial crops and (ii) seasonal crops. Thus land growing seasonal crops before the construction of a percolation tank, on wells with inadequate water supply would be paying 'water facility assessment' at a higher rate when the same land grows perennial crops on the wells with their water supply augmented due to the construction of the percolation tank, *etc.* The rates of water facility assessment for perennial and seasonal crops should be fairly uniform. Since the power to fix these rates would be that of Government the intended uniformity can be easily secured.

Cultivators who are at present reluctant to pay a charge on their wells, generally known to be benefiting from a percolation tank, would have no ground to complain when asked to pay the 'water facility assessment' which is an existing tax. The beneficial measures for augmenting underground water supplies like *nala* bunding and trenching and afforestation of non-cultivated lands and hill slopes can also be pushed ahead by adopting the suggested financial arrangement.

3.8 Irrigation cess

Irrigation cess can be defined as a fee to be paid by every landholder under the irrigable command of a canal system for the facility provided by the State of obtaining water for his fields, and is primarily meant to meet the recurring expenses of the canal system. The liability to pay irrigation cess is not dependent upon the use or otherwise of this facility. It is sufficient justification for the levy of the cess that an opportunity to utilise canal water has been created which did not exist before.

The Cabinet Sub-Committee appointed in 1947 by the then Bombay Government to review the financial position of major irrigation works recommended that in order to hasten irrigation development an irrigation cess should be charged to all those who could take water but do not do so. The Committee argued that an irrigation work has to be maintained even if the water available is not utilised and that, therefore, it was reasonable to charge recurring expenses to all those who could take water if they so desired. The Committee recommended that interest charges should be recovered through water rates which should be levied only on those who make use of the water. Since interest charges have also to be paid on the capital invested on an irrigation project, irrespective of whether or not the water made available is used, it is difficult to appreciate the distinction made by the Sub-Committee between interest charges and recurring expenses.

Government accepted the recommendation of the Cabinet Sub-Committee and accordingly the Bombay Irrigation Act, 1879, was amended in 1950 empowering Government to recover irrigation cess on the irrigation works controlled by Government. Sections 56-C to 56-F of the Irrigation Act pertain to the levy of irrigation cess. There is no provision for such a levy in the C. P. Irrigation Act or the Hyderabad Irrigation Act applicable to the Nagpur and Aurangabad Divisions.

On the existing major storage works in Western Maharashtra the available water is almost fully utilised. Full utilisation of stored water on medium and minor storage works can also be secured by altering the crop pattern suitably and by other measures. There is very little possibility of the monsoon flow in rivers being utilised for *kharif* irrigation without being supplemented by stored water. Very little area, if any, can, therefore, be offered irrigation as an insurance against the vagaries of the monsoon, in addition to what is being actually irrigated in the *kharif* season from year to year. In these circumstances Government found it difficult to follow the procedure recommended by the Sub-Committee and charge irrigation cess on all lands within the irrigable command of an irrigation work, irrespective of whether a piece of land was actually irrigated in a particular year or not. Irrigation cess was, however, levied and is at present being recovered as a surcharge on the water rate, *i.e.*, it is being recovered only from those who take advantage of the irrigation facility available. The quantum of the cess is determined on the basis of the average recurring expenses incurred. We have suggested in paragraph 3.4.6 that both the recurring expenses and the interest charges on irrigation works should be recovered through water rates. In view of this and the fact that without storage there is very little insurance and also that virtually there need be no non-utilisation, we recommend that the existing irrigation cess should be abolished.

3.9. Betterment levy

OBJECT OF CHARGING BETTERMENT LEVY

3.9.1. We now consider two important questions, *viz.*, recoupment of capital invested and recovering depreciation charges.

Betterment levy can be described as a tax meant to tap the unearned increment in the land values consequent upon the advent of irrigation.

The objectives of collecting a betterment levy or charge could be stated as below :—

(i) To appropriate to the State a part or the whole of the unearned increase in the value of the land due to the construction of an irrigation project.

(ii) To recoupe a part or whole of the capital outlay on an irrigation project from the beneficiaries thereof, to provide capital resources for extending irrigation to other areas.

PRESENT POSITION REGARDING IMPOSITION OF BETTERMENT LEVY.

3.9.2. The present position regarding assessment and recovery of betterment levy in the different regions of the Maharashtra State is as below.

Western Maharashtra and Konkan (former Bombay State area): The Cabinet Sub-Committee appointed by the former Bombay Government in 1947 to review the financial position of major irrigation works recommended the levying of a betterment charge on the unearned increment in land values following from the construction of an irrigation project. The Bombay Irrigation Act, 1879, was accordingly amended in 1950 imposing betterment levy on irrigation works completed after 1950. These charges are leviable on all lands coming under the irrigable command of a new canal or improvement/extension of an existing canal, costing more than Rs. 50,000. The increase in the value of such land is the amount by which the value of the land on the completion date of the work is likely to exceed the value of the land on the construction date, and the betterment charges to be recovered from the land owners are to be one-half of such increase in value. Under Sections 50 and 52 of the Bombay Irrigation (Amendment) Act, 1950, dates of commencement and completion of new canals or extension/improvement of existing canals and the scheme of betterment levy are to be notified in the official Gazette. Officers of the Revenue Department are to be appointed to assess the increase in the land value in consultation with the Superintendent of Land Records of the Circle concerned. The Rules regarding the levy of betterment charges were issued in February 1953 which, *inter alia,* stipulate that the betterment charges should be paid within sixty days from the date they become payable under the Act. If the owner of the land desires to pay the charges by easy instalments they can be so paid in annual instalments not exceeding twenty in number. Prant Officers are to act as Betterment Assessment Officers and their duties have been laid down under the Rules.

Vidarbha (former M. P. State area): The Madhya Pradesh Taxation Laws (Amendment) Act, 1956, provides for the levy of betterment charges on irrigation works undertaken on or after the 1st April 1951. Section 58-C (I) of the said Act stipulates that in any area in which a new canal has been provided, every permanent holder of land, whose land is benefited by such canal, shall be liable to pay to the Government annually betterment contribution at the rate to be determined in accordance with the following formula :—

(i) $Z = \frac{X}{Y \times 100} \times \frac{3}{1}$ (for the first five instalments).

(ii) $Z = \frac{X}{Y \times 100} \times \frac{9}{2}$ (for the next ten instalments).

Where—

'X' is the cost of construction, improvement or extension of the canal, incurred during the period of five years immediately preceding the date of issue of the notification under Section 58-D,

'Y' is the acreage benefited by the canal, and

'Z' is the rate of betterment contribution per acre per year.

The betterment contribution is payable consecutively for fifteen years, excluding the years in which the recovery may be postponed by the State Government. The arrears of instalment of betterment contribution are to bear interest at the rate of 6 per cent. per annum. The State Government is empowered under the Act to appoint an officer to fix the exact amount of betterment levy.

Marathwada (former Hyderabad State area): Hyderabad Irrigation (Betterment Contribution and Inclusion Fees) Act, 1952, introduced the levy of betterment charges on irrigation and drainage works completed not earlier than 1st January 1943. The exact amount of betterment charges are to be fixed by the Collector, under Section 4 of the Act, after taking into account the increase in the capital value of the land benefited or capable of being benefited by the completion of construction of any irrigation or drainage work or by any improvement or extension thereto; provided that the contribution shall in no case exceed one-half of such increase in the value of the land.

In the Vidarbha Act betterment charges are linked with the cost of the irrigation project concerned and not with the appreciation of land values as in the Bombay Act. In the Hyderabad Act though betterment levy is linked with the appreciation of land value as in the Bombay Act, the dates with reference to which the increase is to be computed are not specified; notification of the dates of commencement and completion of a work has also not been prescribed as in the Bombay Act. In respect of both the Vidarbha and Marathwada Acts, Rules were not framed by the respective Governments for the levy of betterment charges. Rules under these two Acts have also not been framed by the Bombay or Maharashtra Governments, since the question of unification of laws has been under consideration since 1956.

DIFFICULTIES IN THE ASSESSMENT OF BETTERMENT LEVY

3.9.3. Although in respect of Western Maharashtra the law was enacted in 1950 and the rules thereunder issued in 1953, betterment levy has not even been assessed, let alone recovered, so far. The difficulties in assessment according to the principle of capital appreciation in the value of land, arise from the following three conditions obtaining in the prevailing irrigation system:—

(i) An optional system of irrigation, that is to say, a system under which in the irrigable command there is neither compulsion to the land holder to take water nor a permanent commitment on the part of the Government that water shall be supplied.

(ii) A system under which it is not prescribed that a certain piece of land shall be grown with a particular crop only.

(iii) With the enactment of the tenancy law and implementation of other land reforms there is no market price as such for land.

For these reasons assessment of the levy as a portion of the unearned increase in the value of land is not practicable. The present position of betterment levy, therefore, is that there is a complete stalemate as regards action to be taken for implementing the laws enacted for the purpose, in all the three component parts of the State.

INCREASED PRODUCTIVITY AS BASIS

3.9.4. While it is not possible to recommend action on the lines of the existing legislation, it is necessary to raise the extra resources regarding which expectation was entertained when enacting the betterment levy legislation. Increased productivity is the only basis on which an extra charge like a betterment levy can be made and we recommend that such a levy should be charged on all lands irrigated by Government works whether new or old. In these circumstances, it is obvious that calculations regarding the levy cannot be made in terms of future increments in values of lands. We have also already pointed out that recent legislation highly restricts the market for land and makes it difficult to assess adequately increments in value of lands. In our opinion, the proper justification for a levy or charge corresponding to the betterment levy lies in the need for additional finance for development of the resources of the State. Without such additions being made for financing capital expenditure, the progress of irrigation at the pace we desire would not be possible. There appears to us, a very strong case for raising part of the added finance required by a levy on those who benefit from existing or new irrigation works. In Maharashtra, the difference made by a public system of irrigation to agriculture and agriculturists of a tract is very great and cultivators willingly incur very considerable expenditure for obtaining alternative private sources of irrigation where possible. Furthermore, the bulk of cultivators benefiting from a public system of irrigation would not come within the operation of taxation of personal incomes. We, therefore, consider it justifiable to recommend a special surcharge on water rates in order to provide nucleus of a fund to be used for the extension of irrigation works. We consider that a surcharge of 14 per cent. on the water rates is reasonable and should be recovered on all irrigation works, whether old or new.

DEPRECIATION CHARGES

3.9.5. The depreciation charge is levied for laying by something from the current income to enable an asset to be replaced when it becomes obsolete. The life of an irrigation work would depend on a number of factors such as the type of the project, the nature of the construction, *etc.* The minimum life may be taken at about 60 years. The present capital cost (sum-at-charge) of providing irrigation facilities is about Rs. 1,050 per acre. The annual instalment at 4.5 per cent. rate of interest would be Rs. 3.57. On the cost of water the percentage which the annual instalment will bear would be 6.3. A depreciation charge equivalent to about 6 per cent. of the water rate will cover the cost of the project in 60 years.

CONSOLIDATED BETTERMENT-CUM-DEPRECIATION CHARGE

3.9.6. We recommend that a consilidated betterment-*cum*-depreciation charge equivalent to 20 per cent. of water rate may be charged, the period of recovery being unlimited. When water rates are fixed between 6 and 12 per cent. of the gross income (*vide* paragraph 3.4.8) the betterment levy would be equivalent to 1.2 to 2.4 per cent. of the gross income. The average water rate would be about 10 per cent. of the average gross income. Thus together with the consolidated betterment-*cum*-depreciation charge the irrigator will pay about 12 per cent. of the gross income.

A consolidated levy equivalent to 20 per cent. of the water rate will serve both the objectives of the levy, stated earlier, *viz.*, (i) appropriating to the State a portion of the special benefits derived from the public irrigation system and (ii) recoupment of the capital invested.

USE OF CONSOLIDATED LEVY

3.9.7. The monies recovered as consolidated levy may be credited to an 'Irrigation Development Fund' to be used for the development of irrigation facilities.

CONSOLIDATED IRRIGATION CHARGE

3.9.8. For administrative convenience there should be only a single 'irrigation charge' which should include both the water rate and the consolidated betterment levy. The respective shares of water rate and betterment levy, out of the irrigation charge may be separated and credited to the appropriate heads of accounts, but as far as the irrigator is concerned there should be a single charge for water, namely, the irrigation charge. Whenever this irrigation charge is revised the respective percentage shares of the water rate and the betterment levy should remain unchanged, the incidence of increase or reduction in the irrigation charge being borne proportionately by both the water rate and the betterment levy.

BETTERMENT LEVY DURING DEVELOPMENT PERIOD

3.9.9. Betterment levy should not be charged during the period in which concessional water rates are charged on a new irrigation work, lest the very purpose of giving concession in water rates is defeated.

BETTERMENT LEVY ON ALL WORKS

3.9.10. Betterment levy should be charged on all land irrigated by Government works, whether so far constructed or to be constructed hereafter. The 'irrigation charge' will then be uniform for the same quality of service and in the same geographical region.

LOCAL FUND CESS ON BETTERMENT LEVY

3.9.11. The consolidated betterment-*cum*-depreciation charge is not to be a part of the water rate, although it may be fixed as a proportion of the latter and recovered as a part of the single 'irrigation charge', for administrative convenience. Therefore, local fund cess which is levied on the water rates should not be charged on the betterment-*cum*-depreciation portion of the irrigation charge.

CHAPTER FOUR

Formulation and Execution of Irrigation Projects

4.1. Formulation of irrigation projects

PLANNING OF IRRIGATION PROJECTS

4.1.1. The formulation of an irrigation project is a complex operation involving numerous technical problems as well as some economic aspects. Firstly an irrigation project must be a part of the general plan for the development of the irrigation resources of the basin concerned, as outlined in the relevant Master Plan. This requirement determines to some extent the scope of the project. The designing of the different components of the project, *e.g.*, headworks, canals, *etc.*, embraces many fields of irrigation engineering such as geology, soil-mechanics, concrete and structural construction, various types of works along the canals and organising and handling of earth-moving and other machinery. The considerations regarding the dependability of water supply, distribution of irrigation benefits over the area to be served, the crop pattern likely to emerge in the context of the soil-climate complex of the area, *etc.*, involve many geographical and economic aspects, which considerably influence the process of detailed formulation of irrigation projects.

Another important factor which renders the process of formulation of an irrigation or a hydel project a complex one is the necessity of conceiving it initially itself in its final shape; unless the ultimate storage proposed, the ultimate areas to be served, *etc.*, are finalised at the very outset, the designing of the storage and canal becomes difficult and sometimes unnecessarily costly. A review of the progress of construction of the various irrigation projects in the Second Five Year Plan will illustrate this point. Some of the projects in the Second Plan such as Mula, Manar, *etc.*, could not be started up to the beginning of the third year of the Plan period, while others like Warna, Kurnoor, *etc.*, have not been started even now. This delay is mainly because the ultimate development proposed under the project could not be finalised earlier. It is, therefore, absolutely essential that there should be detailed and thorough planning of an irrigation project before its actual construction is started.

FORMULATION OF IRRIGATION PROJECTS

4.1.2. The formulation of irrigation projects has necessarily to follow a specific sequence to ensure economic and full utilisation of the available water resources. As already pointed out, the first step is the preparation of Master Plans for the different river basins. Government has already taken steps to get Master Plans prepared for the different river basins. We have, in chapter II, discussed those aspects of irrigation policy which have a bearing on the preparation of Master Plans.

Because of the complexity of the problems involved in the formulation of irrigation projects it has to go through three stages, *viz.*, (i) preliminary investigation, (ii) detailed investigation and (iii) preparation of detailed plans, designs and estimates. Formulation of a project in stages enables the most advantageous alternatives in respect of site, type of construction, design, alignment, *etc.*, to be selected. The method of formulation of a project in stages should not, therefore, be abrogated for the sake of speed; speed in the formulation of irrigation projects is often wasteful in cost and utility. Rather should the purpose of expedition be achieved by initiating the formulation of large projects sufficiently ahead. All possible alternatives of site should be investigated during the first stage, *i.e.*, of preliminary investigation and in enough detail and under competent direction at sufficiently high level, preferably of the Chief Engineer, the Chief of the Design Organisation and an expert Geologist. This course of action will ensure the rejection of less desirable sites and effect a saving by way of avoiding higher cost. Normally, estimates prepared on the basis of the preliminary investigation are submitted for administrative approval. The accuracy of the various provisions made at this stage determines whether the estimates would need revision at a later stage or not. A review of the Second Five Year Plan projects shows that estimates for headworks are usually worked out in enough detail and are, therefore, sufficiently accurate. This is not, however, the case in respect of other items like canals, land acquisition, construction of distributaries, *etc.* The provisions made for these items are often found to be inadequate, thereby giving the impression that the estimates have been inefficiently made. The Commission considers it desirable that fairly detailed estimates for canals and the main branches, as well as for land acquisition, should be prepared after an actual survey, *i.e.*, in the same manner as that adopted for estimating the cost of headworks. There is no objection to estimating the cost of the remaining items, *viz.*, distributaries, buildings, roads, *etc.*, on the basis of the experience gained in other works, provided realistic norms are prepared and laid down for the guidance of the estimating officers. The Irrigation and Power Department has already prescribed norms in respect of some of these items. Similar norms should be laid down for the remaining items.

The important stage of detailed investigation should be carried out in close consultation with the Designs Organisation and the Geologist. An important item of detailed investigation, which is often overlooked, is the survey and testing of local constructional materials. Inadequate or inaccurate information in this respect has often led to unsuitable design and wrong estimation. This item of investigation should, therefore, be considered important. A study of the various alternatives worked out in the Designs Office, on the basis of the detailed investigation, will lead to the most suitable design being adopted. Such detailed studies of alternative designs based on detailed field investigation have saved, we are told, about Rs. 90 lakhs on the Vir Project and Rs. 50 lakhs on the Girna Project.

IMPORTANT POINTS TO BE ATTENDED TO IN FORMULATION

4.1.3. The following points should be specifically attended to in formulating irrigation projects:—

(i) The likely crop pattern has to be worked out for the formulation of an irrigation project. This should be done on the basis of a complete soil survey and a careful study of the existing crop pattern in an adjacent area with a similar type of irrigation facility as the one in view in the project to be formulated. The likely crop pattern should be finalised only in consultation with the Agriculture Department and knowledgeable local farmers.

(ii) The present practice of designing canal capacities at the head just sufficient to meet the peak demand is correct, but it is necessary that canal capacities in the lower reaches should be 25 to 30 per cent. more than those required for carrying enough discharge to satisfy the peak demand in the respective reaches. This extra capacity lower down the canal will enable larger discharges being carried during the monsoon for giving seasonal irrigation and thereby making greater use of the monsoon flow. This will also help in filling up tail-tanks in a much shorter time. Such increase in canal capacity would no doubt increase the canal cost but the extra cost (which would be less than proportionate to the increased capacity) would be fully justified in our opinion.

(iii) The needs of drinking water supply of villages in and adjoining the command should be taken into consideration at the time of formulating an irrigation project. In such cases a near 100 per cent. dependability need not be considered as indispensable for water supply. Such drinking water supplies would also have to bear some cut when there are general shortages in particular years. The distress in rural areas in respect of domestic water supply is generally so acute that even a supply with a lesser dependability would mean a great relief.

The villages and towns in the command areas can draw raw water from the canal and use it for domestic or industrial purposes after necessary treatment. Such arrangement will necessarily need balancing tanks, filtration units, *etc.* The Public Health Engineering Section should evolve suitable type designs for these works, which would greatly expedite water supply arrangements in the rural areas.

(iv) For efficient management of irrigation, quick communication facilities like telegraphic and telephonic systems are very essential. Provision for these means of communication should invariably be made at the time of formulating irrigation projects.

(v) Wherever canals pass by village sites or cross important public roads, *ghats* for the use of villagers and ramps for watering cattle should be invariably provided. Service roads along the distributaries, which normally run along the ridges, should be made public roads. These should, therefore, be provided in the project according to the standard specifications laid down for roads. The road system in the canal command should be studied, in consultation with the officers of the Buildings and Communications Department with a view to finding out which sections of the service roads on the main canal would be needed by the public as a link between public roads; such portions of service roads as can serve as linking roads should be broadened and metalled and thrown open to the public.

(vi) Even where it is not proposed to generate power immediately, provision for turbine pipes should invariably be made in the design of the headworks, so that power can be generated whenever it becomes possible to do so, without any difficulty.

(vii) Wherever possible the reservoir should be made use of for pisciculture and the site made suitable as a tourist centre. For attracting tourists provision should be made for terrace gardens, illumination (where power is generated), rest-houses, *etc.*

(viii) Tail-tanks are useful for dispersing the benefits of irrigation over a larger area. There is no doubt that equivalent storage at the main reservoir can be provided at a lesser cost but the advantage of dispersal should outweigh the consideration of additional cost which would not be large. Wherever possible tail-tanks should be provided for.

(ix) At present small tanks are not considered and well construction not encouraged in the commands of projects of major irrigation works. This is probably being done with a view to avoiding duplication of capital investment. The Commission has recommended in paragraph 2.6.2. that flow irrigation should be combined with lift irrigation. Therefore, if there are already some wells in the command they will help in the expeditious development of such combined irrigation system. The Commission, therefore, considers that well construction should be encouraged in the commands of major irrigation schemes and small tanks should also be constructed in the command area. As regards the local priority to be accorded to such works, especially small tanks, that is another matter to be judged on the consideration of the widest dispersal of benefits of outlay for development of water resources.

(x) Construction of small irrigation works in the catchment area of an existing major storage scheme is not permitted at present, on the ground that such small works may affect the yield for the major storage scheme. It has already been suggested that the needs of all the areas in a river basin should be considered and the available water resources equitably allocated between the different parts of the basin. Small irrigation works should not, therefore, be ruled out where they are needed in pursuance of this objective even when they lie in the catchment areas of new major projects. This should equally apply to projects which have already been undertaken. Especially the fact that we are far from being anywhere near the optimum utilisation of the water resources of any valley (especially on the lower dependability that we have recommended) makes it still practicable to meet all such urgent local demands which, while small in themselves, are yet of vital importance to the beneficiary areas.

(xi) It is sometimes contended that minor irrigation works, which have both the catchment and the irrigated areas in the low rainfall zone, are not useful because in years of good rainfall water is not required by irrigators, while in years of low rainfall there is no water in the tanks to be supplied to irrigators. Though this is true for very good or very bad years, there are years with normal total rainfall but with bad distribution, when such tanks are very useful for ensuring a good yield. With good yields in such years, the irrigators under these tanks would be able to face better a very bad year which may occur once every five years or so. To this extent these tanks are helpful in reducing hardship in some of the bad years. They also help by maintaining water supply in wells useful for drinking-water and irrigation.

(xii) Continuous erosion of the soil in the catchment areas of reservoirs causes silting, which, if allowed to continue unchecked over a long period, reduces the capacity and thereby the efficiency of the reservoir. We have recommended elsewhere that contour bunding of the entire cultivated area suitable therefor should be completed as quickly as possible. However, a large part of the catchment is likely to be under forests. If this area has an adequate vegetative cover, erosion will be reduced to the minimum. We would, therefore, suggest that plans for the afforestation of denuded forest areas in the catchments of reservoirs should be formulated along with the irrigation project itself and the Forest Department should, as a part of its own afforestation programme, execute the plan of afforestation simultaneously with the project.

If some of the area is to be disforested, *e.g.*, for the rehabilitation of displaced farmers, care should be taken to see that contour bunding or other anti-erosion measures are taken before the area is actually brought under cultivation.

(xiii) The opinion is often expressed that minor irrigation works are cheaper, that they can be executed in a short time and that development of irrigation on such works is very much faster than on large works. It is, therefore, pleaded that minor irrigation works should be given preference over major works while formulating the programme of irrigation development.

This opinion is based on the assumption that the essential difference between major and minor irrigation schemes is their size. This is, however, not so in the conditions obtaining over the greater part of the Maharashtra State. Minor works differ from major works in their *character*. Major irrigation schemes have their storages in the dependable rainfall zones whereas most of the minor storage schemes get their water supply from the precarious rainfall zone in which their command is also situated. On account of this difference obtaining in Maharashtra the question of giving preference to one over the other type does not virtually arise. Even apart from this difference the opinion that minor irrigation works are cheaper per unit of area irrigated is also not borne out by experience. The details in Table No. 32 will clearly indicate that the cost per MCft. of live storage for medium and minor irrigation works is nearly 2 to 2.5 times that for large irrigation projects. Experience shows that the development of irrigation on minor works is also not faster than on large works as may be seen from the data contained in Tables Nos. 47 and 48.

The only point in favour of minor irrigation works is that an individual work can be completed in a slightly shorter period than is the case with a large project. This advantage should not, however, tip the balance in favour of minor works since irrigation works are a long term investment and an advantage of one or two seasons should not outweigh the permanent disadvantage of a higher capital investment per unit of water utilised. However, it has already been stated that certain areas which cannot be served by major works will have to be served by minor works, to achieve a wide dispersal of irrigation benefits. The importance of dispersal of benefits is so great that the possibility of being able to bring under irrigation a somewhat larger area elsewhere, with the same investment of capital resources, should not result in the creation of irrigation facilities only in those areas which can be served by major works.

(xiv) The sight of an old tank lying unused or being used for a very much smaller area owing to silting, often leads to the demand for its renovation by desilting.

Desilting is a fairly costly operation. Even at the minimum rate of Rs. 2.5 per 100 c.ft. the cost of adding one MCft. of storage capacity would be about Rs. 25,000. The average cost of minor tanks is about Rs. 12,000 per MCft. of water stored as may be seen from Table No. 32. Raising the height of the bund is more economical than desilting provided there are no other technical difficulties and the additional land to be submerged is not very valuable. The Commission does not, therefore, recommend increasing the irrigation potential of tanks by desilting as a normal method.

INDUCING CONTRACTORS TO OFFER COMPETITIVE RATES

4.1.4. The bulk of the construction work is being and will continue to be carried out through contractors. It is, therefore, necessary to create conditions which would induce contractors to offer competitive rates. The Commission recommends that the following steps may be taken to achieve this object.

(*a*) Estimates should be prepared on the basis of realistic rates. It would be helpful if the estimates prepared by the investigation engineer are checked before they are finally sanctioned and put to tender, by an engineer in charge of construction, with a view to ensuring that they are realistic.

(*b*) Detailed and complete information about site conditions and availability and leads of construction materials should be made available to prospective contractors prior to tendering.

(*c*) Active steps should be taken to build up a reputation for prompt payment and settling of claims.

(*d*) A reasonable period should be provided in the agreement for completion of the work.

(*e*) Timely steps should be taken for advance procurement of materials (including controlled articles) to be supplied to the contractors.

4.2. Organisational set-up

ORGANISATIONAL SET-UP FOR PREPARATION OF MASTER PLANS

4.2.1. Master Plans for the different valleys are prepared as the first step in the exploitation of water resources. This is followed by specific investigations of the various projects outlined in the Master Plan. The present arrangement is that the Water Resources Investigation Circle (W. R. I. C.) deals with the preparation of Master Plans, while the Irrigation Projects Investigation Circle (I. P. I. C.) deals with the investigation of specific projects. This arrangement appears to be generally suitable but the Commission considers that some improvements are necessary to make for better planning and proper formulation of irrigation projects. Our suggestions are as follows:—

(i) The Water Resources Investigation Circle should take into account the domestic and industrial water requirements while formulating Master Plans for the different basins.

(ii) We have separately recommended that a survey of underground water resources should be carried out. The Water Resources Investigation Circle should make use of the results of this survey for working out the irrigation possibilities from that source.

(iii) The Irrigation Projects Investigation Circle should take up the investigation of projects which are likely to be taken up in the fourth Plan period, after it has completed work on the Third Plan projects. Detailed investigation, designing and estimation of irrigation projects is a comparatively long and slow process. In view of the amount of work contemplated in the next few Plan periods, it is necessary that the Government should have a stock of fully investigated projects which can be taken up even at short notice, if and when funds become available.

(iv) Even though the main work involved in this respect, is for the engineers to handle, there are various other items such as working out the crop pattern suitable for the soil-climate complex of the area and other developmental problems which can be more effectively dealt with by experts in those fields. It will, therefore, be useful to associate officers from the Agriculture, Co-operative and Revenue Departments with the work of preparation of Master Plans and individual projects.

ORGANISATIONAL SET-UP FOR DETAILED DESIGNING

4.2.2. An important phase in the formulation of irrigation projects is detailed designing. Examples of economies that can be achieved by adopting the most suitable design have already been mentioned. In fact the maximum scope for economy is afforded at the stage of preparation of detailed designs. There should, therefore, be a well-staffed Designs Organisation working under the Chief Engineer in charge of designs. The Designs Organisation should be manned by capable and experienced staff. The officers in the Designs Organisation are expected to keep themselves posted with up-to-date developments in theory and practice of designs. They must, therefore, be given sufficient time for study and also for working out the various possibilities and alternatives regarding the projects under investigation. It would be a false economy to burden the designs staff with too much work and to measure their performance in terms of arbitrary or purely quantitative yardsticks of work. The staff should be sanctioned on a liberal scale to achieve substantial economy in the costs of irrigation projects.

There should be a regular programme of training of junior engineers, who have an aptitude for designing work, so that they can acquire knowledge of advanced techniques.

We recommend that within the Designs Organisation the practice should be to have the work of designing and estimating done by one unit checked by another unit.

TECHNICAL SANCTION TO LARGE PROJECTS

4.2.3. The State Government is undertaking big irrigation projects involving heavy capital outlays. The responsibility of sanctioning a particular design entirely rests with the Chief Engineer concerned. We feel that this responsibility is too heavy to be shouldered by a single officer, whatever be the range of his experience. We, therefore, recommend that an expert team, comprising senior engineers in the State Government service and suitable retired engineers, should be associated with the Chief Engineer in his technical scrutiny of large projects—say costing more than Rs. 10 crores each. Although the responsibility for the technical sanction to be given to a project will continue to remain that of the Chief Engineer concerned, the technical advice given by this expert team should be of considerable assistance to the Chief Engineer in reaching decisions on difficult issues in the technical sphere. The opinion of the expert team should be on record as well as the reasons of the Chief Engineer for making deviations, if any, from the opinion of the expert team.

RESEARCH IN METHODS OF DESIGNING

4.2.4. The efficiency of the Designs Organisation would be greatly enhanced if research for testing the efficiency of various designs and their suitability under the local circumstances obtaining in the area of a project is undertaken. The State has recently established the Maharashtra Engineering Research Institute which should be adequately equipped for undertaking comprehensive research schemes in this sphere.

USE OF MECHANICAL EQUIPMENT

4.2.5. Execution of an irrigation work is much more speedy if mechanical equipment is used, such as earth-moving machines, concreting plants, trucks, compressors, mixers, *etc.* It is very necessary that such equipment be maintained properly to get the maximum benefit in both speed and economy. There should, therefore, be sufficiency of maintenance staff and well equipped workshops. Various kinds of gates required for storage works and canals also call for specialised designing as well as fabrication. The State Government has recently made a start by setting up a mechanical organisation for the purpose.

POWERS OF TECHNICAL SANCTION OF PROJECT CONSTRUCTION STAFF

4.2.6. The construction organisation is often hampered in its work on account of lack of sufficiently wide powers exercisable by the officers in the field. This lack of powers is particularly harmful in emergent circumstances which often arise during the course of construction work. At present Executive Engineers have powers for technical sanction only up to Rs. 25,000 and Superintending Engineers up to Rs. 2 lakhs. All works costing more than Rs. 2 lakhs have to be sanctioned by the Chief Engineers. Since most irrigation projects cost more than Rs. 2 lakhs almost all technical sanctions to projects have to be given by the Chief Engineers. The lower officers exercise their powers of technical sanction only in respect of working estimates which individually cost less than these sums. The Commission considers that these powers need to be considerably enhanced with a view to securing speed and efficiency in the execution of irrigation projects. It has been suggested to us in this connection that Executive Engineers should be given powers to accord technical sanction for works costing up to Rs. 1 lakh, while Superintending Engineers should exercise these powers up to Rs. 5 lakhs. This may be considered by Government.

UNIFIED CONTROL OF PROJECT STAFF

4.2.7. Government has already set up a mechanical organisation with a view to ensuring proper maintenance and use of mechanical equipment and also for manufacturing the various types of gates required for irrigation works. The Commission has, however, observed that centralised administrative control over the staff working the mechanical equipment on a project often hampers smooth progress of the work. It is necessary that the officer in charge of the work should have administrative control over the mechanical staff also, along with the civil engineering staff. The role of the expert mechanical organisation at the headquarters should normally be confined to giving help and guidance in the proper maintenance of the mechanical equipment and technical control of the staff in regard to undertaking repairs and marshalling and deployment procedures. If on a particular project the entire job is very highly mechanised, the officer in charge of the project may as well be a mechanical engineer and the local civil engineer should in such cases be under his control. In either case, it is necessary to have unified overall control of work on a project. The opinion of the officer in charge of a project about the work of the staff under his control, including the mechanical staff, should form a part of the confidential personal records of the staff.

TRAINING OF ENGINEERS

4.2.8. The Technical Personnel Committee appointed by the Government of India a few years ago laid great emphasis on in-service or refresher training of construction engineers. The Committee observed that "in view of the enormous advance that the progressive countries of Europe and America have made in the field of engineering and technology, it is desirable that officers should have the benefit of training, both theoretical and practical, in and through selected universities of those countries". In view of the large programme of irrigation works, to be completed by 1980 as recommended by the Commission, it is important that engineers likely to be posted to construction jobs are given in-service training immediately. The present shortage of experienced men should not be allowed to stand in the way of sparing officers for training for short periods, since refusal to suffer some inconvenience now would result in much greater shortage of experienced engineers when faced with the ever increasing demand for such officers required for completing the formidable task set as the target. The Commission, therefore, recommends that a long term and continuous programme for training of engineers within the country and abroad should be immediately formulated and implemented, in spite of the non-inclusion of such a training programme in the Third Five Year Plan. Steps should also be taken to ensure the proper utilisation of technical specialisation and experience by posting officers to jobs in which their training and experience would be useful.

In this connection we also feel that it would be advisable to depute for short periods some of the senior engineers to central bodies like the Central Board of Irrigation, the Central Water and Power Commission, *etc.* These officers will bring back a fund of exeprience which would help in increasing the technical efficiency of the State Engineering Service.

SATISFACTORY SERVICE CONDITIONS FOR CONSTRUCTIONAL STAFF

4.2.9. The Commission feels that an important matter relating to service conditions of engineers should be attended to forthwith if the staff is to work with enthusiasm and initiative in the task entrusted to it. Although this matter may be applicable to the personnel of some other departments also, we wish to emphasise that its wider relevance should not stifle action with regard to the engineering services. The Commission has noticed that a large percentage of the staff is continued on a temporary basis and is thereby deprived of the benefits derived by those in permanent service. It is not desirable that a high proportion of the staff should continue to suffer the disabilities of temporary Government servants and for no valid reason. Large scale retrenchment is not at all likely to be effected in the foreseeable future—certainly not with the continuous expansion of activities in respect of development of water resources required to be effected. The Commission, therefore, recommends that a very large proportion of the existing temporary staff should be made permanent.

APPRECIATION OF GOOD WORK

4.2.10. Appreciation of meritorious work is the best incentive to the staff to achieve distinction by putting in the maximum effort. The Commission suggests that good work, *i.e.*, far above the average, should be appreciated by awarding medals or certificates to the personnel concerned—both individually and by groups, such as Divisions or Sub-Divisions. Government should also consider introducing a system of giving cash bonuses or granting of advance increments in appreciation of extraordinarily good work done.

4.3. Execution of irrigation projects

CONSTRUCTION PLANNING

4.3.1. Construction work to be economical and speedy needs careful advance planning. This need is often overlooked. It is essential that construction planning receives more attention than what has hitherto been paid to it. Construction planning involves planning for men, materials and equipment. It should be done in as much detail as possible so that the entire construction activity is carried on smoothly and according to schedule. One of the objectives in this planning should be that the work in question should start giving benefits in as short a time as is possible. This requires that at least a part of the canal system should be ready for use by the time a part of the storage becomes available. If there is no such synchronisation a large part of the capital invested remains unnecessarily idle. The Gangapur project is a flagrant instance of non-synchronisation in construction planning. In this project, storage was ready by 1954 but the same could not be utilised till 1958 as canals were not ready till then. In fact, the canal work was started only after the work on storage was completed. Construction of canals takes comparatively longer time than that required for construction of headworks. Construction of canals should, therefore, be started at least simultaneously with the work on the reservoir, if not in advance of the latter. Such planning will help towards utilisation in part as soon as some storage water becomes available.

The recurring cost of mechanical equipment can be kept down only by keeping it continuously busy. This can be done by arranging that the periods of its use on the different works follow each other in rapid succession. Therefore, not only has a plan to be prepared for each project individually, but also for all the projects to be undertaken during a period (*e.g.*, a Five Year Plan period) together.

SHORTENING THE PERIOD OF CONSTRUCTION

4.3.2. The discussion in paragraph 3.4.5 will indicate the need of keeping down interest charges during the construction period. The longer the period of construction heavier are the interest charges; they add to the sum-at-charge. It is, therefore, essential on this count also to prepare a construction plan for all the projects to be executed during a period so that their different phases of construction can be so dovetailed as to result in the most economical use of mechanical equipment, expert personnel, *etc.* The financial allocations for irrigation projects both during a Plan period and from year to year would consequently have to be so made as to fit in with the overall construction programme. The employment of investigation and construction staff as well as the availability of mechanical equipment make it necessary that at a given moment different projects are in different stages of construction, *i.e.*, some projects should be under detailed investigation, some at the preliminary stage of construction while the remaining at an advanced stage of construction. It is not at all necessary that all the projects included in a Five Year Plan should be started and completed during the same Plan period. Plan periods are arbitrarily determined groups of years meant for convenience of financial planning, while construction activity is a continuous process. If work from the stage of preliminary investigation is started on all the projects in a Plan at the beginning of that Plan period very little work will be done during the initial years and the financial burden will fall unequally on the years in the later Plan period. It is, therefore, desirable that at the beginning of each Plan period there should be under investigation and construction a number of projects at various stages of progress, which would be technically a 'spillover' from the preceding Plan period. The above does by no means imply that the construction period of a project should be staggered; in fact the construction period of each project, individually considered, should be the minimum possible so as to reduce the idle period of the capital investment.

SPEEDING UP LAND ACQUISITION

4.3.3. Out of the factors which contribute largely to delay in the execution of irrigation projects is land acquisition. Many of the construction engineers interviewed by the Commission were of the view that construction works should not be taken in hand unless the required land is not only acquired but possession given to the construction organisation. They complained that at present they have to devote considerable time and energy to pursuing these non-technical matters, which avoidably commits the time and energy of technical staff admittedly short of requirements. It is, therefore, suggested that for expediting land acquisition work a suitable unit of revenue staff under a revenue officer should be appointed along with the skeleton staff sanctioned for a project and this unit should be controlled by the construction engineer. This unit should complete all the necessary papers for acquisition of land. It should be so arranged that land becomes available for construction work by the time the other preliminaries such as preparing working estimates, inviting tenders and fixing of agencies are completed. Normally no specific item of work should be started unless the land required for it actually becomes available.

At present any land which has structures on it cannot be taken over under the urgency clause. This provision often results in delay in taking possession of land required for the construction of irrigation works. We propose that the law should be amended to provide for the application of the urgency clause to all land, irrespective of whether or not it has structures on it.

We have also made a proposal in paragraph 4.4 for amendment of the land acquisition law for acquiring land for the rehabilitation of farmers whose lands are acquired for the construction of irrigation projects.

DEPARTMENTAL EXECUTION

4.3.4. Efficient execution of irrigation works calls for proper understanding of the different techniques involved. These can be learnt by the supervisory staff, only if it is given an opportunity to handle some work themselves, *i.e.*, departmentally. Construction staff should, therefore, be required to execute departmentally every year, works costing about Rs. 50,000 in each construction division. Moreover, this would also help to keep down costs because, with a nucleus of departmental staff conversant with actual construction, engineers will not be chary of undertaking construction of a work departmentally, whenever contractors form a ring and quote unreasonably high rates.

EXECUTION OF SMALL IRRIGATION WORKS

4.3.5. The general principles mentioned above would also be applicable to small irrigation works, such as minor tanks, drainage works, *etc.*, except in respect of detailed designing. Designs for some of these works can be standardised and suitable type designs evolved. These can be used by the proposed Zilla Parishads through their technical staff.

EXECUTION OF CO-OPERATIVE LIFT IRRIGATION SCHEMES

4.3.6. The present procedure for implementing a co-operative lift irrigation scheme has been found to be unnecessarily time-consuming and often results in the promoters losing heart on account of the delay. This is mainly due to too many agencies being involved in the clearance of the scheme. We suggest that only two Departments, *viz.*, the Co-operative and the Irrigation Departments, should handle this work. The Irrigation Department should give a general indication of the areas where lift irrigation schemes are likely to be workable. (Perhaps the W. R. I. Circle could do this outside of existing irrigation systems and the Circle Officers in charge so far as existing irrigation systems are concerned). We have suggested in paragraph 3.7 6. that 'norms' of recurring cost of lift irrigation for the different crops and for different lifts should be prepared. With the help of the information regarding areas of likely success and the norms mentioned above, the Co-operative Department can decide where to intensify its effort of organising co-operative lift irrigation societies and whether the circumstances of a specific site are suitable with reference to the norms of recurring cost. After a society is organised, it should carry out all the works strictly according to the approved plans and estimates and under close supervision of the Irrigation Department, where indeed they would not like to entrust the execution itself to the Irrigation Department. These steps should result in the expeditious construction of lift irrigation schemes and reduce chances of failure and avoid the waste of effort and dampening of enthusiasm and infructuous expenses frequently caused at present.

RECLAMATION OF WATER-LOGGED AREA

4.3.7. On the existing Deccan Canals nearly 70,000 acres of area has become waterlogged and saline. The problem of improving these lands is not receiving as much attention as it should. The cost of improving the lands already damaged would be about Rs. two crores, while the provision made in the Third Plan for this work is hardly about Rs. 40 lakhs. At this rate, it will take another 25 years before the entire land is reclaimed. It is much cheaper to reclaim an acre of waterlogged land than creating irrigation facilities for an equal area of non-irrigated land ; the cost of the former would not exceed Rs. 300 per acre while that of the latter would be about Rs. 850. The Commission feels that Government should find the additional funds necessary for completing the work at an early date.

Because of the peculiar nature of drainage works, the progress of their construction with manual labour is necessarily slow. It is, therefore, necessary to use mechanical excavators for the work. An effort in this direction which was made in the past failed because there was only one isolated machine working at a place, without proper arrangements for its maintenance and repairs. With the mechanical organisation now functioning in the State, it should be possible to use a small unit of 3 to 4 draglines at one place with the necessary technical staff. The unit can be moved from place to place as one drainage project after another gets completed.

It is very necessary to prevent, to the maximum extent possible, land which has been brought under irrigation becoming waterlogged and saline. We have recommended dispersal of irrigation benefits and introduction of the lift-*cum*-flow system of irrigation. Implementation of these recommendations together with rigorous observance of 'X' limits of perennial irrigation in each catchment should, in our opinion, result in the virtual disappearance of the problem of waterlogging in respect of new irrigation works. The introduction of the lift-*cum*-flow system of irrigation on the existing canals would help considerably in reducing the intensity and extent of the existing problem.

CONTOUR BUNDING WORKS

4.3.8. A large part of the State cannot be served by flow irrigation from surface sources. In this area underground supplies must be augmented to the maximum extent possible by measures which result in moisture conservation. Contour bunding, *nala* plugging and terracing are important among measures of moisture conservation. It is estimated that nearly 260 lakh acres out of the total culturable area in the State, *viz.,* 525 lakh acres, would require contour bunding. The area which will ultimately be included in the culturable command of irrigation projects, will not need contour bunding. Even though the programme of contour bunding was initiated as early as in 1942, it has gained momentum only since 1958-59. During the sixteen years from 1942-43 to 1957-58 the total area contour-bunded was 7.80 lakh acres, whereas during the two years 1958-59 and 1959-60 bunding work was done on an area of 6.79 lakh acres. The target for 1960-61 was 7.41 lakh acres. By the end of the working season of the year 1960-61 the total area bunded was to be 22 lakh acres or about 8 per cent. of the total bundable area. Even granting that in a work of this nature momentum is gained as time elapses, we feel that the achievement since 1958-59 is praiseworthy. It would be possible to complete the bunding work in the remaining 92 per cent. of the bundable area in the next twenty years, *i.e.,* up to 1980, provided sufficient funds are made available.

It is presumed that a suitable technique for deep soil areas will have been evolved in the meanwhile; the Agriculture Department has already taken up research work in this regard. The Commission recommends that this research should be intensified and a suitable technique finalised at an early date.

The Commission also feels that the technique now in vogue for light and medium soils needs re-checking on the basis of experience so far gained. Such re-checking will possibly result in revision of designs of bunds thereby effecting considerable economy. This work should, therefore, be undertaken immediately.

Contour bunding is an item of land development work and it should, therefore, be possible to evolve a system of financing this work through land mortgage banks. If this is done the burden on the State Plan will be considerably reduced.

IRRIGATION WELLS

4.3.9. At present wells account for more than 50 per cent. of the area under irrigation. There is further scope for increasing irrigation under wells, especially after contour bunding has been carried out to the fullest extent. Well irrigation can easily be increased from the present eight lakh acres in the area outside the culturable commands of irrigation works to about twenty-three lakh acres and from four lakh acres to fifteen lakh acres within the culturable commands. Government has already taken up an intensive programme of well construction under which farmers are given loans through land mortgage banks and subsidies from Government. It is, however, necessary that this programme of expansion of well irrigation should be based on a scientific study of the underground water resources. Such a study would indicate the limits of exploiting this source of irrigation and also help in preventing excessive digging in particular areas. It is necessary to establish a unit which will collect the necessary data regarding wells recently dug under the wells programme and evaluate the usefulness of the wells in the different areas. If a proper and comprehensive *pro forma* is prescribed for collection of dada, it would serve as a good basis for a detailed survey of underground water resources. We, therefore, urge the establishment of such a unit immediately.

Many witnesses told the Commission the difficulties faced by farmers in getting loans from land mortgage banks. Once the steps, which Government is contemplating with regard to the legal aspect of mortgaging land as surety for the loans, are taken the present difficulties would largely disappear. The Commission was also told of difficulties in regard to procuring of blasting materials, bricks, cement and iron. Much can be done for improving the situation in this respect. There is also difficulty with regard to skilled labour required for blasting and masons for building wells, especially in the remote areas or where a large number of farmers get loans for digging wells at a time. With regard to blasting the blasting units of the Agriculture Department need to be increased manifold.

The Commission was impressed with the experiment made by the Collector of Aurangabad in one of the talukas of the district. All the agriculturists who desired to sink wells in their fields were asked to form a co-operative well construction society. The society arranged to fix contracts for excavation, to obtain materials for well construction and employ skilled labour. The society could complete all the wells for which loans were granted in the taluka in one working season. Besides relieving the individual farmer of the botheration normally experienced in well construction, there was also economy in the cost. The Commission recommends that this experiment should be copied elsewhere in the State, with such modifications in the procedure as further experience may indicate.

The Commission was told by some witnesses that digging of wells in the deep soil areas involves the risk of the sides of the excavation collapsing. The technique of sinking wells adopted in Gujarat and in north India, where the entire depth of a well is in soil, can be adopted in these deep soil areas of Maharashtra. The possibilities of adopting this technique in Maharashtra have not yet been explored by the Agriculture Department. It should do so immediately and arrange to put into the field demonstration parties and train those who wish to acquire the skill.

PERCOLATION TANKS

4.3.10. Percolation tanks are of great value for conservation of moisture. They help to enrich the sub-soil water table and thereby make well irrigation in the area downstream of the tank more assured. With respect to moisture conservation percolation tanks are an extension of the principle common to contour bunding and *nala* plugging. Although benefits of percolation tanks are accepted as a fact their precise extent in different topographical situations and with different kinds of substrata has not so far been ascertained. If this is done the siting and designing of percolation tanks can be done on a scientific basis leading to the maximum benefit from the capital invested in these tanks. We recommend that a scientific study of the benefits of percolation tanks should be undertaken as early as possible. In the meanwhile percolation tanks should be located only at sites where minor irrigation tanks are not possible.

Percolation tanks should be so designed that they are empty by the end of February every year. If this is not ensured a considerable quantity of the stored water would be unnecessarily lost by evaporation. The above can be achieved by a number of designing devices, *e.g.*, cut-off trench not being taken down to the impervious strata, material for construction being borrowed from the murumy area, *etc*. These devices should, however, be used within limits imposed by the consideration of the safety of the structures.

BRIDGE-CUM-WEIRS

4.3.11. It is necessary to use all possible means to conserve water and enrich the sub-soil water table. We, therefore, recommend that wherever possible road-bridges should be converted into bridge-*cum*-weirs for holding water during the post-monsoon period. As a further aid for charging sub-soil, submerged diaphrams (sometimes merely of *chopan* impervious soil) in sandy river and *nala* beds can be constructed at suitable points.

4.4. Rehabilitation of displaced farmers

A scheme for rehabilitation of the farmers whose lands are taken over for construction of an irrigation project needs to be worked out along with the project itself. It should be seen that a comprehensive rehabilitation plan is prepared, which should be sanctioned together with the project itself. The concerned Departments should execute the portion of the plan with which they may be concerned, expeditiously so as to complete the work before the lands are actually submerged or taken over.

The market value of property taken over as at present customarily assessed, is generally less than the cost of its replacement. Paying compensation on the basis of such market value, therefore, causes hardship. We, therefore, recommend that in addition to the compensation determined according to the existing law, Government should pay *ex gratia* an amount equal to the difference between the market value payable as compensation and the cost of replacement of the property taken over.

Government should accept the responsibility of rehabilitating the persons concerned physically that is by providing to them similar or near similar land and houses elsewhere. Acceptance of cash compensation should be at the option of the affected persons.

It appears that at present Government have no powers to acquire land for rehabilitation of persons displaced from the areas submerged by irrigation storages. The need for acquisition of land for this purpose would not be obviated by the operation of the Ceiling Law since sufficient area of land may not become available by its implementation to meet all the specific requirements of rehabilitation. The Commission, therefore, recommends that necessary powers to acquire land for this purpose should be taken by Government by amending the relevant legislation.

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CHAPTER FIVE

Irrigation Management

5.1. Present system

5.1.1. The system of irrigation management, as it now obtains in Western Maharashtra, is largely the outcome of physical factors such as topography, soil-climatic complex, the nature of the water resources, *etc.* Unlike in the Punjab and U.P., where irrigation canals draw water from perennial rivers and run through flat country, canals in Maharashtra have to depend upon storages and to negotiate undulating terrain before they are able to command sufficient culturable land. Secondly, unlike in the Indo-Gangetic plain, where there is little variation in the soil from the head to the tail end of a canal, the soils in Maharashtra vary greatly almost from field to field. In the low rainfall belt the erratic nature of the monsoon results in varying the demand for canal water, not only from year to year and from season to season but sometimes even from one rotation to another. Similarly, even though the storage works in Maharashtra are comparable in respect of their necessity to those in the southern States, the soil-climate complex in those States has led to the development of a largely single crop pattern in the areas COMPLEX NATURE OF THE SYSTEM under irrigation, making irrigation management in those States very much simpler than that in Maharashtra. Since the water resources of this State are inadequate in comparison to its area, the intensity of irrigation under a project has to be kept low in order to disperse the benefits of irrigation. High capital cost, fluctuating demand for water, the multi-crop pattern, low intensity of irrigation, *etc.*, have combined to make irrigation management in Maharashtra much more intricate than in the rest of the country.

PRE-DETERMINATION OF CROPS TO BE IRRIGATED

5.1.2. In the Punjab and U.P., water being comparatively cheap and plentiful the canals are run continuously distributing available water to the irrigators in the command in proportion to the total area of their holdings. There are practically no restrictions on the crops to be grown, provided the water drawn by a cultivator is within his fixed share. In the southern States there are no restrictions on the quantity of water drawn since the entire area is practically under one crop. Thus regulation of the quantity of water supplied according to the crops grown is not necessary in those States. In Maharashtra the farmer has to decide in advance which crops he would like to irrigate and get the areas for each crop sanctioned by the Irrigation Department. These sanctions are governed by the current irrigation policies such as maximising utilisation in the *kharif* season, encouraging the growing of foodgrain crops in the *rabi* season, minimising utilisation in the summer in order to avoid large evaporation losses and most important of all, the need to restrict the area under perennial crops like sugarcane for the fear of waterlogging and salt efflorescence. Uncontrolled growth of sugarcane areas under the Nira Left, Godavari and Pravara Canals in the past has amply proved the necessity of controlling the area under perennial crops. Thus controlling the area under sugarcane on the Deccan canals is a preventive measure. Sanctions for sugarcane are normally restricted to lands which have a soil cover of not less than 18 inches and not more than 8 feet. Moreover, the total sugarcane area in a sub-catchment is restricted according to the topography and the natural drainage facilities of the area. The upper limit thus laid down is known as the 'X' limit for that area. 'X' limits are generally fixed for different soil covers as under:—

	'X' limit
(i) Area with a soil cover of less than 18 inches.	Nil.
(ii) Area with a soil cover of more than 18 inches but less than 8 feet.	1/6 to 1/10 of the area of the entire sub-catchment.
(iii) Area with a soil cover of more than 8 feet	1/15 to 1/20 of the area of the entire sub-catchment.

This system of restricting the sugarcane crop to a predetermined extent has contributed substantially to the prevention of large scale damage through waterlogging.

After getting the areas under individual crops sanctioned, the farmer has to obtain permission at each rotation for irrigating the sanctioned crop. This is done through a system of 'passes' issued to farmers for growing crops as sanctioned. Before each rotation the irrigation official enters the date for receiving water on these passes, after which the farmer becomes entitled to get canal water for a particular crop and on the date specified.

LONG TERM CONTRACTS AND THE BLOCK SYSTEM

5.1.3. At present, sanctions for the various crops are given mostly on a long term basis, *i.e.*, for six years or sometimes even longer. This is the 'block system' which incorporates the various policies pertaining to crop pattern, safeguarding land from waterlogging, maximising utilisation of the run of the river during the monsoon, *etc.*

The important types of blocks at present in force on the Deccan canals are (i) cane blocks, (ii) fruit blocks, (iii) garden and seasonal blocks, (iv) garden blocks and (v) new type of two seasonal blocks. Water is also supplied for casual irrigation on application in Form No. 7.

(*i*) *Cane Block.*—Cane blocks are sanctioned in multiples of 1.5 acre and the basic cane area is restricted to one-third of the total block area. This is referred to as the 'one-in-three cane block'. As sugarcane necessarily requires 'overlap', additional cane area to the extent of 50 per cent. of the basic cane area is allowed to be under sugarcane, but only during the months from July to March or with special sanction even in April but never in May and June. However, permission for 'overlap' has to be obtained separately every time. In the block area which is not under sugarcane any seasonal crop is allowed to be grown during the *kharif* and *rabi* seasons but subject to general restrictions, if any, imposed by the Irrigation Department. A consolidated water rate is charged for the entire area of the block according to the crops permitted to be grown but irrespective of whether the same are actually grown or not. The present rate per acre is Rs. 61, *i.e.*, Rs. 183 for three acres, out of which Rs. 160 are for the basic cane area of one acre and the rest for the seasonal crops allowed to be grown. Additional charges have to be paid for the cane overlap area according to sanctions actually given. The normal period for this type of block is six years.

(*ii*) *Fruit Block.*—In this block, fruit trees which stand in the field for a long time, such as *mosambis*, oranges, mangoes, *etc.*, are allowed in the entire block area. Usually the contract sanctioned for this block is for 12 years and is generally renewable. The present rate per acre is Rs. 100.

(*iii*) *Garden and Seasonal Block.*—In this block, light perennials like lucerne and vegetables, and short term fruit trees like *papaya* are allowed in one-half of the area, while in the remaining portion seasonals like *kharif* and *rabi* crops are allowed. This block is taken advantage of especially for growing lucerne and vegetables, which are rotated after a certain period with seasonal crops. This block is usually sanctioned for 6 years and the rate for the same is Rs. 57.5 per acre.

(*iv*) *Garden Block.*—In this block, short term fruit trees and other light perennials are allowed. This block is sanctioned for 6 years. The present rate for the block is Rs. 100 per acre.

(*v*) *New type of two seasonal block.*—In this block, only *kharif* and *rabi* seasonals are allowed to be grown, with the restriction that only one-half of the area should be under irrigation in each of the two seasons. This block is sanctioned for 6 years and the rate per acre is Rs. 7.5.

Casual irrigation on Form No. 7.—This form is used for giving sanctions for casual irrigation for all kinds of crops. The main crops allowed under this form are *kharif* seasonals and *rabi* seasonals. The rate charged is according to the season in which the crop is sanctioned.

In addition to these types of blocks, long term sanctions have been given for sugarcane grown on a large scale by sugar factory farms and big landlords, for periods varying from 12 to 30 years. Such sanctions are normally permitted irrespective of the 'X' limits of the area concerned. The reason put forward for this relaxation of the restriction of 'X' limits is that water is supplied on actual measurement of volume and that consequently there is little danger of over-irrigation. The only restriction which is imposed is that there should not be more than three sugarcane crops on the same land in any five consecutive years. The rate charged per MCft. is based on the current area rate equated at 124 acre-inches (supplied at the distributary head) to an acre. The rate per MCft. (equivalent to Rs. 160 per acre) works out to Rs. 355.30.

SYSTEM IN THE VIDARBHA REGION

5.1.4. The system of sanctions in the rice growing area of Vidarbha is somewhat different from the one followed in Western Maharashtra. There are two types of sanctions, *viz.*, (i) the agreement system and (ii) the demand system. In the 'agreement system' if and when, either the permanent holders occupying not less than two-thirds of the irrigable land or 95 per cent. of the total number of permanent holders of irrigable land in a village, Mahal (part of a village) or Chak (command of an outlet) agree to take water for a certain period (which is generally 10 years), an 'agreement' is entered into with all the cultivators in the area for supply of irrigation water, at a rate which remains fixed for the period of the agreement. The minority of the occupiers or permanent holders, who did not originally agree to take irrigation water, are compelled to take it. Such an agreement can cover more than one crop. In the 'demand system' an occupier whose land is not situated in an agreement area, can on application get casual sanction for water supply. The demand system is analogous to the system of supply of water on Form No. 7 in Western Maharashtra. The rate charged for the crop is called the 'demand rate' which is considerably higher than the 'agreement rate'.

NEED TO REDUCE COMPLEXITY

5.1.5. The complicated system of irrigation management in Western Maharashtra creates many points of friction and irritation, between the irrigators and the Irrigation Department, some of which are avoidable. Delay in the issue of sanctions, seeking permission for watering before each rotation and non-observance of *Shejpali* (irrigation from the tail end) are reported to give rise to undesirable practices, believed to be prevalent on a considerable scale. These points appear to account for the major area of friction and irritation in the sphere of irrigation management. It is, therefore, highly desirable to improve the existing system of irrigation management.

5.2. Crop pattern

CROP PATTERN ASSUMED WHILE FORMULATING A PROJECT

5.2.1. A certain crop pattern has necessarily to be assumed at the time of formulating an irrigation project. Without making such an assumption it is not possible to determine the required capacity of the storage or of the canals. The assumption regarding this crop pattern has to be realistic from the agricultural point of view. Areas under crops requiring heavy irrigation have to be limited according to the nature of the soil and drainage facilities in the commanded area. Similarly, possibilities of other crops have to be studied in the context of the soil-climate complex of the region. The necessity of taking these aspects into consideration can be illustrated by the following instances. In a number of irrigation schemes under construction, a considerable percentage of light *kharif* seasonals has been assumed, when experience on the older works in the adjoining areas would have clearly indicated that this assumption was over optimistic. Sometimes entirely new crops like long staple cotton may become possible in the commanded areas after irrigation facilities become available. It is, therefore, necessary to assume a realistic crop pattern.

FREEDOM TO CHOOSE CROPS TO BE IRRIGATED

5.2.2. Having assumed a realistic crop pattern for the purpose of deciding the capacities of storage and canals in an irrigation project the question to be considered is how far this assumed crop pattern should be sought to be realised in practice, by means of restrictive measures in relation to the choice of crops to be grown. Having regard to the fact that the maximum benefit must be derived by the irrigator from the water used by him, that the periodic fluctuations in the prices of crops alter their relative profitability and that variations exist between the physical and economic conditions of one farm and another in the same area, we recommend that restrictions related to irrigation management should be so devised as to leave to the irrigators the maximum possible freedom to grow under irrigation those crops which, in their own judgment, would prove most beneficial to themselves. This freedom should get circumscribed only so far as is inevitable with regard to the suitability of the soil for heavy irrigation (both in relation to its own situation as well as its situation in the sub-catchment), the need for preventing damage to land on account of continuous heavy irrigation, and the prevention of wasteful use of water. In spite of the best and most realistic contemporary estimation, the ultimate crop pattern may develop differently from the one assumed while formulating the project, but this change should not be sought to be prevented or curbed as long as it is possible to supply water within the designed capacities of the storage and the canals.

DESIRABILITY OF LONG TERM CONTRACTS

5.2.3. Whatever the crop pattern assumed and whatever the crop pattern which develops under an irrigation scheme, it is desirable that all sanctions should be on a long term basis. We, therefore, recommend the retention of the basis. *viz.*, six years, as is the case under the block system on the Deccan canals or ten years as in the agreement system in Vidarbha.

LOCALISATION OF CROPS

5.2.4 'Localisation' is a term commonly used in the southern States of India. In this system a soil survey of the commanded area is carried out, the areas most suitable for different crops like *kharif* and *rabi* seasonals and perennial crops are demarcated once and for all, and only such crop or crops as are prescribed for an area allowed to be grown therein.

At present, in this State only perennial crops like sugarcane, plantains, *etc.*, are restricted on the basis of soil suitability while all other crops are allowed to be grown on any soil. Thus localisation as understood in the south is not followed in this State. It is often argued that localisation will make for easy assessment of betterment charges and irrigation cess, since both the Government and the irrigators will know the precise extent of the benefit which will accrue in the different areas in the command. The main objection to localisation is that it would permanently debar certain areas from receiving the benefits of irrigating certain crops. The intensities of irrigation in the irrigation projects in this State have to be low and permanent localisation of certain areas for certain crops, only for the convenience of levying betterment charges and irrigation cess, would be unjustifiable.

In paragraph 3.9.4 we have been able to recommend a reasonable and workable basis for the recovery of betterment levy, for which localisation is not necessary. Localisation would unnecessarily restrict the liberty of the irrigator to grow the crops of his choice. The Commission considers that this freedom to choose crops is valuable and is, therefore, of the view that localisation, in the sense understood elsewhere, should not be introduced in this State.

5.2.5. A suggestion has been made that the Phad system prevalent in the Nasik and Dhulia districts should be introduced on the major canal systems. In the Phad system, as it is now followed on the old bandharas in these districts, the command area is divided into three or four blocks (Phads). In each block there is only one crop at a time, and the crops are rotated in a definite sequence, from year to year. The entire irrigation management is handled by the Irrigation Panchayat of the village and waterings, *etc.*, are looked after by a Patkari appointed by the Irrigation Panchayat. This system has developed under certain historical conditions and now each irrigator possesses a piece of land in each block. Achieving such a pattern of ownership on the new canals would involve large scale exchange of land which seems quite unlikely to be acceptable to the irrigators. It is not, therefore, possible to think in terms of a general adoption of the Phad system elsewhere. **PHAD SYSTEM**

However, there are certain good points in the Phad system which should, as far as possible, be incorporated in the system of irrigation management on Government canals where they do not already exist. These points are given below:—

(i) Crop rotation, a desirable agricultural practice, obtain-in the Phad system. This is secured in the block system.

(ii) Under the Phad system each one of the Phads is under one crop at a time. This helps to make management of water distribution easier because of concentration of each crop in a compact area. Growing of a crop in a compact area, particularly a perennial crop like sugarcane, may be encouraged by giving preference in the matter of sanctioning perennial crop area to those farmers whose lands are contiguous and who agree to grow each crop in a compact block to the extent of the aggregate area sanctioned to them individually.

(iii) Perhaps the most important merit of the Phad system lies in the fact that irrigation management is carried out by the irrigators themselves, without outside help or interference. In paragraph 5.4.9 the Commission has recommended that distribution of water should be handed over to co-operative societies of irrigators.

5.3. Long term commitments under proposed annual utilisation

PROPORTION OF TOTAL SUPPLY TO BE COMMITTED ON LONG TERM BASIS

5.3.1. We have recommended earlier that (a) wherever necessary and possible all irrigation works should be designed for utilising 50 per cent. dependable flows and that (b) all irrigation sanctions should, as far as possible, be on long term basis.

The point which needs detailed consideration is whether long term commitments should be undertaken to the full extent of the maximum annual utilisation based on storage with 50 per cent. dependability, or whether such commitments should be limited only to a portion of the annual utilisation and, if so, what that portion should be.

Before making specific recommendations in this respect an illustrative study of four Deccan Valleys, *viz*., Nira, Mutha, Ghod and Bhima, was carried out. The crop pattern assumed for this study was as under:—

	Percentage of the irrigable command
(i) Sugarcane (basic)	12
(ii) Overlap cane (50 per cent. of basic)	6
(iii) Other perennials including vegetables	5
(iv) Cotton (long staple)	25
(v) Seasonal crops in *kharif*	12
(vi) Seasonal crops in *rabi*	40
Total	100

The requirements of water of the different crops in the different seasons as percentages of the total annual utilisation would be as below:—

(*A*) *Monsoon*—	
(i) Sugarcane including overlap	10·4
(ii) Other perennials	3·3
(iii) Cotton	3·6
(iv) *Kharif* seasonals	1·7
	19·0
(*B*) *Rabi*—	
(i) Sugarcane including overlap	24·7
(ii) Other perennials	7·7
(iii) Cotton	3·9
(iv) *Rabi* seasonals	12·4
	48·7
(*C*) *Summer*—	
(i) Sugarcane including overlap	14·5
(ii) Other perennials	6·2
(iii) Cotton	11·6
	32·3
Total	100·0

The Commission considers that the extent of long term commitments must be such that, in any year when shortage is felt, the crops already allowed to be planted during the *kharif* season can be allowed water up to their maturity. The maximum saving which can be effected by refusing to allow the planting of any new crop in the *rabi* and summer seasons would be about 36 per cent. of the total annual requirement as detailed below:—

	Saving as percentage of annual requirements
(*a*) For pre-seasonal irrigation of cotton	11·6
(*b*) For *khodwa* or *suru* cane	11·6
(*c*) For *rabi* seasonals	12·4
Total	35·6

In other words it means that 64 per cent. of the normal annual requirements would be the minimum quantity necessary for bringing to maturity those crops which are allowed to be planted in the monsoon or pre-monsoon months in the hope that the season will be normal. If in any year total run-off falls below 64 per cent. of the proposed maximum annual utilisation, even standing crops would have to be refused water resulting in heavy losses to irrigators. This must, therefore, be avoided.

In the graph (No. 10 of Appendix 'G') run-offs in different years in the valleys under study are plotted in terms of percentages of 50 per cent. dependable flow. It can be seen that if the entire 50 per cent. dependable flows are committed in long term sanctions there would be 4 or 5 years out of twenty, when even standing crops would have to be refused water. If such occasions are to be kept down to the minimum, then it is clear that long term commitments should be restricted to a portion of the annual flows of 50 per cent. dependability. If such commitments are restricted to about 85 per cent. of the 50 per cent. dependable flows, then standing crops at the end of the monsoon can be sustained in the remaining period of the year, in all years except in a very bad year like 1918. With long term commitments restricted to 85 per cent. of the 50 per cent. dependable flows, the balance whenever available can be used for sanctioning additional areas of *rabi* and summer seasonals. In this arrangement the average gross benefit to the irrigators over a period of years is larger than that obtained when the entire 50 per cent. dependable flow is committed in long term sanctions. Table No. 44 shows the average value of the gross produce over a period of years for each of the four valleys under study. The above study shows that 50 per cent dependable flows can be safely harnessed provided only 85 per cent. of those flows are committed in long term contracts. It would be desirable to work out the extent to which long term commitments should be made in respect of each project under consideration. What is of primary importance is that an attempt should be made to utilise all the water with 50 per cent. dependability, ensuring at the same time that the crops standing at the end of the monsoon are not allowed to suffer, save as a very rare exception.

Block system 5.3.2. It has already been stated that long term contracts are desirable. However, in the block system to be introduced the freedom of the farmer to choose the crops to be grown, subject to limitations the nature of which has been indicated in paragraph 5.2.2, should not be fettered. The block system is desirable, *inter alia*, from the point of view of irrigation management and provided that the crop composition of blocks is not rigidly fixed but allows sufficient scope for growing a wide range of crops there is no objection to offering to the irrigators the option of entering into long term contracts under a block system. Those who do not wish to make long term contracts in terms of the prescribed 'blocks' should be free to get irrigation water for growing the crops of their choice, but only to the extent of the water supply remaining unallotted after meeting the demand for blocks.

The agreement system in Vidarbha is suitable, where only a single crop is grown in a season and particularly where the system of field to field irrigation is practised. In this system there is collective freedom to take or refuse to take water. The freedom of the individual, who is in a very small minority, can be justifiably denied for the benefit of the community as a whole.

We suggest the following seven types of blocks:—

(i) *Cane Block, 'A' Type*:—Agronomically it is advisable that the cotton crop should follow the cane crop. Cotton thus grown makes the maximum use of the residual manure in a cane field after the cane crop is removed. If, however, cotton is thus allowed, it would mean giving additional cash crop benefit to the cane block holders. To offset this advantage and also to attain wider distribution of cash crops, it is suggested that this type of cane block should carry only one-fourth of its area under basic cane, *i.e.*, it should be a one-in-four cane block, instead of the present one-in-three. Such a cane block will also reduce concentration of cane in the different catchments and will help in lessening the rate of damage to land. In such a cane block the following crops may be allowed:—

	Acres
(i) Basic cane or plantains	1
(ii) Overlap cane	½
(iii) Long staple cotton	1
(iv) Any crop (excepting long staple cotton or perennial crops) in *kharif* or *rabi* seasons.	1½
	4

(ii) *Cane Block, 'B' Type*:— This block should be similar to the existing one-in-three cane block. In a block of 3 acres there would be one acre of basic cane or plantains, ½ acre of overlap cane and the remaining 1½ acre should be allowed to be sown with any seasonal crop which does not require irrigation before the 1st July.

(iii) *Fruit Block.*—This should be for a period of twelve years and normally renewable for successive terms. The entire area of the block should be under long term fruit trees, *e.g., mosambis,* oranges, guavas, grapes, *etc.*

(iv) *Garden Block*:—One-third of the area should be under perennials other than sugarcane, plantains and long term fruit trees, another one-third under long staple cotton and the remaining one-third under any crop excepting long staple cotton or perennial crops.

(v) *Two Seasonal Block, 'A' Type*:—This block should have one-third area under long staple cotton and the remaining area under any crop excepting long staple cotton or perennial crops.

(vi) *Two Seasonal Block, 'B' Type*:—This would be similar to the old type two seasonal block. In this block the entire area of the block should be allowed to be put under any crop, excepting long staple cotton or perennial crops.

(vii) *Optional Rabi Blocks*:—According to the suggestion made by us that only a portion of the proposed annual utilisation (85 per cent. in the study carried out) should be committed on long term basis, some quantity of water would be available for use in years in which the actual supply exceeds the committed supply. In order that this quantity should have ready customers and to avoid delay in sanctioning *rabi* crops after the supply position is known at the end of September, we propose that Optional *Rabi Block* may be given on the clear understanding that water may be refused for a part or the whole of the block at short notice. Such notice should be given before the 15th October. Any *rabi* seasonal crop should be allowed to be grown on the entire area of the block, which should be granted for a period of six years. No water rate should be charged in those years in which irrigation water is not supplied owing to its insufficiency.

In the first four types of blocks one or the other cash crop has been provided for. The two seasonal block, 'B' type is suggested to enable those farmers to take a block, who are not in a position to grow any cash crop at all. The above types of blocks are suitable, without much modification, for almost the entire State. All of them can be adopted for the Deccan canals and the Marathwada area, while types (iii) to (vii) would be suitable for the fruit and cotton growing areas of Vidarbha. The two seasonal block, 'B' type, should be suitable for the rice growing areas of Chanda and Bhandara. Types (iii) to (vii) should be suitable for the fruit and rice growing areas in the Konkan.

EQUITABLE DISTRIBUTION OF BLOCK AREAS

5.3.3. There is generally a keen demand from cultivators for blocks, particularly of those types in which cash crops like sugarcane are permitted. In order to achieve equitability in this regard, maximum limits of block areas which may be sanctioned to an individual should be fixed from time to time with reference to the availability of water and the demand. However, as an encouragement to the concentration of cane areas co-operative farming societies may be given 12 ½ per cent. more area under cane blocks than that which would otherwise be admissible to the society on the basis of the area held by its members as individuals.

It would be necessary to reduce from time to time the maximum limits fixed with a view to accommodating new applicants. This would be at the time of renewal of block contracts, *i.e.*, at the end of the six-year period. Any drastic reduction would upset the economy of the farmers whose block areas would be so reduced. Therefore, the cut to be made every six years should be about 33 ⅓ per cent. of the area sanctioned to an applicant for the previous six year period. No cut should be applied to cane areas of 2 acres and less.

5.4. Improvement in the present system of irrigation management

TIME LIMIT FOR DISPOSAL OF APPLICATIONS FOR SHORT TERM SANCTIONS

5.4.1. The block system, though it gives an assurance of water for a period and saves the irrigators the botheration of applying and obtaining sanctions every year or season, it does not entirely dispense with the need of making applications for short term sanctions. We heard persistent complaints that such sanctions are not given in time and considerable inconvenience is caused to the irrigators. This could be avoided if time limits are fixed for disposal of all applications.

SANCTIONING SUGARCANE OVERLAP AND PRE- AND POST-SEASONAL WATERINGS

5.4.2. We have suggested in paragraph 3.4.11 that with the maximum limit of overlap of 50 per cent. and with no overlap in May and June, a consolidated rate at 133 per cent. of the annual rate should be levied for sugarcane. The maximum limit for overlap and the clear months for which such overlap is not allowed, should form part of the sanction for the cane blocks. Similarly, whenever crops which necessarily require pre-seasonal and post-seasonal watering, such as long staple cotton or finer varieties of rice are sanctioned, such watering should be made part of the sanction for the crop itself. This will remove the necessity of applying for overlap or pre- or post-seasonal watering every time. Since there will be crop rates the question of recovering water charges for such overlap or pre- or post-seasonal watering would not also arise.

X LIMITS

5.4.3. In paragraphs 1.3.4 and 5.1.2 the present method of fixing X limits has been briefly described. This method was evolved nearly 40 years ago and considerable new data have since become available. The method should be rechecked and necessary modifications in the method made. An attempt should be made to incorporate in the method objective tests for verifying the correctness of the X limit fixed for any sub-catchment.

Periodic revision of X limits should be done well in advance of the date when blocks are due for renewal.

CONVERSION OF ONE TYPE OF BLOCK INTO ANOTHER TYPE

5.4.4. The different types of blocks which may be offered to the irrigators are described in paragraph 5.3.2. A block once sanctioned will normally be in force for six years or so. However, if an irrigator desires conversion of his block from one type to another, it may be allowed within his share of irrigation water and subject to other normal restrictions regarding soil suitability, *etc.* Special care should be taken while sanctioning conversion to fruit blocks and it should be ensured that the conversion is not sought merely for the purpose of getting a commitment for a longer period, *i.e.,* for 12 years, in place of 6 years.

ABOLITION OF NEW TYPE TWO SEASONAL BLOCK

5.4.5. The new type of two seasonal block has been recently introduced by the Irrigation Department with a view to ensuring utilisation of the spare capacity of canals during the monsoon. In the new type of two seasonal block it is laid down that 50 per cent. of the area of the block should be used for *kharif* seasonals and the remaining 50 per cent. for *rabi* seasonals. Experience has, however, shown that *kharif* seasonals are not grown to the extent expected. In an effort to increase the popularity of this type of block, Government has allowed certain concessions such as permission to grow paddy, *tur, etc.,* in restricted portions of the block. This step, instead of helping to develop the demand for *kharif* seasonals, has complicated the working of the new type of two seasonal block. We consider that the new type of two seasonal block has not served the purpose with which it was started, is unpopular with the irrigators and that, therefore, it should be withdrawn.

USE OF SPARE CAPACITY OF CANALS DURING MONSOON

5.4.6. The question of utilising the spare capacity of canals during the monsoon should be tackled in the following manner:—

(i) The old type two seasonal block should be introduced as already suggested (two seasonal block 'B' type). This will ensure demand for *kharif* crops for 10 to 15 per cent. of the area as was the experience prior to the introduction of the new type of two seasonal block.

(ii) Pre-seasonal water to crops like long staple cotton should be freely allowed, since these crops create a monsoon demand. This will automatically happen when the different blocks suggested earlier are introduced.

(iii) If any spare canal capacity is still found available, water should be supplied in the monsoon to crops grown on wells. However, such supply should not be considered as creating a right to allocation of such water to the area concerned whenever further irrigation projects are undertaken in that river basin.

(iv) If some canal capacity is left surplus even after providing for (i) to (iii) above, the same should be used for surcharging the sub-soil water table by passing down water during the monsoon through distributaries and escapes.

ECONOMY IN THE USE OF WATER

5.4.7. Even though in our State, due to the prevalence of a detailed canal distribution system (instead of the inundation system prevalent at many other places in the country) over virtually all the area served by major irrigation the use of water in general is economical, we feel that there is still further scope for such economy. From the records of water used it can be seen that in some cases crops are taking heavier doses of water than they really need. It is, therefore, necessary that irrigators are given water by measurement. This step alone can bring home to them the importance of economical use of water. How supply of water by measurement leads to economy is fully illustrated by the following details regarding irrigation on the Nira Right Bank Canal.

Nearly 75 per cent. of the cane area on the Nira Right Bank Canal is supplied water on volumetric basis. The entire irrigation (*i.e.*, irrigation on volumetric basis as well as on area basis) requires one MCft. of storage for every 7.15 acres. But when the consumption of irrigation water on the area basis is separately worked out, irrigation per MCft. of storage works out to five acres only. The reason for the difference is obvious, that there is a large area of cane on volumetric basis which gives higher acreage per MCft. of storage for the entire irrigation on the Nira Right Bank Canal. The increase in area is nearly 45 per cent. in this case and if all the area is put under measurement system, the area irrigated per MCft. would be still larger.

The advantages of distributing water by measurement are obvious. Firstly, it will lead to an increase in the area under irrigation. It will reduce the waste of water, thereby minimising damage by waterlogging. There are, however, certain difficulties in introducing the system of supply of water by measurement and immediate steps must be taken for overcoming these difficulties.

MEASURING DISCHARGE AT DISTRIBUTARY HEAD

5.4.8. Firstly, it is not possible to supply water by measurement to each and every individual as suitable water meters are not available or likely to be available in the near future, for measuring supply to an individual field. It is, however, possible to measure the discharge (and thereby the quantity of water) at the head of each distributary or minor which supplies water to a group of irrigators. It would neither be possible nor necessary to install mechanical meters on all such outlets to start with ; water can be measured with the help of standing wave flumes to begin with. What would immediately be necessary is the provision of standing wave flumes at all such points of distribution and keeping all the masonry works meant for controlling distribution of water, such as *Baras*, headwalls, *etc.*, below these points of distribution, in perfect working condition to avoid wastage. Automatic level and discharge recorders suitable for installation at the head of distributary channels are now being manufactured in India and they can be installed at all distributing points, in due course.

MANAGEMENT OF WATER DISTRIBUTION BY IRRIGATORS

5.4.9. The proposal to supply water by measurement cannot be implemented unless the water measured at the distributary head is handed over to a body of irrigators on the distributary concerned. We propose that these bodies of irrigators should be co-operative institutions formed by the beneficiaries themselves. The by-laws of the co-operative societies to be organised should provide for admission to membership of each and every irrigator to whom water has been sanctioned by the Irrigation Department. The society should have no option to refuse admission as member to any irrigator. When the distribution of water is entrusted to co-operative societies, it would be obligatory on each and every irrigator to join the co-operative society. A co-operative structure should be built up from the distributary level to the divisional level. There should be primary co-operative societies of irrigators at the distributary level, federal bodies at the sub-divisional level and apex bodies at the divisional level. Provision should be made under the irrigation rules for the handing over of water by measurement at the distributary head to the primary co-operative societies of irrigators

The primary societies should consist of all the irrigators on each distributary, but where a distributary is big, different societies for suitable branches thereof may be organised. The primary co-operative societies would be responsible for collection of the irrigation charges from their members and remitting the amount to the Irrigation Department. They will be responsible for obtaining passes from the Irrigation Department for distribution amongst the irrigators. The societies must arrange for the completion of the rotation within the allotted quota of water and ensure that the '*shejpali*' system is properly enforced. The water supply should be measured at least twice a day, jointly by an officer of the Irrigation Department and a representative of the co-operative society. The chairmen of primary co-operative societies should be given the powers of a Canal Inspector under the Irrigation Act and should exercise concurrent powers of inspection, report and making *panchnamas* for breach of rules.

The co-operative society at the sub-divisional level should be a federal body consisting of all the primary co-operative societies of irrigators within the sub-division. These sub-divisional societies should fix the rotation and quota of water for different distributaries and keep a watch on the working of the primary co-operative societies.

The apex institution at the divisional level should advise on allocation of water between the different areas served by the irrigation system. Where an irrigation system extends over more than one irrigation division the apex body should have jurisdiction over the entire irrigation system and should have all the sub-divisional societies as its members. Powers should be taken for nominating 33⅓ per cent. of the members of the executive committees of the divisional societies from amongst non-irrigators in the command of the canal system. All matters regarding water rates, sanctions, *etc.*, would be dealt with by the Irrigation Department according to the orders of Government. The divisional society should advise the Executive Engineer concerned on all matters pertaining to irrigation which are to be decided by him in his discretion, including the policy to be adopted with respect to sanctioning of applications for casual irrigation. This society would be purely advisory but a convention should be established that if an advice given is to be rejected the reasons for doing so should be recorded and reported to the higher authorities and also explained to the society. Irrespective of whether the advice of the society is accepted or not the responsibility, for acting according to the rules and regulations and the directions of higher authorities or Government, would remain that of the Executive Engineer.

The primary co-operative societies will be required to employ their own Patkaries, either full time or part time, for the management of water distribution. At present there is a Patkari of the Irrigation Department for about every 1,000 acres of irrigated area. The primary co-operative society will have about 500 acres of irrigated area under its control. The irrigation revenue from the 500 acres, where sugarcane is sanctioned, would be about Rs. 25,000. Government may give five per cent. of the irrigation revenue on the water course concerned to the society as grant for the expenses of management of water distribution and for collection of water charges. The annual income of a society controlling about 500 acres would be about Rs. 1,250.

The society will have to employ a person for the management of irrigation whose remuneration may be about Rs. 1,000 per year. The society will, therefore, be left with about Rs. 250 for its other miscellaneous expenses. With the entrustment of the work of distribution of water beyond the distributary level to the primary co-operative societies suggested above, it would be possible to entrust to the Patkaris of the Irrigation Department an irrigated area of about 2,000 acres. The expenditure saved on account of the reduction in the number of Patkaris of the Irrigation Department would be about Rs. 500 for a block of 500 acres. The remaining portion of the grant given to primary co-operative societies, namely, Rs. 750 per annum, would be more than made good for Government in the shape of irrigation revenue from the additional area under irrigation made possible on account of the saving in water due to supply by measurement. Even if the increase in the irrigated area is of the order of 5 per cent. it would bring in an additional irrigation revenue of Rs. 1,250 for every existing 500 acres; the actual increase would be very much greater. Thus, the change over from the present departmental management to management by co-operative societies of irrigators would not be uneconomic from the Government's point of view. It will reduce complaints regarding undesirable practices against the lower staff of the Irrigation Department. More important than this it will lead to decentralisation of power and train irrigators in co-operative living.

The above arrangement for distribution of water can also be introduced on minor irrigation works. The advantage to

Government in this sphere will be considerably enhanced since at present management of water distribution on these small and scattered works is costlier than that on the major canal systems.

IRRIGATION YEAR AND IRRIGATION SEASONS

5.4.10. The present irrigation year starts from 15th February every year. There is no particular advantage in starting the irrigation year from 15th February. On the other hand, it would be more advantageous to have the irrigation year coincide with the storage year which begins with new replenishment. The dates of first replenishment for the existing big tanks have been analysed and the result is shown in Table No. 45. It will be seen that while replenishment was received before the 15th June in about 30 per cent. of the years it was received before the 1st July in 80 per cent. of the years. Moreover, the agricultural year all over the country begins on 1st July. The irrigation year can also conveniently start from 1st July. The Commission, therefore, recommends the following changes in the irrigation year and irrigation seasons:—

Year/Season	Present	Proposed
(1)	(2)	(3)
Irrigation year	15th Feb. to 14th Feb. ..	1st July to 30th June.
Monsoon season	15th June to 14th Oct. ..	1st July to 30th Sept.
Rabi season ..	15th Oct. to 14th Feb. ..	1st Oct. to 28th Feb.
Hot weather season.	15th Feb. to 14th June ..	1st March to 30th June.

ROTATION PERIODS

5.4.11. Many of the irrigators interviewed by the Commission stated that no fixed rotation system is being followed by the Irrigation Department and that the rotation period is changed from time to time to the detriment of crops. The Commission feels that this indicates lack of sound management. Proper rotation periods should be fixed for each season and the officers concerned should strictly follow them. The Commission considers that for Western Maharashtra a rotation of ten days in the summer for sugarcane is proper and should be strictly adhered to. If post-monsoon river gains do prove below normal in a particular year, 12-days' rotation can be adopted up to and including March but the 10-day rotation from April to the end of June should not be lengthened in any case. Suitable rotation periods should be similarly fixed for Vidarbha, Marathwada and Konkan in the light of the temperatures and other conditions in those areas.

Unitisation of fields

5.4.12. Unitisation, after completing the levelling of the fields to be irrigated, leads to economical use of water. Formerly irrigators were compelled to carry out unitisation under the Irrigation Rules. The system was, however, withdrawn on the recommendation of the Visvesvaraya Committee which thought that it was irksome to the irrigators. Government reintroduced the system of unitisation in 1955 as far as the major canals in the Deccan are concerned, but its enforcement is not strict. The Commission considers that unitisation is very useful and should be encouraged by charging a small penalty, say 5 per cent., on the water rates in respect of those fields which are not unitised. The wastage of water which occurs when fields are not unitised would justify such penalty.

Maintenance of copies of record of rights

5.4.13. According to the existing orders the Irrigation Department is required to maintain copies of Village Form No. VII/12 as far as it shows the record of rights. These copies are also required to be verified with the originals with the Revenue Department, twice a year. These orders are not being follwed in practice and every now and then an irrigator is asked to present a copy of this record by obtaining it from the village officers. This creates unnecessary difficulties for the irrigators and results in delay in sanctioning water applications. The Commission, therefore, feels that the present orders should be strictly enforced and that the Sectional Officers should be made responsible for maintaining the records up-to-date.

Restriction on perennial irrigation near village sites

5.4.14. At present no perennial irrigation is allowed on lands situated within two furlongs of the boundary of a village site (*gaothan*). This restriction has been imposed in order to prevent accumulation of water leading to breeding of mosquitoes, *etc.*, which is deleterious to public health. An individual field falling within the limit may, however, be exempted from the application of this rule if the Public Health authorities certify that on account of the extent and direction of slope, *etc.*, perennial irrigation in that field would not adversely affect the health of the village. It is suggested that in respect of new canals, the Irrigation Department should arrange to notify in advance all the survey numbers of the villages concerned which would not be allowed to have perennial irrigation. Before notifying such survey numbers, the Irrigation Department, in consultation with the Public Health authorities, should see that the survey numbers in which perennial irrigation is not likely to affect the village health are excluded from such notification. Such notification would help the irrigators to know the restricted survey numbers and the energy and time spent in approaching the Public Health authorities individually would be saved.

CULTIVATION OF 'GALPER' LANDS

5.4.15. It is often observed that decisions regarding allocation of *Galper* lands (lands which are submerged when a tank is full but are exposed as water level goes down) for cultivation are made late resulting in avoidable loss to the prospective cultivators. The Commission considers that it should be possible to avoid this by leasing out these lands on a long term basis say 3 to 5 years, the allocation being made at least six months in advance of the date by which cultivation normally becomes possible in the tank beds. In allotting *Galper* lands for cultivation in reservoirs hereafter built we recommend that the first priority should be given to persons whose lands have been submerged under the reservoir concerned.

REDUCTION OF CANAL LOSSES

5.4.16. Data regarding canal losses on the major canals in the Deccan for the *rabi* and hot weather seasons have been collected for the past 15 to 20 years. It is seen from these data that, for the same canal transit losses fluctuate widely from year to year. The range of the variation can be seen from the following table which gives the minimum and maximum losses as percentages of the water utilised at distributary heads for the different canals:—

Serial No.	Canal	*Rabi* losses		Hot weather losses	
		Min.	Max.	Min.	Max.
(1)	(2)	(3)	(4)	(5)	(6)
1	Nira Left Bank Canal ..	31	55	38	59
2	Nira Right Bank Canal	25	45	33	54
3	Pravara Left Bank Canal	21	40	23	57
4	Pravara Right Bank Canal	20	52	25	60
5	Godavari Left Bank Canal	13	33	8	36
6	Godavari Right Bank Canal	23	90	26	90
7	Girna Left Bank Canal	10	34	8	40

The wide variation (maximum exceeds the minimum by 60 per cent. to 400 per cent.) is difficult to explain. It is often argued that the whole configuration of the strata (through which the canal passes) and the sub-soil water level greatly influence losses in transit. This may at the most explain the difference between losses on one canal as compared to those on another canal. But this would not explain the large variations on the same canal from year to year. Such annual variations are sometimes attributed to changing weather conditions such as temperature, pressures, wind velocity and to the condition of the canal section, *i.e.*, with or without silt film. Losses by evaporation in the canal are very small compared to total losses and are, therefore, normally neglected. Weather conditions cannot explain such wide variations in canal losses. The other explanation based on the condition of the canal section (*i.e.*, with or without silt film) cannot also be a major factor in respect of those canals which have been functioning for many years past and have thus attained a stability in their sections. It would be correct to state that transit losses on these old canals can vary only within 5 to 10 per cent. from year to year. By accepting the wide variations in canal losses, to the extent indicated in the Table above, two undesirable factors are encouraged, *viz.*,

(*a*) wasteful use of water, and
(*b*) inefficient management.

If the extra transit losses are properly controlled it would be possible to expand irrigation on a permanent basis. The transit losses for each of the old canals should be fixed and variation accepted within a small margin. Without such control on transit losses no improvement in canal management is possible. Any deficiency in management such as overdose of water, wastage of water, inefficient working of canals, and even unauthorised irrigation is apparently being explained away as transit losses.

There is a large scope for improving canal management with a view to increasing the area irrigated per MCft. of irrigation water. This has a considerable significance to the State which is in short supply of water resources and where utilisation of the available water resources entails comparatively high capital cost. Increasing the area irrigated per MCft. of water would not only mean better utilisation of the available water resources but also that irrigation charges can be lowered. The Commission, therefore, considers that the utmost efforts should be made to prevent losses due to pilferage, *etc.* For doing this the administrative machinery must be tightened up and consciousness created amongst the higher officers of the Irrigation Department that it is one of their important duties to check wastage of water through pilferage. It is necessary that stringent action taken by these officers is supported at the highest level to encourage them to undertake the work with enthusiasm. The co-operation of the co-operative institutions proposed to be set up for distribution of irrigation water should also be enlisted in this respect.

5.4.17. The seasonal duties adopted for working out water requirements at present are as under:— CANAL DUTIES

Season	Seasonal duty for cane at distributary head	Equivalent acre inches	Acre inches allowed on volumetric basis	Excess of (3) over (4) (Per cent.)
(1)	(2)	(3)	(4)	(5)
Monsoon	65	45	30	50
Rabi	70	42	41	2·5
Hot weather	50	58	53	10

The above table shows that while duties for *rabi* and hot weather allow 'deltas' which are comparable to normal known requirements of cane, the monsoon duty permits disproportionately larger delta. It is, therefore, necessary to study the reasons for such low duty (equivalent to high delta) in the monsoon.

Data for the monsoon season for a few canals in the Deccan for the years 1956 to 1960 were collected. The results obtained are indicated in the table below:—

Monsoon duties as realised on the different canals during 1956 to 1960.

Canal	1956	1957	1958	1959	1960
(1)	(2)	(3)	(4)	(5)	(6)
Nira Left Bank Canal	77·8	61·6	62·0	56·7	57·6
Pravara Right Bank Canal ..	124·5	66·7	63·0	57·5	69·7
Pravara Left Bank Canal ..	77·2	46·7	65·2	43·5	60·7
Average ..	93·2	58·3	63·3	52·4	59·3

Average for the five years—65.3

It would appear from the above that the duty of 65 for cane, adopted for the monsoon season is reasonable. There are, however, certain important factors which are not taken into consideration in working out the monsoon duties as stated above. There are large cane areas on all these canals, which take water on volumetric basis. If the areas irrigated and water consumed on volumetric basis are accounted for separately, then the seasonal duty for crops taking water on *area basis* would work out as under:—

Canal (1)		1956 (2)	1957 (3)	1958 (4)	1959 (5)	1960 (6)
Nira Left Bank Canal ..	..	74·5	60·8	58·4	55·2	55·2
Pravara Right Bank Canal	..	104·5	62·4	67·1	56·5	58·9
Pravara Left Bank Canal	..	77·9	40·7	63·9	35·0	54·7
Average	..	85·6	54·6	63·1	48·9	55·6

Average of the five years—61.5

The above duty has, however, been worked out on the usual assumption that the conversion factor for converting seasonal *bhusar* area into equivalent cane area is 1/3. However, in making this assumption no credit on account of rainfall in the command areas has been given. This is not correct. For instance the total rainfall in 1956 during June to October in the command areas of the Nira Left Bank Canal, the Pravara Right Bank Canal and the Pravara Left Bank Canal was 17.06", 25.7" and 27.24", respectively. This rainfall was also well distributed. After considering the effective rainfall in this year for the three different canal commands, on the basis of distribution of the rainfall over the season, it can be said that in 1956 *bhusar* areas on the Nira Left Bank Canal needed only one watering while those on the Pravara Canals, none. When such corrections for effective rainfall are taken into account (as far as water requirements for *bhusar* areas are concerned) the actual duties for cane and other perennials taking water on area basis work out as below:—

Canal (1)		1956 (2)	1957 (3)	1958 (4)	1959 (5)	1960 (6)
Nira Left Bank Canal ..	..	39·5	38·1	46·0	35·6	34·6
Pravara Right Bank Canal	..	95·5	53·4	49·8	48·7	52·6
Pravara Left Bank Canal	..	66·2	35·0	52·9	32·4	48·6
Average	..	65·7	42·2	49·6	38·9	45·3

Average for five years—44.3

The above figure of duty of 44.3 then becomes the correct average monsoon duty. This is equivalent to a delta of 65.5".

The above study indicates that the average monsoon duty of 65, for the combined irrigation of all area and volumetrice irrigation, when spilt into its proper components, results in a very low duty for cane on area basis. Such a low duty (equivalent to a high delta of 65″) would mean that the monsoon requirement is far greater than even hot weather requirement. Further, when figures of water supplied to cane on area basis on individual canals are considered it is seen that in one year it worked out to as much as 84″ on the Nira Left Bank Canal, and 90″ on the Pravara Left Bank Canal. These figures are obviously unacceptable. The conclusion that flows from these details is that there is considerable pilferage of water during the monsoon and that control on the canal working is far from satisfactory. The data for monsoon utilisation (and area irrigated) are not reliable and shows that the water account for the monsoon season is not kept correctly. There is, therefore, considerable scope for improvement in canal management in this respect also.

The discussion in paragraph 5.4.16 and in this paragraph would clearly indicate the necessity of very close supervision over water utilisation. Such supervision cannot be exercised unless the supervisory staff of the Irrigation Department from the Chief Engineer downwards makes it one of their primary duties to carry out water audit every year. It seems that the loss of valuable irrigation potential and of revenue which occurs on account of this omission to keep a close watch on the quantum of water utilised is not sufficiently appreciated. The Chief Engineer in charge of irrigation management should consider himself responsible for seeing that the supervisory staff of the Irrigation Department maintain due vigilance in this regard and should have a water audit of each irrigation system carried out every year regularly and submit the results to Government.

Delay in water applications in the initial stages

5.4.18. In the initial years of irrigation development of new canals, late water applications should not be penalised straightway but a grace period of a fortnight or so should be allowed. Even for the applications received after the grace period the penalty should be nominal for the first three years.

Water supply to forest plantations and village grazing areas

5.4.19. In the initial years when the demand for water is not developed to the full extent and surplus water is available, it should be supplied freely for village grazing areas and for establishing new plantations of forest trees in the revenue forests and other forest areas within the command.

Growing trees on canal lands

5.4.20. The land between the canal boundary and the toe of the canal generally has enough sub-soil moisture to encourage good tree growth. It is, however, difficult for the canal maintenance staff to plant and protect the trees. It is essential to make use of this available land for growing trees. It may perhaps be possible to make use of canal lands for growing trees, if special officers are appointed with the sole responsibility of seeing that trees are planted and reared in these lands. The Forest Department can depute special officers to the Irrigation Department for this purpose. The object of using canal lands for tree growing can also be achieved if owners of fields adjacent to the canal land are allowed to use it for this purpose and are given the right of usufruct of the trees planted by them. If the field owners do not come forward to grow trees the village panchayats concerned may be allowed the use of these lands for tree-growing.

CANAL COMMUNICATIONS

5.4.21. As already mentioned in paragraph 4.1.3 an efficient communication system is necessary for proper canal management. Some of the old works, especially those in Vidarbha, have no telegraphic or telephonic system. This should be provided on all major and medium irrigation schemes, wherever necessary.

BLOCK SYSTEM ON MINOR IRRIGATION WORKS

5.4.22. The block system should be introduced on minor irrigation works also, those types of blocks being selected for introduction for which the magnitude and the dependability of supply from the work in question are suitable. Blocks containing perennial crops like sugarcane and plantains should also be allowed, wherever the water supply for the purpose is available.

MAINTENANCE OF IRRIGATION WORKS

5.4.23. Maintenance of headworks and canals of irrigation works should continue to be the responsibility of Government. Maintenance of watercourses should continue to be the responsibility of irrigators. But if, in any case, irrigators are unable to discharge the responsibility satisfactorily, Government should repair the watercourses and recover the cost from the irrigators concerned. Masonry works on watercourses of old canals are in need of urgent repairs and they should, therefore, be attended to immediately.

UNIFORMITY OF MANAGEMENT SYSTEM.

5.4.24. The system of irrigation management should as far as possible be uniform all over the State for similar types of crop pattern and similar nature of water supply.

5.5. Lift-*cum*-flow system

ALTERNATIVE METHODS

5.5.1. It has already been stated elsewhere that advantage of the sub-soil water resources in the canal commands should be taken for increasing the area under assured irrigation. This is the basis for the lift-*cum*-flow irrigation system. The basic idea in this system is that the underground water from the enriched sub-soil in the canal command should be utilised for supplementing irrigation by flow from the canal, thus increasing the total area irrigated from the limited surface water resources.

Several alternative suggestions have been put forward for working out such a system. Four of them are discussed below.

(i) In the medium and deep soil zones canal water should be denied for perennial crops from October to March, when underground supplies are plentiful which should be pumped out for irrigation by the irrigators themselves. In the remaining six months of the year, the area should be under canal irrigation. The main difficulty in this arrangement would be regarding management. Even when sugarcane growers are asked to maintain their cane on wells during the October—March period, their *rabi* and other crops would have to be supplied water from the canal. In the circumstances, it would be difficult to avoid the mixing up of irrigation from the two sources giving rise to unhealthy practices.

(ii) Growers of perennial crops should be asked to irrigate their crops on wells from the middle of February to the middle of May. Since no other crops would be on the land the canal can be completely closed during the three months. It is doubtful whether wells in the command areas, which largely depend on percolation from canals and irrigated fields, will yield the required quantity of water in these three months. Moreover, this would mean that there should be no hot weather seasonal crops of any kind.

(iii) Canal water should be denied to perennial crops from July to March. This alternative is a modification of the first one with the denial period extended to nine months in place of six months. The same difficulty regarding irrigation management as obtaining in alternative (i) above would have to be faced in this alternative.

(iv) Canal water should be supplied to perennial crops at alternative rotations, the other rotations being taken up by wells. In such arrangement the canal will run continuously but the different distributaries will run at alternate rotations. The continuous running of the canal would keep the underground water table sufficiently high throughout the period enabling well irrigation to be done.

We recommend the fourth alternative for adoption.

GRADUALNESS IN INTRODUCTION OF THE SYSTEM ON NEW CANALS

5.5.2. Even though experience on the existing canals of the Pravara, Godavari and Nira systems supports the view that the underground water table in the command of the canals gets considerably enriched and can support a large area under irrigation, quantitative data are not available for estimating the exact extent to which irrigation can be supported by these underground water resources. Besides, the underground water table does not get enriched immediately after the opening of a new canal. We, therefore, recommend that on a new canal sanctions to cane and other areas should be given in the normal manner to begin with. Subsequently when the underground water table appears to have got enriched, say after about five years, a suitable well grid should be developed in the command and water refused from the canal at every alternative rotation during a short period to begin with. The period during which the denial can be extended should be decided as experience is gained regarding the sub-soil water resources. We also recommend that a scientific study of the nature of surcharging of the underground water table by seepage from canals should be carried out by the Maharashtra Engineering Research Institute.

AGENCY FOR DIGGING OF WELLS

5.5.3. The important point that needs consideration is the agency which should dig wells in the command. One suggestion is that Government should dig all the wells necessary and arrange to lift the water. If this is accepted, it would involve additional capital investment in an area already provided with irrigation at a considerable cost. For an irrigated area of about one lakh acres with 12 per cent. to 15 per cent. cane, approximately 4,000 to 5,000 wells would be needed. At an average cost of Rs. 3,000 per well together with necessary pumping arrangement, the additional capital outlay would be about Rs. 1.5 crore for each irrigated block of one lakh acres. With the present limited resources of Government it would be undesirable to invest them for this purpose.

Enterprising irrigators in the canal areas are at present utilising underground water resources to a considerable extent. But they have to depend entirely on well irrigation and are thus put in a permanently disadvantageous position as compared to irrigators getting canal water all the year round. The co-existence of the two types of irrigators also provides opportunities for unhealthy practices. Moreover, Government cannot realise the normal water rates for the area irrigated from such wells, even though the enrichment of the underground water table is entirely due to Government canals. We, therefore, consider that it is not advisable to let two different types of cane growers operate in the same area, *i.e.*, those who are supplied canal water throughout the year and those who depend entirely on well water. The Commission considers that each perennial sanction holder should be compelled to dig his own well as a supplementary water source, under pain of being refused water altogether. Smaller irrigators can co-operate in digging common wells for doing irrigation at alternate rotations. This arrangement will bring all irrigators on par with each other and at the same time ensure the flow of private capital in utilising underground water.

APPREHENSION OF INCREASE IN SALINITY

5.5.4. The apprehension that repeated use of sub-soil water might result in increase of salinity in the soil thereby adversely affecting yields, is felt in some quarters. Small areas around Kolar on the Pravara Canals have showed such signs, giving rise to the above apprehension. The basis of this apprehension was examined at length and the conclusions reached are as below:—

(*a*) *Nala* water in the command of these canals is not heavily saline and can be safely used for irrigation.

(*b*) Drain (constructed) water is also not usually so saline as to be unsuitable for irrigation. In a few places, however, drain water does have a near prohibitive degree of salt content. Here drain water will have to be used after mixing it with canal water.

(*c*) Water from the sub-soil in areas with less than 8 feet *Murum* Isobath is not harmful and can be used for irrigation in the proposed scheme of lift-*cum*-flow irrigation without any danger.

(*d*) Even in deep soil areas, sub-soil water can be used for irrigation, except in areas where the sub-soils are already saline. Such areas will have to be excluded from perennial irrigation altogether.

In the light of these conclusions the Commission recommends the following steps:—

(i) Sugarcane and plantains should normally be restricted to areas with 18 inches to 8 feet Murum Isobaths. Lift-*cum*-flow irrigation can be adopted without difficulty in such areas when canal water is supplied for every alternate rotation.

(ii) Sugarcane may be allowed in deeper soils provided the sub-soil does not contain a prohibitive percentage of salts. The concentration of cane in such areas should be considerably less as compared to that in areas with 18″ to 8′ M. I. Bs. Cane in such deep soil zones requires less water and can be supplied water from the canal in alternate rotations along with cane areas in (i) above.

(iii) In deep soil areas where salts in the sub-soil exist in a comparatively greater percentage, only lighter crops like lucerne and cotton should be allowed. Canal water to such areas can be supplied at every alternate rotation along with cane in (i). In the cases of both (ii) and (iii) sub-soil water can be used occasionally if found necessary without any ill effects.

FULL RUNNING OF CANALS IN THE MONSOON

5.5.5. As an aid to the development of the lift-*cum*-flow system, the Commission considers it necessary that the canals should be run full during the entire period of the monsoon irrespective of the demand, whenever the waste weir or the pick-up-weir overflows. If necessary, water should be let out through the escape channels.

INTRODUCING THE SYSTEM ON OLD CANALS

5.5.6. It may not be easy to introduce the system straightway on the old canals where lop-sided development has already taken place. The case of each of the old canals will have to be studied in detail and steps taken to bring about the change over to the system of lift-*cum*-flow irrigation in the light of that study.

As a first step, Government should acquire power to control wells in the canal command, both in the case of the new and the old canals. In respect of the old canals wells should be restricted to their present number until a proper assessment of the underground water resources has been made and the manner of its link up with canal irrigation finalised. All wells within the command should be registered and straightway be charged royalty.

5.6. Management of village tanks and bandharas

REPAIRS TO *ex-malguzari* TANKS IN VIDARBHA

5.6.1. In the Chanda, Bhandara and Nagpur districts there was a larger number of *Malguzari* tanks. After the abolition of the *Malguzari* rights the former M. P. Government took over these tanks, except for a small number which provided irrigation only to the lands of the *Malguzars* themselves. These tanks, which are now Government tanks, are distributed as under:—

Serial No. (1)	Name of the district (2)	Number of tanks (3)	Area irrigated in acres (4)
1	Bhandara	3,238	123,733
2	Chanda	3,466	107,599
3	Nagpur	175	8,014
	Total ..	6,879	239,346

Out of these tanks 151 are comparatively large in size, each irrigating more than 250 acres. The total area irrigated by these 151 tanks is about 60,000 acres. The remaining

6,728 tanks irrigate about 180,000 acres. Individually these tanks are small but their total potential is large and, as a group, they are an important source of irrigation. The main crop irrigated by these tanks is paddy. Some sugarcane is also irrigated by these tanks but the area is negligible.

These tanks are being made use of at present. However, their maintenance has been neglected for the past many years. They are, therefore, not irrigating as much area as they were capable of when in good condition. The question of repairing these tanks, has become very complicated on account of the existence of a number of rights (sometimes conflicting) of free water supply, fishing, cultivation of tank bed land, *etc.* These rights (some of them called *Nistar* rights) held by the occupiers of land were not abolished along with those of the *Malguzars.*

The former M. P. Government had estimated the cost of repairs at Rs. 180 per acre of irrigated area on certain design criteria. Detailed estimating for some of the tanks done by the Directorate of Minor Irrigation shows that the cost would be about Rs. 250 per acre. Thus, repairs to these tanks are expected to cost about Rs. 600 lakhs. In view of the possible increase in the irrigation potential, the restoration of the designed irrigation, the preservation of the existing irrigation and the technical improvement in irrigation, both necessary and practicable under these tanks, the Commission recommends that the question of repairs to these tanks should be studied in all its aspects and an appropriate policy evolved without delay.

MANAGEMENT OF *ex-Malguzari* TANKS

5.6.2. The Commission discussed the problems concerning the *ex-Malguzari* tanks with the local leaders, social workers and the officers in the area. After considering all the aspects involved, the Commission recommends the following steps with regard to these tanks:—

(*a*) All *Nistar* rights should be acquired by Government by enacting the necessary legislation.

(*b*) Normal irrigation rates should be charged to all irrigators who take water for irrigation from these tanks.

(*c*) Once the *Nistar* rights are acquired and normal irrigation rates are charged there is no reason to treat the *ex-Malguzari* tanks differently from other minor irrigation works. Those tanks which irrigate 250 acres or less should be managed by the Zilla Parishads and others by the Irrigation Department. The arrangements for management of distribution of water, *etc.,* should be the same as in respect of other minor irrigation tanks of comparable size.

KATCHHA BANDHARAS

5.6.3. The condition regarding katchha bandharas, particularly in the Ratnagiri and Satara districts, where as much as 38 and 22 per cent., respectively, of the total irrigated area is under them, is somewhat similar to that of the *ex-Malguzari* tanks in the Vidarbha region. In many cases persons who have the right to put the katchha bandhara and make use of the water have become 'absentee landlords' or their lands have been sub-divided to such an extent that the present occupiers are not interested in taking the initiative to build the katchha bandharas every year and make use of them. Others who can make use of the water do not have the right to build the katchha bandharas. In these circumstances, a considerable portion of the irrigation potential is lost. We, therefore, suggest that wherever the local Gram Panchayat is willing to take the responsibility of constructing the katchha bandharas within its jurisdiction and arrange to distribute the water equitably, the existing rights of individuals should be acquired by Government and the Gram Panchayat made responsible for constructing and supplying water from the katchha bandharas on payment of water rates to be approved by the Irrigation Department. Government may charge a royalty to the Gram Panchayats in token of the fact that the water used is a public asset.

CHAPTER SIX

Utilisation of the Irrigation Potential and Development of Irrigated Areas.

6.1. Normal period of development

At present irrigation projects are formulated on the basis that full utilisation of the irrigation potential on a distributary would be achieved within three years from the date from which it becomes possible to supply water from it. The rate of progress is expected to be about forty per cent. in the first year and thirty per cent. each in the next two years. However, the progress of actual utilisation of irrigation potential on most of the new canals does not justify this expectation. Furthermore, due to non-synchronisation of work on the various parts of a project and slow progress of construction for want of provision of funds, it takes a long time before the entire irrigation potential of a project is actually created at the field level. We have suggested in section 4.3 how non-synchronisation can be eliminated.

We feel that it should be possible to achieve full utilisation of the entire irrigation potential of a project within eight years from the date of starting the construction work, provided the steps to avoid non-synchronisation in the construction programme and those for removing causes that dampen the. progress of utilisation of irrigation potential are taken. The period required for preliminary investigation and other preliminaries such as approach roads, staff colonies, *etc.*, is excluded from this period. Even then the period of development recommended, *viz.*, eight years, would require very careful planning; the task is no doubt difficult but not impossible. We may assume that on the average of different projects, water could be made available by stages of about 25 per cent. of the area in each of the 4th, 5th, 6th and the 7th years after the starting of construction of a project. Actual irrigation would show a slight lag. Progress of utilisation may be about one-tenth of the total potential in the fourth year, 25 per cent. each in the next three years and the remaining 15 per cent. in the eighth year. Giving of concessional water rates as suggested in para. 3.4.15 would mean that the project would start giving full returns in the eleventh year. We, therefore, consider that the normal period for the full development of irrigation should be taken as eight years after starting construction on a project.

6.2. Non-utilisation of irrigation potential

DEFINITION

6.2.1. Non-utilisation of the irrigation potential is often assessed by merely comparing the area actually irrigated in a given year with that put down in the project. Such a comparison is not valid unless both the figures of acreages are converted to 'standard crop acres'. Without this conversion, it would appear that even on the old Deccan Canals, there is at present underutilisation of the irrigation potential although the entire storage supply is fully booked. It is also necessary to consider (i) the actual storage supply available in a given year (as there is an element of variation in the supply) and (ii) the quantity overflowing the pick-up or waste weir in the monsoon and the canal capacity, for correctly assessing the extent of non-utilisation in a particular year. Taking a more comprehensive view of the development of irrigation, we consider, that the extent of non-utilisation of irrigation potential should be assessed after considering whether the storage supply available together with the utilisable overflow in the monsoon has been utilised to the fullest extent possible or not.

CAUSES OF NON-UTILISATION AND THEIR REMOVAL

6.2.2. A study of the causes of slow utilisation of the irrigation potential reveals that certain management practices and the lack of proper planning of some aspects of irrigation schemes are mainly responsible for the delayed utilisation of the irrigation potential on various works. The Commission, therefore, recommends the following remedial measures to accelerate the pace of development of irrigation; they are arranged in the order in which the respective causes are estimated to contribute to slow utilisation.

(*a*) *Construction of field channels.*—In the case of new irrigation projects, the absence of field channels is the main reason of non-utilisation of the irrigation potential. On account of internal disputes amongst the cultivators and lack of adequate finance for constructing these channels, the cultivators are not able to construct field channels immediately after the distributaries are ready to supply water. The relevant provisions in the Bombay Tenancy and Agricultural Lands Act do not appear to be adequate for ensuring the availability of land for construction of channels. We, therefore, recommend that a layout of field channels in the command areas should be prepared as a part of the project itself and the necessary land should be acquired at Government cost. The crossings of field channels across established roads and tracks should be constructed, as and when required, by the maintenance staff of the canal, at Government cost. The cultivators can then be asked to construct the required field channels according to the layout, as and when required.

(*b*) *Levelling of fields.*—Irrigation water cannot reach all the corners of a field evenly, unless it is levelled. Cultivators are often unable to get their lands levelled due to lack of adequate finance. Co-operative credit societies should provide adequate long term loans for this purpose.

(*c*) *Management practices.*—Restrictions on the cropping pattern in the case of new irrigation projects is another factor contributing to the slow progress of irrigation. Perennial crops like sugarcane and plantains were not allowed on some new projects in the initial period. For instance, we were told that on the Nasik Canal, the cultivators were clamouring for water for perennial crops like sugarcane but it was not sanctioned, as a result of which part of the storage remained unutilised. Although for ensuring equitable distribution of irrigation benefits it would be correct to hold up the making of permanent commitments for perennial irrigation in the initial stages, *i.e.*, for a period of six years from the commencement of irrigation, there should be nothing to prevent the growing of cash crops even in these initial stages, on a temporary basis.

The enforcement of the new type of two seasonal block in the Deccan Canals has resulted in great dissatisfaction amongst the cultivators. We have recommended in para. 5.4.5 that the new type of two seasonal block should be abolished.

Most of the minor irrigation works in Maharashtra are situated in the low rainfall zone. The need for water for seasonal crops, which are mainly food crops, fluctuates widely from year to year according to the nature of rainfall. The availability of water in minor irrigation tanks, which also fluctuates widely from year to year, does not correspond to the degree of need for the same for seasonal food crops. This non-correspondence results in considerable non-utilisation of the irrigation potential of these tanks in some years. In the commands of these minor irrigation tanks many cultivators grow cash crops on wells. The water supply in these wells is comparatively uncertain and the cost of lifting is high. These cultivators would always be willing to take canal water without firm commitment of supply on the part of the Irrigation Department, *i.e.*, as and when it is available. We, therefore, suggest that after meeting the full requirements of seasonal crops during a year, the surplus should be given for perennial crops grown on wells within the command. The water expected to remain in balance at the end of the *rabi* season, *i.e.*, by the 1st March, should be estimated and after providing for hot weather commitments of regular irrigators, the remaining quantity should be offered for perennial cash crops grown on wells. Care should, however, be taken to see that the supply is offered only for such area as can be maintained on the surplus available as on the 1st March until the onset of the next monsoon. This precaution would, however, be unnecessary in those years in which the growers of perennial cash crops on wells take canal water not because of the expected paucity of water supply in their own wells but only because they can save on the expenditure for lifting water from wells by availing of the facility of flow irrigation.

(*d*) *Planning of utilisation in different seasons*.—Table No. 48 shows the water contents in some minor tanks in the State as at the end of the storage year. It may be seen from this Table that large quantities of water have remained unutilised during the period under consideration.

As regards planning of utilisation of the monsoon overflow over the waste weir it can be seen from Table No. 46 that even on an old work like the Nira Canals, utilisation of the overflow during the monsoon varied between thirty-five and fifty-five per cent. of the available overflow, in the years under consideration. A part of the remaining quantity could have been utilised for supplying water to crops grown on wells or even for surcharging the underground water table in the command.

In Chanda and Bhandara areas, the irrigation system is designed for irrigation in the *kharif* season, mainly by the method of flooding of fields. No water channels have been provided in these areas and this prevents irrigation in the *rabi* season. We, therefore, recommend that water channels should be constructed in those areas where *rabi* crops can be grown.

(*e*) *Credit facilities.*—Short term and long term capital requirements of irrigated farming are much higher than those for non-irrigated farming. Wherever the co-operative credit structure is properly organised, credit facilities are generally available, although there are some procedural difficulties in securing loans. It is, however, necessary to ensure that the expansion of co-operative credit societies synchronises with the extension of irrigation to new areas. So far the creditworthiness of cultivators was worked out by multiplying the land revenue assessment on the land offered for security by a fixed multiple. This multiple at present is 180. We understand that this method of calculating the value of assets from the point of view of security is being modified. According to the modification it is proposed to take into consideration the cost of development of the land such as wells, oil engines, *etc.*, and also one-half of the capitalised value of the probable net income expected to be derived from the proposed improvement. The new basis would rectify the difficulty in the previous system to a large extent.

Cultivators in the irrigable command who have large holdings, do not irrigate their entire holdings, mainly due to lack of adequate finance. Similarly cultivators with very small holdings for similar reasons cannot invest the capital needed for preparing the land for irrigation. Underutilisation on account of these reasons can be removed by ensuring adequate credit facilities and vigorous agricultural propaganda.

(*f*) *Marketing facilities.*—Organised marketing facilities are generally available for established crops in the developed areas. But where irrigated crops are newly introduced or a new crop or a new variety of a crop is introduced, absence of a nearby organised market for the commodity in question is a serious handicap to the utilisation of water for the crop concerned. For example, in Marathwada long staple cotton can be grown under irrigation on a large scale. The few cultivators on the Khasapur and Bendsura tanks who do so at present have to transport small lots of produce individually to distant markets. The result is that cultivation of long staple cotton is not spreading in the area as fast as it could have spread. When long staple cotton was first introduced in the Deccan Canals area the Agriculture Department undertook the marketing of the small lots of produce of the pioneers. The normal market developed when arrivals became sizeable, and the Agriculture Department then withdrew from this activity. Some such arrangement is necessary when a new crop is introduced in an area.

Secondly, fluctuations in the prices of crops like onions, chillies and gur, discourage the small cultivators from investing large amounts in irrigating and manuring their lands. It is, therefore, essential to extend co-operative marketing, with adequate facilities for warehousing, in the areas where irrigation is being extended.

(g) *Processing factories.*—The establishment of sugar factories in the canal areas helped towards the stabilisation of sugarcane on the Deccan Canals. Similarly crops like cotton, oilseeds and fruits require further processing before they can be stored or marketed. Establishment of processing industries in the local areas where these crops are being introduced, has numerous advantages, *e.g.*, employment opportunities to local labour, saving in the transport costs of bulky raw materials to marketing centres, better price for the produce in the case of perishable commodities, *etc.* Establishment of processing industries like cotton ginning, pressing and weaving, oil crushing, fruit canning, paper making, dairy products, *etc.*, throughout the irrigated areas would greatly facilitate speedy development of irrigation.

(h) *Demonstration farms.*—Agricultural research and demonstration is done at three different levels. Evolving new varieties of crops, experimenting on new agronomic and fertilising methods, *etc.*, is the first level carried out at central research stations and laboratories. These research stations cannot be located in each and every soil-climatic region while the results of research obtained at the central research stations may not be found to be beneficial in all such regions. Trials to test the suitability of new varieties, *etc.*, in each soil-climatic region are, therefore, necessary. This is the second level. When suitability of a new variety or method is proved at this level what remains is demonstrating the variety or method as the case may be to the farmers. This is the third level. Work at the third level is best done by setting up agricultural demonstration centres on the farms of progressive cultivators. Results achieved on these farms are trusted better by the general body of farmers than those obtained on Government farms.

In respect of areas where irrigation is to be newly introduced it is necessary that the Agriculture Department tries out the irrigated crops commonly grown in the established irrigated areas and ascertains the suitability of agricultural methods practised in those areas, to the areas to be newly irrigated, before starting to propagate them amongst farmers. This work must be done on farms to be newly established in the areas where irrigation is new. These farms can also serve as demonstration farms but only incidentally. The need for setting up agricultural demonstration centres on the farms of progressive cultivators is, however not at all reduced because the trial farms can also serve as demonstration farms.

It would also be useful if some progressive farmers from areas to be newly irrigated are taken on short study-*cum*-demonstration tours of established irrigated areas. These progressive farmers would respond to the propaganda for the development of irrigated crops much more readily and would act as nuclei for disseminating information regarding the practice of irrigated farming. Attempts towards quick development of the irrigation potential would not succeed unless the Agriculture Department demonstrates and propagates the desirable crop planning and proper methods of irrigated farming. Introduction of long staple cotton, hot weather groundnut, certain varieties of fruits and vegetables, *etc.,* would be possible only by setting up trial-*cum*-demonstration farms in newly irrigated areas. In areas like Chanda, Bhandara, Kolaba, Ratnagiri, *etc.,* where only *kharif* paddy is grown, special efforts should be made for the introduction of winter paddy and other Rabi crops.

There are at present only six trial-*cum*-demonstration farms in the State. Four of them are located in the Marathwada region, one in Konkan and one in Western Maharashtra. However, they have not yet started functioning fully, mainly because of the non-availability of water for irrigation from the project under which they were sanctioned. We are of the view that these farms should be set up as soon as the project construction starts with the help of well irrigation. These farms can accelerate the pace of irrigation development only if they start functioning before water from the project is made available to the cultivators. The number of such farms needed in the commanded area of a project would depend on the number of distinct zones with different soil-climate complexes. We, therefore, recommend that trial-*cum*-demonstration farms, with facilities of well irrigation, should be opened in newly irrigated areas as soon as the project construction starts.

(i) *Transport and communications.*—In 1961 the road mileage per hundred square miles of area was 40 in the Konkan and 29 in Western Maharashtra. It was only 9 miles in Marathwada and 13 miles in the Vidarbha area. The State average works out to 21 miles per hundred square miles as against 30 miles for India. Thus in parts of Vidarbha and Marathwada where irrigation is developing, transport facilities seem to be very inadequate. It is noted that in these areas, good qualities of fruits can be grown but in the absence of speedy transport facilities, cultivators would not be inclined to grow these crops. It is also necessary to provide refrigerated transport facilities for certain perishable fruits. Steps may, therefore, be taken to immediately undertake a study of the transport needs of irrigated areas and to formulate a plan to meet those needs.

Certain roads in the irrigated areas are constructed from the Sugarcane Cess Fund, but it was reported to us that proper maintenance and repairs of these roads is often neglected. Proper maintenance and repairs of the communication system in these areas should be ensured.

6.3. Electric power for developing lift-irrigation

We have already stated that the possibilities of flow irrigation in the State are extremely limited. Every effort will, therefore, have to be made for utilising underground water by lifts. This problem assumes greater significance, with the adoption of the lift-*cum*-flow system of irrigation. It will, therefore, be necessary to ensure co-ordination in the extension of irrigation facilities and electrification of villages on the canals and distributaries. Table No. 20 shows that the number of electric pumps rises with electrification of villages. Pumping with the aid of electric power is very much cheaper than by diesel engines. Rural electrification of areas where a large number of diesel engines are being used for pumping, is very desirable. Map 9 shows the distribution of diesel engines and the present and proposed power transmission lines.

6.4. Ancillary development

DEVELOPMENT OF FISHERIES

6.4.1. Development of pisciculture and tourism are the two important ancillary activities which can be undertaken along with storage works.

The Maharashtra State has over 30 fairly large reservoirs and a large number of irrigation tanks, with a total expanse ot water admeasuring over 2 lakh acres. These water resources are now mostly fallow in respect of fisheries, but properly husbanded they form a large potential for the development of culture fisheries. At a modest rate of production of 50 kg. per acre, they should be capable of producing about 10,000 tons of fish per year. At present only an area of 72,000 acres is stocked with quick growing varieties of the Indian major carps. Due to absence of local supply of carp fry (baby fish) the rate of stocking is negligible, *viz.*, 12 fish per acre. The reservoirs should be stocked at an adequate rate for a number of years so that they may then yield quantities of fish large enough to make fishing worthwhile.

A major impediment to fishing in the existing deep reservoirs is the presence of submerged large boulders and trees and sometimes even houses, which prevent efficient operation of boats and nets. In respect of the projects now planned, it has been decided that the area to be impounded should be cleared, as far as possible, and non-removable impediments suitably marked. Nurseries for growing baby fish can be provided without much extra cost by converting excavations below the dam site into regular pits of suitable dimensions to serve as nursery tanks.

DEVELOPMENT OF TOURISM

6.4.2. Holiday resorts at the reservoir sites could be provided with a view to promoting tourism. We consider that provision of gardens, rest houses, approach roads and transport facilities should be invariably provided on all major works. We have seen this aspect being attended to on one project each in Mysore and Kerala and were told that the cost of maintenance of the gardens, *etc.*, is being fully recovered by levying a small fee on the visitors.

ALLOCATION OF COSTS OF ANCILLARY DEVELOPMENT

6.4.3. In providing these facilities to promote tourism and pisciculture, clearly allocable costs in the capital expenditure should be borne by the concerned Departments. The receipts should also go to the Department concerned but any surplus of revenue over the recurring expenditure (including interest charges on the allocable capital cost) should be credited to the project account (only for the purpose of *pro forma* accounts). This net profit would be indicative of the benefit obtained by the multi-purpose use of the reservoir.

6.5. Integrated plan for development

NEED FOR INTEGRATE PLANNING

6.5.1. It would be clear from the above discussion that creation of the irrigation potential alone does not yield fruitful results unless the ancillary problems connected with land, industry, credit, *etc.*, are solved. Hence a unified and integrated approach to the development of a river basin is essential. The Master Plans of river basins so far prepared by the Irrigation and Power Department are only blue prints of storage locations and alignments of canals; there is no co-ordination in the process of preparation of these Master Plans and of the ancillary schemes subsequently prepared by the Departments of Agriculture, Industries, Co-operation, *etc.* Quickening the pace of utilisation of the irrigation potential and the development of irrigated areas are one and the same issue, since the former depends on the latter and *vice versa.* Hence removal of the causes that retard the utilisation of irrigation potential would automatically promote the rapid development of irrigated areas. If the steps to remove these causes are to be effective they should be planned in co-ordination with the planning of the project itself. Government has no doubt provided substantial amounts in the Five Year Plan schemes for implementing some of the steps for hastening irrigation utilisation, but in the implementation of these steps there is considerable lack of co-ordination and synchronisation. We consider that an integrated approach both in planning and in execution of irrigation works is absolutely necessary for the speedy development of irrigation.

INVESTIGATIONS NECESSARY FOR INTEGRATED PLANNING

6.5.2. In formulating an integrated development plan for the areas to be irrigated, the following investigations will have to be made:—

(1) A soil survey with special reference to suitability for irrigation, need for levelling of lands, *etc.*

(2) A survey of the socio-economic conditions of the population in the area, particularly with regard to the standard of cultivation and standard of living. This survey would be useful for comparison with the conditions of the population after the development of irrigation.

(3) A careful investigation of the existing crop pattern, (a) without the use of irrigation and (b) with the use of such irrigation as may be locally available, *e.g.*, on wells and katchha bandharas.

This investigation would reveal the type of crop pattern likely to develop after irrigation is introduced and would also show which new crops could be introduced under irrigation and to what extent the yields of non-irrigated crops would increase due to irrigation.

(4) An investigation into the possibilities of starting new industries as a result of the project, particularly if it is an irrigation-*cum*-power project.

(5) The possibilities of starting industries for the processing of agricultural produce, especially with a view to

increasing the returns to the cultivators and minimising fluctuations in prices.

(6) A survey of the existing facilities of communications and transport and assessment of the need of increasing these facilities with the larger quantities of agricultural produce available for transport.

(7) A survey of the conditions of marketing of agricultural produce with a view to preparing a plan for regulation of markets, establishment of new markets, construction of warehouses and such other facilities.

(8) An investigation of the possibilities of developing pisciculture in the reservoirs, tail tanks, *etc.*

(9) Investigating the possibilities of developing the area (particularly the reservoir area) as a centre of attraction for tourists.

(10) Plan for rural electrification taking into consideration the needs of processing industries and pumping of water for irrigation.

AGENCIES FOR INTEGRATED PLANNING IN OTHER AREAS

6.5.3. Although the basic ideas of integrated river basin development have been universally accepted, the type of agency to plan and execute development programme has varied in different parts of the world. As illustrations, we give below three types of such agencies.

Under the Columbia Basin Authority plan, the Bureau of Reclamation was assisted by many agencies and organisations (Federal, State, regional and local) in working out a planned programme for the development and settlement of the Columbia basin as a whole and in making detailed plans for the areas to be irrigated. Twenty-seven specific problems were selected, on which investigations were carried out. These included basic land surveys, study of farm economy, normal water requirements of crops and proper use of land, practicable ways of avoiding excessive use of water, size, layout and equipment of farms, allocation of costs and repayments, period for development, transport and communications, development plans, underground water resources, rural electrification, industries for processing agricultural produce, *etc.* Assistance of several agencies and individuals was enlisted for carrying out investigations on particular problems. The leader of the study group on a given problem was responsible for working out a general plan of study and ensuring effective collaboration with other study groups on related problems. A field co-ordinator was appointed to circulate information and memoranda of general interest to participants in the investigations. Later a Board of Review was appointed to study the reports of investigations and work out a general plan.

The Tennesse Valley Authority was established in 1933 for carrying out (*a*) maximum amount of flood control, (*b*) maximum development of navigation and generation of electricity, (*c*) development of new agricultural techniques, (*d*) afforestation, and (*e*) the economic and social well-being of the population in the Tennesse basin area. The Tennesse Valley Authority law provides that the Authority shall act as a co-ordinating and unifying agency to discover possibilities of unified control and to assist in co-ordinating the efforts of the various agencies including departments of Federal, State and local Governments. Four different systems of organisation have been tried up till now. Initially the Chairman of the Authority (consisting of three members) exercised administrative powers as approved by the Authority. This was found to be unsatisfactory and each member was assigned certain topics and was made fully responsible within the sphere of his action. After a few years a Co-ordinating Authority was appointed. In the present arrangement, there is a General Manager, who is given general policy guidance by the Board of the Authority. The Board also gives approval for important transactions and plans. This type of organisation has not been adopted in any other basin in the U.S.A.

Similar river basin committees are in existence in the Colorado and Missouri basins. But these committees are voluntary organisations without any power to enforce their decisions. They act only in an advisory capacity, the various Federal agencies giving up none of their statutory sovereignty.

The Damodar Valley Corporation in India is a corporate body constituted under the Damodar Valley Corporation Act of 1948, consisting of a Chairman and two members appointed by the Central Government in consultation with the State Governments of West Bengal and Bihar. The statutory functions of the Corporation are (i) flood control, (ii) the promotion and operation of schemes for irrigation, water supply and drainage, (iii) generation and distribution of electrical energy, (iv) promotion of afforestation and soil conservation, (v) promotion of public health and agriculture, industrial and economic well-being of the population in the Damodar Valley and (vi) promotion and control of navigation. The limits of the valley are defined by the Central Government and the Corporation has powers to do anything which it is necessary to do for the purpose of carrying out the functions mentioned above. The Corporation has a Financial Adviser and a Secretary. Although the Corporation is an autonomous body, the directions of the Central Government on matters involving policy are binding on the Corporation. The Central and the State Governments of West Bengal and Bihar provide the entire capital needed for the project. The Corporation can borrow funds in the open market with the approval of the Central Government. The allocation of costs between the two State Governments is made according to certain principles laid down. The Corporation has to pay interest to the State Governments on the capital contributed by them. The Act requires that provision for depreciation and reserve fund shall be made before the net profit is determined. The arrears of accumulated interest for the first fifteen years are to be made a part of the capital investment.

AGENCY RECOMMENDED FOR MAHARASHTRA

6.5.4. Limited financial resources and the necessity of dispersing developmental activities all over the State would not permit the taking up of all the projects to be ultimately taken up for the full exploitation of the irrigation resources in a river basin or sub-basin, at one and the same time. We do not, therefore, consider that organisations of the kind of the Damodar Valley Corporation would be useful in Maharashtra. Co-ordination in the formulation of the development plan and execution by the different Departments concerned would meet the needs of the situation. To this end, we recommend that regional teams may be formed for the different administrative divisions of the State. Each regional team should comprise experts drawn from the concerned Departments and headed by a co-ordinator.

When the preliminary engineering investigations are made and the Government takes a decision to prepare a particular project, such regional teams should start detailed investigation on the items listed in paragraph 6.5.2. The Statistician attached to the team should process the data collected during these investigations and the team should prepare an integrated and synchronised development plan on all the aspects listed above. Government should approve of the project as a whole and accord sanction to the entire development plan, though the funds may be allotted according to the time schedule laid down in the integrated development plan, to the concerned Departments. For this purpose, it will be necessary that when an irrigation project gets included in the Irrigation and Power Department's budget, the corresponding items of the integrated plan programme should also get included in the budgets of the concerned Departments. For the irrigation projects included in the Third Five Year Plan of the State such Plan provisions should be earmarked in respect of the different projects out of the general related Plan provisions of the Departments concerned. The regional teams while investigating irrigation projects likely to be included in the fourth Five Year Plan should also indicate the Plan provisions which would be required by Departments other than the Irrigation and Power Department. The actual execution of the integrated plan should be carried out by the Departments concerned according to the time schedule laid down. The regional teams should also watch and review periodically the progress of work.

CHAPTER SEVEN

Research, Statistics and Review

7.1. Agricultural research in irrigated farming

7.1.1. With the rapid expansion of irrigation facilities to new areas, it is necessary that research activities relating to the methods of irrigated farming should be intensified. We have stated earlier that the annual cost of irrigation must be fully met by the annual income therefrom. Water rates are to be related to the gross incomes from irrigated crops and unless gross incomes rise, it would not be possible to meet the increasing cost of irrigation works. For these, as well as other obvious reasons, it is necessary to direct agricultural research on irrigated crops not only in the direction of utilising all the available water supplies, but also in the direction of maximising the gross incomes by increasing yields and producing more valuable crops all over the irrigated areas.

OBJECTIVE FOR RESEARCH WORK

7.1.2. There are at present seventy-four research stations in the State where research on various crops is conducted. However, irrigation facilities do not exist at some of these research stations with the result that research on irrigated

INADEQUACY OF RESEARCH FACILITIES

farming cannot be undertaken at those places. Thus, if the existing facilities for agricultural research are inadequate, they are much more so in respect of research in *irrigated* agriculture. We suggest that irrigation facilities should be created at each one of the existing and future agricultural research stations and separate wings for research in irrigated agriculture created therein. New research farms should be established in those soil-climatic regions where none exist at present. Areas irrigated by major irrigation projects should receive priority in the establishment of new and enlargement of facilities in existing research farms.

Some work on trials of new methods is done by farms of sugar factories. It is necessary to coordinate this work with that done by the Agriculture Department in order that unnecessary duplication of effort is avoided.

IMPORTANT PROBLEMS FOR INVESTIGATION

7.1.3. Among the various problems that require investigation, we draw the attention of Government to the following important problems which need to be taken up immediately:—

(i) Water requirements of crops and the rotation periods of irrigation for different crops vary according to the soil and climatic conditions. Research work done so far on these two items is very meagre. We, therefore, recommend that research stations in each soil-climatic region should undertake this work.

(ii) Although the requirements per watering for many crops are only about 3 acre inches, the various modes of irrigation at present in vogue lead to excessive use of water, even up to 6 acre inches per watering. The research stations referred to above should carry out experiments to find out the relative efficiency of the different modes of irrigation, including sprinkler irrigation. The demonstration farms can then propagate—subject of course to consideration of cost in the employment of a new mode of irrigation—the mode of irrigation most suitable to each crop in a particular region. This would lead to the avoidance of excessive irrigation and the water so saved can be utilised for further extension of the irrigated area. It may also result in the saving of labour charges required for watering.

(iii) We have recommended in paragraph 6.2.2 that demonstration centres in the different regions should propagate the introduction of new crops under irrigation. Trials of these new crops should be conducted at the trial-*cum*-demonstration farms before the introduction of irrigation in the area concerned.

(iv) Contour bunding, *nala* bunding, construction of percolation tanks, *etc.*, serve to surcharge the underground water table, which can be exploited for irrigation. There are no systematic studies to evaluate the effect of these measures, on the underground water supply. We recommend that the Agriculture Department should immediately undertake such studies in the different regions. This data would also be useful in the study of underground water resources.

(v) In paragraph 1.6.4. it has been pointed out that crop cutting experiments annually conducted on the principal crops are not designed to obtain average yields of irrigated and non-irrigated crops separately. Such separate estimation would require a larger number of experiments and involve more expenditure. We consider that reliable estimates of yield and production of irrigated crops are vital and recommend that crop cutting experiments in respect of all the principal crops should be enlarged so that the irrigated and non-irrigated yields in respect of crops under irrigation can be precisely estimated for each district.

(vi) Statistics relating to cost of production under non-irrigated and irrigated farming are very scanty. Data on the increase in net income after irrigation from different sources would be necessary for a proper evaluation of irrigation projects and for improving the water rate structure. The data on cost of operation of different types of lifts are also not available. The Agriculture Department should undertake regular surveys to collect these statistics.

(vii) We have recommended in paragraph 5.4.6 that for increasing utilisation of the irrigation potential in the monsoon season, *kharif* crops requiring pre-seasonal irrigation should be allowed by reserving the required quantity of water. In this connection, it is necessary to carry out experiments on growing seedlings of long staple cotton and then transplanting them. Similarly, area required for growing paddy seedlings can be concentrated. The Agriculture Department has taken up some research schemes on a small scale along these lines but intensified research is needed on transplanting of long staple cotton and exploring the possibilities of growing paddy seedlings either on wells or in small concentrated areas on canals. If these measures prove successful, the utilisation of monsoon supplies on storage systems as well as from monsoon bandharas could be greatly increased.

(viii) Irrigation development in certain areas seems to have been thwarted in the absence of research in irrigated farming. For example, in the Chanda-Bhandara area, the possibilities of increasing the yield of sugarcane, growing of fruit trees, growing wheat and other *rabi* crops, growing a second crop of paddy have not yet been properly explored with the result that at present irrigation rests almost entirely on *kharif* paddy. Similarly, we do not know which irrigated crops will grow well in saline soils and what would be the most suitable crop pattern under irrigation in the saline tract of the Tapi-Purna.

These problems are mentioned only by way of illustration. There are doubtless many others. It is necessary that research schemes to solve such problems of different areas are undertaken as they arise and are pursued.

7.2. Research in irrigation engineering

PRESENT POSITION

7.2.1. Research in irrigation engineering has just been started at the Maharashtra Engineering Research Institute at Nasik which was established in 1959. The work undertaken so far at the Institute includes studies on testing of various types of materials for construction, model testing for hydraulic behaviour of structures, river training, problems of soils arising in the construction of dams, *etc*. The Institute also proposes to carry out studies on cheap designs for irrigation structures, pre-cast concrete slabs for canal lining, cheap lining of field channels, evaporation estimation, and several other problems in hydraulic engineering.

IMPORTANT PROBLEMS FOR INVESTIGATION

7.2.2. Research on the following items is recommended particularly to fill in the gaps in the present research activities :—

(i) Excessive digging of wells in a given area is likely to result in lowering the underground water table in all the wells including the existing ones. With the help of data collected in the underground water resources survey, experiments may be carried out to design optimum density and spacing between wells in each region.

(ii) The quantities of water shown against canal losses, evaporation losses, *etc.*, vary largely from canal to canal and from year to year. We, therefore, recommend that steps may be taken to fix the norms of these losses. Research schemes may also be undertaken to find out cheap methods of reducing evaporation losses.

(iii) The estimation of surface flow available for utilisation is based on the hydrological data collected through rain gauges and discharge measurements at various places in a basin. These arrangements may be inadequate in some areas of the State. In view of the large programme of extension of irrigation facilities, it is necessary that the extent to which the facilities for measuring rainfall and discharges need to be augmented should be immediately studied and necessary steps taken to make up the shortage.

7.3. Classification of irrigation works

7.3.1. Irrigation works are classified at present, according to five different criteria as detailed below:— EXISTING SYSTEM OF CLASSIFICATION

(i) *Cost Criterion.*—On the basis of capital cost irrigation works are classfied into (*a*) major, (*b*) medium and (*c*) minor irrigation works. For schemes included in the Third Five Year Plan, the following cost limits have been laid down :—

(*a*) *Major*: above Rs. five crores.
(*b*) *Medium*: Rs. ten lakhs or more but less than Rs. five crores.
(*c*) *Minor*: Up to Rs. ten lakhs.

It is further laid down that this classification is not to be changed even if any revision in the cost of a project, or changes in the cost limits at a subsequent stage should warrant its re-classification into a higher or lower category. Classifiction on this criterion is used for planning, clearance of schemes by the Central Water and Power Commission, *etc.*

(ii) *Productivity Criterion.*—Productivity test consists of assessing whether the net revenue from an irrigation work is at a certain fixed percentage of the capital investment on that work. The test is applied only to those works for which separate capital and revenue accounts are kept on a quasi-commercial basis. The actual classification of a work on the criterion of productivity is made after a period of ten years from the commencement of irrigation. A work which satisfies the productivity test for a continuous period of three years is classified as 'productive' and if it fails to satisfy the productivity test for a continuous period of three years, it is classified as 'unproductive'. Thus classification of a work on the productivity criterion changes from time to time.

(iii) *Purpose Criterion.*—Works which were not expected to become productive but were still considered necessary for providing protection against famine were classified as 'protective works'. Originally, this classification was considered necessary to differentiate between the sources from which capital was expended. Thus, works for which capital was raised from loans were classified as ordinary works and those for which capital was found from the Famine Relief Fund or from the general revenues were called protective works. This differentiation in the method of financing no longer exists. The water rates on both the types of works are the same. The distinction between cropping patterns which existed earlier on the two types of works is non-existent to-day. The system of classifying works as protective and non-protective is, thus out-dated. Another category on the basis of purpose criterion arose with the commencement of the Grow More Food Campaign, *viz.*, Grow More Food schemes, and other schemes. The purpose of Grow More Food schemes was to increase the production of food crops.

(iv) *Accounting Criterion.*—On this basis, irrigation works are classified first into 'capital works' and 'non-capital works'. Those costing Rs. 20,000 or less are classified as 'non-capital works' and those costing more than Rs. 20,000 are classified as capital works. This cost limit seems to have been fixed a long time ago. At present day costs, hardly any irrigation work would get classified as non-capital work. Capital works are further sub-divided into 'commercial works' and 'non-commercial works'. Works for which separate capital and revenue accounts are kept on a quasi-commercial basis are classified as commercial works. Separate capital and revenue accounts are kept for those works which are expected to produce substantial revenue making it worthwhile to examine the returns paid by them individually. Capital expenditure on commercial works is budgetted under the head '99', the revenue realised therefrom is credited to the head 'XXXIV' and working expenses are also debited thereto. Works for which separate capital or revenue accounts are not kept, either because they produce little or no revenue or are of restricted size, are classified as 'capital non-commercial works'. Capital expenditure on these works is budgetted under the head '100' and the revenue realised credited to the head 'XXXV'. All non-capital works are *ipso facto* considered as non-commercial works. Capital expenditure on these works is budgetted under the head '44' and revenue realised is credited to the head 'XXXV'.

(v) *Management Criterion.*—On this criterion, irrigation works are classified as (*a*) first class and (*b*) second class irrigation works. Those in charge of the Public Works Department for management are classified as 'first class' irrigation works and those in charge of the Revenue Department for management as 'second class' irrigation works.

The fact that a classification according to one criterion is suitable only for the specific purpose in view is not sufficiently realised, with the result that classification by one criterion is often used for another purpose resulting in confusion and inconvenience, *e.g.*, classification according to the cost criterion is used for deciding the expected crop pattern. Similarly, the accounting criterion may be confused with classification on the cost criterion.

7.3.2. We recommend the following modifications in the existing system of classification:—

MODIFICATIONS TO THE EXISTING SYSTEM

(i) *Cost Criterion.*—The system of classifying irrigation works as major, medium and minor, depends on the capital cost of the project and as such, the cost limits have to be modified from time to time as the cost level changes. It would be improper to apply current cost limits to old works and reclassify them. The classification of an old work made according to the cost limits prescribed at the time of its constrution should not be changed. However, care will have to be taken while comparing the financial results of works classified into the same group but constructed at different times and at different levels of capital cost.

(ii) *Productivity Criterion.*—In view of the recommendation made in paragraph 3.6.1 that norms of capital cost should be based on the water rates prescribed from time to time and the fact that the financial position would be judged for irrigation works in the State as a whole and not individually, we recommend that classification according to the productivity criterion should be abolished.

(iii) *Purpose Criterion.*—As stated earlier, the classification between 'protective' and 'non-protective' works is out-dated. Secondly, the accent on growing more food has now diminished and emphasis is being laid on intensifying production of all agricultural commodities including non-food crops. The existing classification according to the purpose criterion should, therefore, be abolished.

(iv) *Management Criterion.*—Under the Zilla Parishads and Panchayat Samitis Act, 1961, it is proposed to hand over for management all works irrigating 250 acres or less to the Zilla Parishads. It would, therefore, be convinient, if all works managed by the State Government are classified as 'first class' irrigation works and those managed by the Zilla Parishads as 'second class' irrigation works.

(v) *Accounting Criterion.*—'Restricted size' and 'substantial revenue' which decide whether a work should be classified as a 'commercial' work or a 'non-commercial' work are not defined at present. All works irrigating 250 acres or less are to be managed by Zilla Parishads. A work irrigating about 250 acres would cost less than Rs. two lakhs. It may, therefore, be laid down that an irrigation work either costing less than Rs. two lakhs or irrigating 250 acres or less should be classified as 'capital non-commercial work'; other works should be classified as 'capital-commercial works'. The existing limit for classifying a work as 'non-capital work' may be raised to Rs. one lakh in view of the increase in costs to roughly five times of those prevailing prior to the Second World War.

ADDITIONAL CRITERION FOR CLASSIFICATION

7.3.3. The question of duration and dependability of supply of irrigation water is not taken into account in any one of the existing criteria of classification. It is the duration and the dependability of supply which determine the expected crop pattern and the scale of water rates. We, therefore, recommend that an additional criterion of classification should be laid down which may be called the 'supply of water criterion', on the following lines:

(A) *Flow irrigation works*:

(1) *Storage works*—

(*a*) *Perennial*.—Those storage works from which water can be supplied for irrigation throughout the year without undue loss due to evaporation should be classed in this category. Most of the storage schemes now classed as 'major' and 'medium' on the cost criterion as well as some of the 'minor' storage schemes would fall in this category.

(*b*) *Seasonal*.—Those storage works from which water can be supplied for irrigation during the *kharif* and *rabi* seasons only, either because of the smallness of the storage or heavy percolation or excessive proportion of losses due to evaporation, would fall in this category. Some of the 'minor' tanks and perhaps a few of the 'medium' works may get included in this category.

There are no storage works which can supply irrigation water only during the *kharif* season.

(2) *Diversion works*—

(*a*) *Perennial*.—Where there is a substantial perennial flow or natural storage, enabling supply of irrigation water throughout the year would be included in this category. There are practically no diversion works of this nature in the Maharashtra State.

(*b*) *Eight-monthly*.—Where the flow normally lasts up to the end of the *rabi* season enabling supply to be made only during the *kharif* and *rabi* seasons would fall in this category, *e.g.*, diversion works on streams having a post-monsoon-flow up to the end of the *rabi* season.

(*c*) *Monsoon*.—Where the flow only lasts long enough to irrigate *kharif* crops. Diversion works on streams having little or no post-monsoon flow would be included in this category.

(B) *Lift irrigation works*:

Lift irrigation works are those where water is lifted before being made available for irrigation. It may be lifted from (*a*) rivers, nalas, tanks or canals having (i) perennial supply or (ii) seasonal supply and from (*b*) wells.

In the case of (*a*) the water which is lifted may be (i) ordinary water, (ii) percolation water in natural or artificial drains or (iii) sewage or sullage water.

Secondly, some of these works may be both constructed and operated by Government while in others operation may be by private parties such as co-operative societies and individuals.

(C) *Percolation tanks*:

Where there is no direct irrigation from the storage or diversion but the benefit is derived from wells in which the supply is augmented and/or lasts for a longer period would be classified in this category.

Each work may be classified according to the (i) cost, (ii) accounting, (iii) management and (iv) supply of water criteria. This should be done for all existing works and for new works at the project stage. When each work is classified according to the four criteria mentioned above, it would be possible to assess the financial position and examine the cropping pattern for any desired group of works; such assessment and examination would facilitate the formulation of irrigation policy from time to time.

7.4. Socio-economic surveys of irrigated areas

The increase in agricultural production through irrigation, sets into motion a chain of activities in other sectors. In formulating new irrigation projects, financial forecasts are restricted to the direct benefits accruable. The secondary and the tertiary benefits of the irrigation system are generally not assessed. Very few studies have so far been carried out to assess these benefits in respect of the existing irrigation systems. Two such studies known to us are the 'Reports on the Direct and Indirect Benefits of the Godavari and Krishna Anicuts in Madras' published in 1858 and the 'Economic effects of irrigation from the Godavari and Pravara Canals' which was a survey carried out by the Gokhale Institute of Politics and Economics, Poona, in 1938-39 at the instance of the then Government of Bombay. In respect of the other Deccan Canals irrigation has already developed and comparable data about the conditions in these areas prior to development of irrigation are not available. However, useful data regarding improvements in the socio-economic conditions in these irrigated areas would be obtained if a proper evalution survey is conducted.

With an integrated approach to the development of irrigated areas advocated by us, it would be necessary to assess both the direct and indirect benefits from such an integrated development plan. To this end, evaluation type studies to assess these benefits should be undertaken. We understand that the Bureau of Economics and Statistics has carried out pre-project surveys of the socio-economic conditions in the areas commanded by three irrigation projects taken up in the First and Second Five Year Plans in the State. However, in view of the large number of irrigation projects which have been undertaken in the two Five Year Plans and those which have been included in the Third Five Year Plan, the Commission recommends that these surveys should be intensified and that their scope should be made more comprehensive to include all the factors covered by the integrated development plans. These surveys may be planned in consultation with the regional teams to be appointed to formulate irrigation development plans. We have also noted that there is a considerable gap between the completion of a survey and the publication of its report. We, therefore, recommend that steps may be taken to ensure that reports of such surveys are published promptly after the completion of the surveys.

7.5. Irrigation statistics

ANNUAL SEASON AND CROP REPORT

7.5.1. Irrigation statistics are available in the Season and Crop Report compiled by the Agriculture Department and in the Irrigation Administration Report prepared by the Irrigation and Power Department. The Season and Crop Report gives the following statistics, districtwise:—

(*a*) Cropwise area irrigated ;

(*b*) Sourcewise area irrigated ;

(*c*) Number of wells and oil engines and electric pumps used for irrigation ;

(*d*) Standard normal yields in respect of certain irrigated and non-irrigated crops.

The following suggestions are made with a view to improving these statistics:—

(i) At present the cropwise area irrigated by each source of irrigation is not available. It is understood that the data are available in the village records but are not being compiled and published. It is, therefore, recommended that these figures may be compiled districtwise and published in the Season and Crop Report.

(ii) The Agriculture Department compiles some statistics at the taluka level, but the precision of these statistics is very low and, therefore, these figures are not published. We recommend that steps may be taken to improve the reliability of these statistics and they may be published in a suitable form.

(iii) The Season and Crop Report gives a statement showing area sown under crops, every year. However, the sugarcane crop extends over more than twelve months and hence it is necessary to include in this statement both the area of land under sugarcane during the year and the area harvested during the year. These figures should be compiled and published in the Season and Crop Report.

(iv) The census of sources of irrigation, *viz.,* number of wells, bandharas, tanks, *etc.,* is at present taken quinquennially. In view of the rapid expansion of irrigation in recent years, we recommend that the census of sources of irrigation should be taken every year, and the results published in the Season and Crop Report.

(v) The extension of irrigation generally facilitates double cropping. Cropwise details of the area sown more than once and the area irrigated more than once are not given in the Season and Crop Report. Suitable *pro forma* for compiling this information may be designed and the data included in the Report.

(vi) Data regarding area and production of all varieties of a crop are compiled together. Although the work of compiling these data for all varieties would be too cumbersome it is necessary in respect of certain varieties of crops, *e.g.,* long staple cotton and hot weather groundnuts. Arrangements should be made to compile area and production statistics of such varieties of crops.

Annual Irrigation Adminis-tration Report

7.5.2. The Irrigation Administration Report, which is published annually by the Irrigation and Power Department, gives extensive statistics about Government irrigation works. Part I of this Report gives a general outline of the work carried out during the year by the different Circles and Divisions. Summary statements giving workwise information such as storage capacity, annual rainfall, area irrigated in different seasons, quantity of water consumed, *etc.,* are included in this Part. A statement showing districtwise area under second class irrigation works is also given in this Part. Detailed statistical statements about the irrigation works for which capital and revenue accounts are kept, are included in Part II of the report. Most of the data given in these statements are supplied by the Accountant General.

A scrutiny of this report shows that there is no uniformity in the manner of compiling the information as obtained from the Circle and Divisional Offices. This is particularly noticeable in Part I of the report. There is no systematic and uniform presentation of the information about the activities of the different Circles and Divisions. In Part II of the report we have noted that there is much duplication in the statements which are compiled. There is no timeliness in the publication of these reports. The latest printed report available relates to the year 1955-56.

In paragraph 7.3.2 we have recommended classification of irrigation works according to four criteria. The statistical tables included in the annual administration report should be so designed as to make available information regarding the cropping pattern and the financial position of irrigation works for each type of classification. It is also necessary to give in Part I of the report an overall picture of irrigation including that from non-Government sources, with a view to making the lay reader interested in the report. We also consider it necessary that the Chief Engineers should express their views in this part of the report, about the problems which they had to face during the year in respect of management and construction of irrigation works. These views need not necessarily be those accepted by Government. We feel that publishing of the views of heads of departments in the annual administration reports would be conducive to enlightened public opinion on irrigation problems.

Improvement in the statistics given in the Irrigation Administration Report should be effected on the following lines:—

(i) The Irrigation Administration Report does not clearly indicate the overlap acreage under sugarcane. The area for which casual or pre-seasonal or post-seasonal irrigation is given, is also not clearly shown. Similarly areas of long staple cotton and ordinary cotton and *kharif* groundnut and hot weather groundnut are not shown separately. We have noticed that clear and uniform instructions are not laid down for the compilation of these statistics. We, therefore, recommend that detailed instructions may be issued to the Divisional Officers for compiling statistics which are to be published in the report.

(ii) To be able to assess the extent of non-utilisation of irrigation potential, quantities of water in the different storages and the replenishments received at the different periods during the year should be given.

(iii) Cropwise area irrigated for each group of works, classified according to the supply of water criterion, should be compiled and published.

(iv) It is necessary to collect and analyse regularly comparable statistics relating to irrigation in other States in India.

7.5.3. With a view to making the general public alive to the problems of irrigation development, we recommend that an Irrigation Atlas of the State should be prepared and published. The Atlas should include maps showing storage locations and the areas commanded by the canal systems and statements giving broad statistics of these projects. A brief history of the construction and development of each project should also find a place in this Atlas. To encourage tourism, the Atlas should also give information regarding inspection bungalows near storage works, transportation facilities, *etc.* The Atlas should be published in English as well as in Marathi and may be revised every ten years. IRRIGATION ATLAS

7.6. Irrigation accounts

7.6.1. Sometimes 'extensions and improvements' to an irrigation project are so extensive that they are considered as separate projects. For example, the original Bhatghar reservoir and the Nira Left Bank Canal were 'extended' by the construction of the Nira Right Bank Canal and by raising the capacity of the Bhatghar reservoir, which has now been further extended by the construction of the Vir dam. The accounts of the three projects are, however, kept separate. The cost of the new Bhatghar dam is entirely borne by the Nira Right Bank Canal. The result is that while the Nira Left Bank Canal shows a return of 10 per cent. on the capital outlay, the Nira Right Bank Canal runs at a loss. On the other hand, the accounts of the Godavari Canals system, *i.e.*, the Godavari Right and Left Bank Canals and the Darna Dam, have been combined with the accounts of the Gangapur project. The Gangapur project has not yet fully developed, with the result that although the old Godavari Canals system is running at a profit, the combined accounts of the two projects show a loss. There should be uniformity in maintaining accounts of such extended projects. We consider that since such extensions become an integral part of the entire system, accounts of each system should invariably be unified. Thus, the accounts of the Bhatghar dam, the Vir Dam and the Nira Right and Left Bank Canals should be combined. UNIFIED ACCOUNTS OF EACH IRRIGATION SYSTEM

7.6.2. Individual accounts of 'capital-commercial schemes' are maintained by the Accountant General and are annually consolidated and sent to Government in the shape of Finance EXAMINATION OF IRRIGATION ACCOUNTS

Schedules. We have noticed that these schedules are not carefully examined in the Irrigation and Power Department, perhaps because they are not to be laid before the Public Accounts Committee. The result is that these finance schedules are left almost unnoticed. It is necessary that the accounts of irrigation works should be properly maintained and scrutinised. Such examination would disclose the reasons for shortfall of income or increase of expenditure as the case may be. This work should be entrusted to the Statistical Cell in the Irrigation and Power Department proposed by us in paragraph 7.7.2. Suitable orders should be issued every year to the field officers in charge of maintenance of these works with a view to rectifying the defects noticed. We have recommended in paragraph 7.7.1 that the State Irrigation Board should examine the accounts of irrigation works with a view to finding out whether and to what extent the various assumptions made at the time of formulation of projects are fulfilled in practice.

7.7. Maharashtra State Irrigation Board

FUNCTIONS OF THE BOARD AND ABOLITION OF THE STATE WATER UTILISATION COMMITTEE

7.7.1. In order to study and remove the hindrances which prevent full utilisation of the water obtainable from the various irrigation works, Government appointed the 'State Water Utilisation Committee' in 1957, to make a field survey of areas having non-utilised irrigation potential and make recommendations to Government for facilitating speedy utilisation of the irrigation potential.

In 1958, Government constituted the Maharashtra State Irrigation Board for advising Government in regard to policies for the development and management of irrigation in the State.

It is necessary to exercise continuous vigilance over the implementation of irrigation policy. The financial aspect of irrigation works both individually and as a whole requires to be examined regularly. We have recommended that the water rate structure should be based partly on the gross incomes from irrigated crops. This will entail studying the fluctuations in the prices of irrigated produce and generally carrying out a periodic review of water rates. The water accounts must be audited annually, work by work, and the reasons for non-utilisation of irrigation potential, brought out and remedies suggested. We feel that all this work could be done by the State Irrigation Board. We recommend that the Board should be enjoined to undertake these duties. We also do not consider it necessary to continue the State Water Utilisation Committee since its functions can be performed more efficiently by the State Irrigation Board, charged with the duty of advising Government on all other aspects of irrigation; water utilisation cannot be considered in isolation without reference to these other aspects.

STATISTICAL CELL

7.7.2. The functions which we have envisaged for the State Irrigation Board can be performed by it only if it is provided with the necessary staff for undertaking the work of compilation and analysis of the relevant statistics. This work cannot be done by the existing staff of the Irrigation and Power Department, both because it is already fully busy with other duties and secondly because it will not possess the necessary independent approach to the problems involved, on account of its own participation in the work to be examined. We, therefore, propose that a Statistical Cell should be established in the Irrigation and Power Department which should work under the guidance of the Deputy Secretary in that Department, who also acts as the Secretary of the State Irrigation Board. The following would be the important functions of the Statistical Cell:—

(i) To carry out the water audit of all irrigation projects with a view to finding out the leakages in water distribution by checking duties and transit losses in canals and distributaries.

(ii) To examine the financial results of all irrigation schemes both individually and by categories, for discovering excess in establishment cost, maintenance and repair charges, *etc.*

(iii) To maintain and compile information regarding prices of irrigated produce, changes in the cropping pattern and yields with a view to carrying out a periodic revision of water rates.

(iv) To prepare the Irrigation Atlas proposed by us.

The Cell should be adequately staffed. It should necessarily have on its staff one engineer with insight and experience of irrigation management and a Statistician, who has preferably had experience of conducting surveys and investigations on irrigation problems. The expenditure incurred on the Statistical Cell would not be large and will certainly be worthwhile; the economies which will result on account of its labours will be several times its cost. Irrigation is a quasi-commercial undertaking and a regular examination of its working, besides the present audit of its cash transactions, is absolutely essential.

In view of the functions which we have envisaged for the Maharashtra State Irrigation Board, Government may consider whether it should not be suitably reconstituted so as to enable it to discharge those functions efficiently.

7.8. Periodic review of irrigation policy

Irrigation policy relating to long term measures, *e.g.*, extension of irrigation facilities to new areas, crop patterns, allocation of water for power generation, *etc.*, requires to be periodically reviewed say every ten or fifteen years. Such a review should be carried out by special committees appointed for the purpose.

CHAPTER EIGHT

Summary

1. The Maharashtra State has an area of 765 lakh acres (according to village papers) of which 529 lakh acres, or about 70 per cent., are available for cultivation. Excluding 27 lakh acres under current fallow and 5 lakh acres under tree crops and groves, 497 or roughly 500 lakh acres would be the 'ultimate cultivated area', *i.e.*, when all the cultivable waste and long term fallow land is brought under cultivation. At present 23.2 lakh acres, or a meagre 5.2 per cent. of the net sown area, are irrigated. This is the lowest percentage amongst all the sixteen major States in India. Of this small percentage, a little more than one-half is contributed by wells and the remaining from surface sources like large storage reservoirs, tanks, bandharas, *etc.* Irrigation works constructed by Government account for only 5.1 lakh acres of the irrigated area or approximately one per cent. of the ultimate cultivated area of the State.

2. Over the major portion of the State, rainfall is not adequate for the proper growth of crops. Temperatures and soils are favourable to a large variety of valuable crops which can be grown if enough water is available. In respect of perennial tropical crops, high yields can be obtained. Yields of

sugarcane in Maharashtra are the highest in the country. Increases in yields due to irrigation in respect of other crops are also large.

3. Topographically the land is undulating and there are no large rivers having a perennial flow. The sources of most of our rivers lie in the Sahyadri range and in the Satpura hills in eastern Vidarbha, which receive heavy rainfall, which if impounded is a large source of irrigation water. The total annual run-off, with a dependability of 75 per cent., is estimated at 4,000 Thousand Million Cubic feet (T.MCft.); of this the utilisable yield has been assessed, on the basis of surveys already made, at about 2,000 T.MCft., out of which about 300 T.MCft. may ultimately be used primarily for power generation. By the use of supply of lower dependability suggested by us the likely increase in utilisable yield would be about 15 per cent. or 300 T.MCft. The total utilisable supply for flow irrigation would, therefore, be about 2,000 T.MCft. which would be enough for irrigating about 100 lakh acres, *i.e.*, about 20 per cent. of the ultimate cultivated area. In the canal irrigated areas the sub-soil water table, which gets enriched by percolation, can be tapped through a net-work of wells and the water used for irrigation in combination with canal water. This system of lift-*cum*-flow irrigation may increase the irrigated area by about 15 per cent. Another 15 lakh acres would be added to the irrigable command on account of additional quantities of water available at the distributary head due to lining of canals. Thus the total area irrigated from surface sources would be about 130 lakh acres or 26 per cent. of the ultimate cultivated area. With an intensity of irrigation of 66 per cent. the total culturable command of irrigation works will be about 200 lakh acres or 40 per cent. of the ultimate cultivated area in the State.

Out of the area available for cultivation about 325 lakh acres would not be reached by irrigation works utilising surface water sources. To-day this area perhaps has about 8 lakh acres under well irrigation. A fairly accurate estimate of the irrigation potential from underground water sources in this area cannot be made in the absence of a survey of underground water resources. On the basis of the existing development of well irrigation in some parts of this area, we have estimated that during the next twenty years another 15 lakh acres could be added to the existing area under well irrigation, especially if the measures designed to enrich the underground water resources such as contour bunding, *nala* plugging and the construction of percolation tanks are taken to the fullest extent possible. Thus the total irrigation potential from all sources may be assessed at 153 lakh acres against the present 23 lakh acres. The area enjoying irrigation facilities will be about 223 lakh acres or 45 per cent. of the ultimate cultivated area.

4. Up to 1951 only 200 T.MCft. of the surface flow was being utilised, 40 T.MCft. for power generation and the remaining for irrigation. The schemes included in the first two Five Year Plans will push up the utilisation to about 500 T.MCft., out of which 80 T.MCft. will be for power generation and 420 T.MCft. for irrigation. When all these schemes are completed by about 1965 we will still have used only about 22 per cent. of the utilisable surface water wealth. While there was almost no progress between 1931 and 1950 in the percentage of cultivable area that was under irrigation from surface sources, that between 1951 and 1965 would be only 0.2 per cent. per year. This rate of increase is the lowest in India; the rate for India as a whole during this period is 0.87 per cent. per year. The Maharashtra State lags considerably behind most of the States in India, not only in respect of progress towards attaining the target of exploiting the entire water resources to the fullest extent but also in respect of the annual rate of increase in the percentage of cultivable area that is irrigated. To achieve the maximum possible utilisation, which will result in the increase of the area irrigated from surface sources to 26 per cent., we will take about ninety years after 1965, if the rate of progress in Maharashtra remains what it is at present.

5. Financial scrutiny of the existing irrigation works for which quasi-commercial accounts have been kept individually, shows that only large storage works are not being run at a loss at present. Small storage works and bandharas are not earning enough income to meet their recurring cost and interest charges. The capital cost incurred on the existing large storage works is less than Rs. 2,000 per MCft. of live-storage whereas present day costs are about Rs. 6,000. At today's capital costs even large irrigation works would not pay, unless the current water rates are revised. Fixation of water rates from time to time has been done on an *ad hoc* basis. There is no uniformity in water rates in the different parts of the State even for the same type of service.

6. It was intended to recover the annual recurring expenses by levying an irrigation cess on all farmers within the command of a canal, irrespective of whether or not they took advantage of the irrigation facility created. This intention could not be translated into practice and irrigation cess is

at present being charged as a surcharge on the water rates. Betterment levy was imposed by law more than ten years ago. But it has not been assessed so far nor recovered, on account of difficulties in giving effect to the provisions of the law as enacted.

7. We have recommended that irrigation policy in Maharashtra should be guided by the following four main principles: —

(i) In Maharashtra development of irrigation is the *sine qua non* for not only the improvement of conditions in the rural areas but also for the general economic and industrial progress of the State. Therefore, all the utilisable water resources of the State—both surface and underground—should be fully exploited within the shortest possible period. We have recommended that this be done by 1980.

(ii) The total utilisable water resources—both surface and underground—are enough only for about 30 per cent. of the ultimate cultivated area. It is, therefore, necessary to disperse the benefits of irrigation over as large an area of the State as is physically possible. Equitable distribution of the scarce resources of irrigation, both as between areas and persons, should be the primary consideration in deciding locations and coverage of irrigation works.

(iii) The meagre water resources must be stretched as far as possible. Apart from the steps designed to achieve this objective there should be no unnecessary restrictions or controls in other matters.

(iv) Since provision of irrigation facilities is a service which substantially benefits the cultivators there is no reason why the general tax payer should be made to bear even a part of the cost of providing this service. The water rates structure should, therefore, be so designed as to recover in the shape of water rates the recurring costs including interest charges to the full extent.

Our detailed recommendations, which have been summarised in the following paragraphs, flow from these four principles of irrigation policy.

8. With a view to achieving maximum utilisation of the available water resources, we have recommended that water of lower dependability, up to 50 per cent., should be harnessed in those basins where the available yield of 75 per cent. dependability is inadequate. We have also suggested that wherever possible flow irrigation should be combined with lift irrigation. In the areas not within the command of irrigation projects, underground water resources should be

exploited to the full. We have recommended that an underground water resources investigation survey should be initiated forthwith and carried out throughout the State.

Our estimate of the capital outlay required for the development of irrigation resources, both surface and underground, together with that required for measures to augment the underground water supply, is Rs. 1,430 crores, to be expended between 1961 and 1980. At to-day's rates our existing surface irrigation works would cost about Rs. 90 crores and the 5,86,000 irrigation wells about Rs. 175 crores; our existing assets are thus worth about Rs. 265 crores. We will have to spend about 5.4 times this amount in a period of twenty years. We consider that this is both possible and necessary.

9. Until about 1930 preference was being given to the traditionally known scarcity areas in the matter of location of irrigation projects. There was no development of irrigation for nearly twenty years after that date, *i.e.*, until the formulation of the First Five Year Plan. At present there is no well defined policy regarding the dispersal of irrigation facilities. Most of the existing irrigation works were laid out to serve extensive portions of the scarcity areas but development was allowed to take place according to local response and the need, from a purely technical point of view, of utilising irrigation water as near the upper reaches of the canals as possible, to save transit losses. The contemporary experience is that farmers located in the irrigated areas, particularly where perennial cash crops can be grown, become much more prosperous than even those in areas of assured rainfall. The result has been that development of irrigation has been lopsided, in so far as these pockets of all-round prosperity have been confined to narrowly circumscribed areas. In short, the social aspects of distribution of benefits of irrigation water have not been given sufficient weightage. The Commission has recommended that in each river basin irrigation should be spread over as large an area as possible permitting the development of pockets of prosperity all along the river course from the reservoir to the State's borders. In order that the area between the reservoir and the pick-up-weir should receive the benefit of irrigation we have recommended that a portion of the stored water should be allowed to be lifted from the river and charges equivalent to one-half of the rates fixed for canal irrigation should be recovered, the beneficiaries themselves bearing the cost of pumping. The construction of small irrigation tanks and wells in the catchments of large irrigation projects should

also not be totally interdicted as hitherto. In order that areas along the canals, but out of their command, should also be eligible to the benefit of irrigation, we have recommended that cultivators should be allowed to pump water from the canals by paying normal rates of irrigation. We have recommended that other forms of irrigation such as wells, should be concentrated in areas which will not be reached by schemes providing flow irrigation.

10. Equitability in the distribution of the irrigated area as between one cultivator and another should be secured by fixing maximum limits of area up to which individual irrigators should be allowed to take irrigation water, particularly for cash crops. In the past the policy has been to secure quick development of irrigation even by encouraging big landlords to make contracts for large areas growing cash crops like sugarcane. We have recommended that fresh applicants for irrigation water should also be accommodated by reducing the sanctioned areas of existing irrigators to the extent necessary, but that at each stage such reduction should be limited to one-third of the then existing area, so as to avoid large scale hardship. Sanctioned areas under perennial crops below two acres should not be further reduced.

11. So far no definite policy regarding priorities as between the different uses of water, *e.g.*, domestic supply, industrial supply, power generation and irrigation, has been laid down. In fact, there is no co-ordination between the different departments handling each one of these uses and there is often considerable inter-departmental controversy over the relative superiority of their respective claims. We have recommended that domestic needs should receive the highest priority. Water for domestic supply should be made available from irrigation works at reasonable and uniform rates all over the State, and the fact that the source of supply is not nearly 100 per cent. dependable should not deter us from giving this much-needed amenity, particularly to the rural areas. The needs of domestic water supply generally speaking would always be modest and even after the next twentyfive years are not expected to be more than 100 T.MCft. We have recommended that the next priority should be given to the requirements of industries. The present requirements of industries are as small as 5 T.MCft. and even if these requirements were to increase several-fold the total demand on the water resources would not be such as to affect their use for irrigation to an appreciable extent. We have suggested that industries requiring large quantities of water should

preferably be located in those basins which have adequate water resources. We have proposed that rates which each group of industries can bear should be fixed for supply of water to them.

Between irrigation and power, we have proposed that priority should be accorded to that alternative which gives the maximum benefit per unit of water utilised. In making comparison of benefits accruable from irrigation and power generation some initial weightage should be given to irrigation, in view of the fact that while irrigation is possible only with the use of water, power can be generated from alternative sources. On the other hand in the Western Ghats there occurs an exceptionally favourable conjuncture for the utilisation of hydro-power in the service of a region far removed from the coal fields. We have also proposed that wherever possible irrigation water be utilised also for power generation and *vice versa*.

12. We have proposed that Master Plans for the utilisation of water resources of the different basins and sub-basins should be made comprehensive, *i.e.,* they should take into account the needs of water not only for irrigation but also for other categories of uses.

13. Individual accounts of 'capital-commercial schemes' are maintained by the Accountant General and are consolidated and sent to Government by him in the shape of annual Finance Schedules. These Schedules are not being carefully scrutinized at present. We have suggested that the Finance Schedules should be studied and presented to the Maharashtra State Irrigation Board which should undertake an annual financial review of irrigation schemes, based on these studies.

14. At present the financial test for judging the soundness of a project consists primarily in making comparison of the capital cost per acre of irrigation likely to result from the proposed project, with the current yardstick of maximum capital cost per acre irrigated. This procedure allows room for adopting an unrealistic crop pattern to suit the yardstick. We have, therefore, recommended the adoption of norms of capital cost as fixed per MCft. of annual utilisation and the forecasting, as accurately as possible, of the crop pattern under the proposed project.

15. We have suggested that the cost of a multipurpose project should be allocated between its major uses only. We have pointed out that in two hydro-power projects in the State, in which water is first used for power and then for irrigation, allocation of capital costs has not been made and the entire cost is being borne by irrigation. We have

proposed that allocation of costs of these projects should be done immediately.

16. There is no uniformity in water rates not only as between the old Bombay State area and Vidarbha and Marathwada, but in some cases also between two Irrigation Circles in the same administrative division. Seasonal rates put an equal burden on crops grown in the same season but which vary widely in their gross incomes. We have suggested a water rate structure and enunciated the principles on which water rates should be fixed. We have kept before us three main objectives, *viz.*, that water rates should not result in non-utilisation of the irrigation potential created, that the total recoveries should not be less than the annual cost incurred for providing the service and that the water rate for a crop should be related to its ability to bear it. We have shown that on the major canal systems in Western Maharashtra water rates varying between 6 per cent. and 12 per cent. of the gross incomes of the various irrigated crops would yield an income sufficient to meet the annual cost. We have proposed that the existing seasonal rate system should be changed to the crop rate system. The main reason for the suggested change is that the existing system is not suitable for making water rates equitable with reference to the gross incomes derived from the different crops. It is also more convenient, in a crop rate system, to sanction water at one time for the entire period of growth of a crop. We have proposed that there should be periodic revision of crop rates to take into account changes in gross incomes due to those in yields and prices.

The actual application of the crop rates would be mostly in the form of block rates since we have recommended that long term commitments be made on all the canals under the prevailing block system. We do not feel the necessity of continuing the irrigation cess as a surcharge on water rates. since the entire recurring cost on irrigation works can be recovered through water rates. We have, therefore, recommended abolition of the irrigation cess.

17. Co-operative lift irrigation schemes are, by and large, proving uneconomic because of the defective manner in which their feasibility is judged. We have suggested a method of determining the feasibility of those schemes which should lead to viable schemes alone being undertaken.

18. We have pointed out the circumstances in which consolidated land revenue should be recovered and suggested that where these circumstances do not obtain the irrigation charge should be separated and normal water rates levied.

19. With regard to the recovery of betterment levy the position in the Maharashtra State is that a stalemate has been reached. In view of the present virtual absence of a market price for land, rendering the estimating of the increase in land values almost impossible, we have suggested that the basis for charging betterment levy should be the increase in the productivity of land due to irrigation. We have, therefore, suggested the recovery of betterment levy as a surcharge on water rates.

We have also proposed that depreciation charges should be recovered and that a consolidated betterment-*cum*-depreciation charge equivalent to 20 per cent. of the water rates should be levied on all irrigators benefiting from Government irrigation works.

20. Formulation of projects is a complex process. We have pointed out that it is essential to formulate projects in three stages. We have suggested that greater accuracy of estimates should be achieved by carrying out actual surveys of alignments of canals and of the value of the land to be acquired for the project. Estimates based on such actual surveys of the distribution system would then be nearly as accurate as those of headworks. We have also suggested that surveying and testing of local construction materials should invariably be done. While we have suggested the steps which should be taken to induce contractors to offer competitive rates, we have proposed that the constructional staff should be given opportunities of gaining experience in actual construction work to enable them to take up such work departmentally, if and when contractors form a ring and quote unreasonably high rates.

In the formulation of projects we have suggested some improvements, *e.g.*, that canal capacities in the lower reaches should be larger than those required for carrying enough water during the peak requirement period, that the requirements of domestic water supply of the rural areas, through which canals and distributaries are to pass, should be taken into consideration, that *ghats* should be built on canals for use by villagers, that service roads, which can be complimentary to public roads, should be constructed according to the specifications for the latter and thrown open to the public, *etc*.

21. Having regard to the need of developing the irrigated areas in all respects with a view to securing full utilisation of the irrigation potential created, we have suggested that an integrated development plan, embracing all other aspects besides engineering, should be prepared for each project.

For preparing these integrated plans teams of experts drawn from the departments concerned should be formed for each region in the State. We have suggested that construction of irrigation projects, both individually as well as collectively (*i.e.*, those undertaken during a period), should be planned. The object of construction planning is that irrigation should be made available before construction work is fully completed. For this purpose, we have suggested that the construction of canals should be started along with that of the head-works. We consider that on most irrigation works water can be made partly available during the fourth year after the commencement of construction. With a view to making the most economical use of technical personnel and mechanical equipment we have suggested that the construction plans of projects undertaken during a period should be so arranged as to obtain, at any one time, projects in the various stage of construction. This will make spill-over from one Five Year Plan period to another inevitable but should be welcome since it will also make the financial burden from year to year during a period more uniform.

Lengthening of the period of construction is often the result of delay in the acquisition of land. We have suggested the appointment of units of revenue officers for large projects and also amendment of the relevant legislation, with a view to enabling the application of the urgency clause to land with structures.

22. With regard to the rehabilitation of persons displaced by a project, we have suggested that the concept of market value of assets taken over should be replaced by that of rehabilitation cost. We have also suggested that Government should accept the responsibility of physical rehabilitation of the displaced persons.

23. We have pointed out that reclamation of waterlogged areas is very much cheaper than providing irrigation facilities to new areas and that larger allocation of funds should be made for reclamation work.

24. With regard to the construction of wells we have suggested that the Agriculture Department should put into the field more blasting units and in deep soil areas should arrange for demonstration of the appropriate method of well sinking. We have commended the experiment in co-operative well construction carried out in the Aurangabad district and have proposed that it should be emulated elsewhere.

25. We have made suggestions regarding organisational matters which would be conducive to speed and economy in the construction of irrigation projects. We have suggested

that the designs and estimates prepared by one unit in the Central Designs Organisation should, as a matter of ordinary procedure, be checked by another unit. We have also suggested the association of a team of expert engineers in the technical scrutiny of large irrigation projects, *i.e.,* those costing over Rs. 10 crores. We have proposed that there should be unity of command on an irrigation project and that the staff belonging to the mechanical circle should work under the overall control of the engineer in charge of the project. We have also proposed that the powers of technical sanction of Superintending Engineers and Executive Engineers should be enhanced.

26. We have noticed that there is considerable dissatisfaction and consequential lack of initiative and enthusiasm on account of the denial of benefits of permanent service to a large section of the engineering staff. We have proposed that the bulk of the temporary staff should be made permanent. We have also made some proposals for showing appreciation of work of a high order done by the constructional staff.

We have proposed that a long term and continuous programme of training junior engineers in designing work and for giving in-service training to construction engineers should be undertaken.

27. We have recommended that irrigators should have complete freedom to choose the crops to be irrigated, subject only to such restrictions as must be put with a view to avoiding wasteful use of water and to preserve the productivity of land. We have pointed out that localisation of crops is unnecessary in the light of the method for recovering betterment levy suggested by us. We found enthusiasm in some quarters for the Phad system of irrigation obtaining in the Nasik and Dhulia districts. We have suggested that the system of granting concentrated cane blocks, now prevalent on the Godavari and Girna Canals, should be encouraged to secure the advantages of having one crop over a comparatively large area. We have supported the present 'block' system and have suggested a new set of blocks for adoption. We have examined the question of utilising water of lower dependability, namely 50 per cent., in relation to long term sanctions. In the study made, we have come to the conclusion that long term sanctions should be confined to 85 per cent. of the supply of 50 per cent. dependability. We propose that such limits of water to be committed in long term contracts should be worked out for the different projects, with a view to avoiding hardship to the irrigators on account

of inclusion in the utilisable supply, water of lower dependability. We have indicated the steps to be taken for using the spare capacity of canals during the monsoon. We have proposed that unitisation should be enforced strictly and a small penalty charged to those who do not carry out unitisation.

We have studied the reported losses of water on the various canals and have concluded that a strict and continuous vigil should be kept on these losses and excesses over 'norms', laid down for the different canals, closely investigated.

The losses reported at present indicate laxity in irrigation management and pilferage of water on a considerable scale. This, we feel, can be more effectively avoided by supplying water on measurement of its volume, although the water rates would be continued to be charged on the basis of the area actually irrigated. We have given in detail the kind of organisation of local irrigators which should be built up for management such as changes in the irrigation year and beyond the distributary level.

We have suggested some other improvements in irrigation management such as changes in the irrigation year and irrigation seasons.

We examined the present state of the *ex*-Malguzari tanks in the Chanda and Bhandara districts, in consultation with local leaders at a special meeting held at Nagpur. We have made proposals for the early repairing of these tanks and entrusting their management and maintenance to bodies of beneficiaries. We have also made similar proposals for utilising the water of small streams by putting up katchha bandharas across them.

28. At present the period for development of irrigation is reckoned as ten years from the starting of irrigation. We have proposed that it should be shortened to eight years from the starting of construction work or five years from the starting of irrigation. The task of developing irrigation within the period suggested is no doubt difficult but we feel that it is not impossible of achievment. Even with the period of development proposed by us, the sum-at-charge on the capital cost of Rs. 6,000 per MCft. of live storage works out to Rs. 7,550. A longer period of development would be reflected in higher water rates which must be sought to be kept as low as possible.

We have studied the causes of slow utilisation of irrigation potential and suggested steps for the removal of those causes.

We have suggested that the lay-out of field channels should be prepared along with the project and the land required for these channels acquired at Government cost. Co-operative credit should be supplied for levelling and cultivation expenses to the required extent. Trial-*cum*-demonstration farms should be started by the Agriculture Department in newly irrigated areas with the aid of well irrigation, much before irrigation water from the project becomes available to the farmers. Rural electrification should be synchronised and co-ordinated with the extension of irrigation facilities particularly when the lift-*cum*-flow system is introduced.

29. We have pointed out that it is not enough that agricultural research solves individual problems pertaining to irrigated crops but that the objective of the research should be to enable irrigators to realise increasingly larger gross incomes by the cultivation of those crops. This is important because of the fact that the cost of irrigation works would continue to increase as the exploitation of irrigation resources proceeds further. We have also pointed out the importance and urgency of solving some of the problems pertaining to irrigated crops such as transplanting of long-staple cotton, growing of paddy seedling in concentrated blocks, *etc.* With regard to research in irrigation engineering we have indicated the gaps in the present programme of research which need to be filled in.

30. We have pointed out certain deficiencies in irrigation statistics and irrigation accounts and have proposed modifications in the present system of classification of irrigation works, with a view to enabling a better scrutiny to be made of the working of irrigation projects. We have suggested some modifications in the presentation of the annual Irrigation Administration Report and have suggested the preparation of an Irrigation Atlas. With a view to enabling an assessment to be made of the benefits of irrigation, we have proposed that socio-economic surveys of areas proposed to be brought under irrigation should be carried out before the construction of those projects and also subsequently.

31. The need for a continuous review of the implementation of irrigation policy cannot be overstressed. We have suggested that the Maharashtra State Irrigation Board should undertake this task and that a Statistical Cell should be organised in the Irrigation and Power Department to enable the Board to discharge this function efficiently.

Finally we have proposed that an examination of the irrigation policy should be undertaken every ten to fifteen years by the appointment of special commissions of inquiry.

Bombay:
Dated, 9th June 1962.

S. G. BARVE,
Chairman.
D. R. GADGIL,
Member.
M. L. CHAMPHEKAR,
Member.
ANNASAHEB P. SHINDE,
Member.
DATTA A. DESHMUKH,
Member.
YESHWANTRAO L. GIRME,
Member.
KRISHNARAO G. DESHMUKH,
Member.
SRIPATRAO L. KADAM,
Member.
SHANKARRAO B. PATIL,
Member.
S. P. MOHITE,
Member.
G. N. PANDIT,
Member.
D. A. GADKARY,
Member and
Associate Secretary.

S. K. BEDEKAR,
Secretary.

APPENDICES

APPENDIX A (I)

The Maharashtra State Irrigation Commission: Appointment of the—

GOVERNMENT OF MAHARASHTRA
IRRIGATION AND POWER DEPARTMENT
Resolution No. CME-1060-P.
Sachivalaya, Bombay, 7th December 1960.

GOVERNMENT RESOLUTION

Government is pleased to appoint a Commission to investigate into and report on the problems of Irrigation and other aspects of Water-resources development in the State of Maharashtra. The Commission will be known as "Maharashtra State Irrigation Commission".

2. The Commission will be constituted as under:—

(1) Shri S. G. Barve, Secretary to the Government of Maharashtra, Irrigation and Power Department—*Chairman.*
(2) Dr. D. R. Gadgil—*Member.*
(3) Shri M. L. Champhekar—*Member.*
(4) Shri Annasaheb Shinde—*Member.*
(5) Shri Datta Deshmukh, M.L.A.—*Member.*
(6) Shri Yeshwant Rao Girme—*Member.*
(7) Shri K. G. Deshmukh, M.P., Amravati—*Member.*
(8) Shri Sripat Rao Kadam, Bhir—*Member.*
(9) Shri S. P. Mohite, Agricultural Commissioner—*Member.*
(10) Shri G. N. Pandit, Chief Engineer (Irrigation Projects) and Joint Secretary, Irrigation and Power Department—*Member.*
(11) Shri D. A. Gadkary, Director of Minor Irrigation—*Member and Associate Secretary.*
(12) Shri S. K. Bedekar—*Secretary.*

3. Shri Gadkary will work as Associate Secretary in addition to his duties. Shri Bedekar will be the whole-time Secretary of the Commission. One post of Officer on Special Duty equivalent to that of a Deputy Secretary to Government, and carrying a special pay of Rs. 200 in addition to the grade pay in the senior scale of the I.A.S., is created in this department with effect from the date of this Resolution for this purpose which will be held by Shri Bedekar.

4. The terms of reference for the Commission will be as follows:—

(i) To assess the water resources of the State of Maharashtra and consider their utilisation for all purposes, namely, hydro-power, irrigation, industrial and domestic use, and in particular to examine and report on the potentialities of irrigation by different means, *i.e.*, major, medium and minor irrigation works, wells, tanks, bandharas, *etc.*, in the territories of the State of Maharashtra.

(ii) After assessing the extent of irrigation facilities available from works already constructed or in progress, to consider and formulate, as far as may be, a specific plan of action for carrying out various types of irrigation works, with a view to affording protection to scarcity-affected areas as well as securing an optimum utilisation of the water resources available in the territories of the State of Maharashtra. In this connection the Commission will in particular consider the pros and cons of utilising some of the available water resources for Power, alternatively to their utilisation for irrigation.

(iii) To consider problems of crop patterns and crop planning in irrigation commands including the problems of localisation in new commands; water-logging and drainage; policy relating to supply of water from Government irrigation works to various consumers including sugar factories, industrial undertakings as well as individual farm-holdings, large and small; water rates, including compulsory irrigation cess, full utilisation of irrigation potentialities-present and prospective; simplification of procedures as well as other problems of irrigation management, including measurement and distribution of water, repairs and maintenance of head works and the distribution system, etc.

(iv) To examine the financial return on existing irrigation works; to consider the question of "betterment levy" in all its aspects; and recommend the means of ensuring, as far as may be, an adequate financial return from the various types of irrigation works, *i.e.*, productive, protective, major, minor, *etc.*

(v) To consider generally all connected and ancillary matters relating to economic development and general prosperity in the irrigated areas of the State.

5. In addition to the above terms of reference a memorandum of instructions is appended to this Resolution for the guidance of the Commission (Annexure "A").

6. The Commission may visit different areas of the State and take evidence before framing its recommendations.

7. The administrative and technical establishment as specified in Annexure "B" is sanctioned for facilitating the work of the Commission, for the period of one year in the first instance.

8. The Commission should be permitted access to all the relevant records of the Irrigation and Power Department and the Department of Agriculture and their field units.

9. The non-official members of the Maharashtra State Irrigation Commission will be eligible to draw travelling allowance and daily allowance for the purpose of attending the meetings of the Commission according to the Scale I of rule (1) (b) Section I of Appendix XLII-A of the Bombay Civil Services Rules, Vol. II, as modified from time to time.

The travelling and daily allowance of the official members will be regulated by the Bombay Civil Services Rules. The Secretary of the Commission should be the Controlling Authority in respect of the Travelling Allowance Bills of the non-official members of the Commission.

10. The Commission should submit its report within twelve months from its formation.

11. The Headquarters of the Commission will be at Bombay.

12. † [The expenditure on account of the Maharashtra State Irrigation Commission should be debited to the budget head '57-Miscellaneous-C-Special Commissions of Enquiry' and should be met out of the advance of Rs. 31,450 sanctioned from the Contingency Fund under Government Memorandum, Finance Department No. CNF-1160-263-XVII, dated 6th January 1961. A supplementary demand to enable repayment to the Fund should be obtained at the first or the second session of the State Legislature as may be practicable, after the date of this order.]

By order and in the name of the Governor of Maharashtra,

Y. S. KULKARNI,

Under Secretary to the Government of Maharashtra,

Irrigation and Power Department.

Accompaniment to Government Resolution, Irrigation and Power Department, No. CME-1060-P, dated the 7th December 1960.

ANNEXURE "A"

Memorandum of instructions for the guidance of the Maharashtra State Irrigation Commission.

The State of Maharashtra has at present one of the lowest percentages of cultivable land under command of irrigation amongst the States of the Indian Union. At the same time, large tracts in certain regions of the State are in exceptional need of irrigation by way of safeguarding them against the paucity and vagaries of the monsoons and the consequential liability to scarcity and famine conditions. In contrast to the alluvial plains of northern India or the deltaic regions in the east of the Peninsula the terrain of Maharashtra also presents special difficulties in providing flow irrigation works, *e.g.*, need for storage reservoirs, the limited extent of irrigation in narrow strips along rivers which alone is generally feasible, the cost of canal works due to unevenness of the country, *etc.* These circumstances render the problem of irrigation of exceptional significance in the territories of the State of Maharashtra.

The last enquiry into irrigation problems in the State of Bombay was made by the Vishwesvarayya Committee of 1938. The context of such an enquiry has vastly changed now, *inter alia*, as a result of the embarkation on a series of Plans designed, among other things, to obtain the fuller utilisation of the water resources of the territories of the State.

It is necessary in the present context to draw up an integrated programme according to an appropriate place to each type of irrigation

† [ ] Inserted by corrigendum No. P. 74/287-B, dated the 16th January 1961.

works—major, medium, minor, tanks, bandharas, wells—having regard to the costs and benefits of each, within the water resources available in the territories and the established possibilities of utilising them. In this connection, the question of lift irrigation (including the suggestion of compulsory lift in irrigation commands for part of the water requirements) particularly with the assistance of cheap electrical power is highly pertinent and needs special attention. The Commission may also consider the 'norm' or 'norms' that may be adopted as regards 'dependability' for irrigation storages as a part of the optimum water planning in the different regions of the State and for different kinds of irrigation works. The Commission may consider generally the organisational set-up of the different Departments and administrative agencies concerned in the rapid execution of such programmes of Irrigation development and the utilisation of irrigation facilities thus created and recommend how these may be improved.

It appears probable that even after optimum practicable utilisation of water resources a large proportion of the cultivable area in the Maharashtra territories would still have to be cultivated on dry farming basis and without the benefit of irrigation. The crop patterns appropriate in this context in the irrigation commands of the various types of works must be considered.

The high cost of irrigation, the limited extent to which these benefits can be extended and the high differential in the productivity between irrigated and non-irrigated areas invest a special importance in the problem of levying betterment charges—whether by way of a compulsory irrigation maintenance charge, *i.e.*, "Irrigation cess" or by way of a levy on capital appreciation of the land commanded or both—on areas under irrigation command.

The problem of utilisation of available irrigation waters to the greatest advantage is also highly significant in these circumstances and deserves special consideration.

The Commission is requested to consider and recommend *inter alia* the simplification of irrigation practices, forms and procedures. It may also consider to what extent decentralisation of management of irrigation works including such management by co-operatives of the irrigators themselves could be introduced in the system of irrigation administration.

The Commission will also consider and recommend on the policy that may be followed in regard to supply of water with reference to the sizes of holdings and the nature of crops for which supply of water may be sanctioned, having regard to the need on the one hand of productivity and quick development and on the other of distributing the scarce benefits of irrigation water as widely as possible.

Certain matters relating to agricultural prosperity in irrigated areas, *e.g.*, "extension activities" of the Agriculture Department, supply of good seed, supply of fertilizers, rural credit and marketing of agricultural produce, matters relating to establishment and running of processing industries for utilising the produce of irrigated crops have an integral relationship to and a vital bearing on the welfare of the community of irrigators. They may also be considered and reported upon by the Commission to the extent to which such consideration is attracted by the Commission's terms of reference.

The Commission may make a comparative study of irrigation planning, management and practices in such of the tracts in other States as may be necessary for a consideration of the problems arising in Maharashtra.

ANNEXURE "B"

Non-Technical (1)	Pay-Scale (2)
	Rs.
Officer on Special Duty attached to Secretariat.	800—50—1,000—60—1,300—50—1,800 with Special pay of Rs. 200 per mensem.
One Research Officer	220—15—400—E.B.—20—500—E.B.—25—650.
One Assistant Secretary	650—50—950.
One Senior Assistant	210—15—300.
One Statistical Assistant	120—10—250.
Three Stenographers (one Marathi)	180—10—310—15—400.
Two Typists	75—5—140—E.B.—8—220.
Two Clerks	75—5—140—E.B.—8—220.
One Naik	40—1—50.
Nine Peons	35—½—40.
One Stenographer of lower grade ..	140—8—220—10—270.
Technical.	
*One Executive Engineer	500—30—650—E.B.—45—1,100 *plus* Special pay of Rs. 150.
Two Deputy Engineers	220—15—400—E.B.—20—500—E.B.—25—650. *plus* Special pay of Rs. 80. each per mensem.
One Tracer	46—3—85—E.B.—4—105.
One Draughtsman	100—4—120—E.B.—5—170. or 110—10—180. } According to qualification.

*This post will be equivalent to that of a technical Under Secretary in Irrigation and Power Department.

APPENDIX A (II)

The Maharashtra State
Irrigation Commission.

GOVERNMENT OF MAHARASHTRA
IRRIGATION AND POWER DEPARTMENT
Resolution No. CME-1060-P.
Bombay 32, 17th January 1961.

Read.—Govt. Resolution No. CME-1060-P, dated 7th December 1960.

Resolution.—Government is pleased to appoint Shri Shankarrao Bajirao Patil, M.L.A., as a member of the Maharashtra State Irrigation Commission, constituted under Government Resolution, Irrigation and Power Department, No. CME-1060-P, dated 7th December 1960.

By order and in the name of the Governor of Maharashtra,

M. G. BARTAKE,
Assistant Secretary to Government.

APPENDIX B

Maharashtra State Irrigation Commission

QUESTIONNAIRE

I. Planning of future development of irrigation

Irrigation works may be classified into those meant (i) for storage and distribution of rain-water, *e.g.*, large storage reservoirs and medium and minor tanks and canal distribution systems respectively therefor, (ii) for utilisation of naturally flowing water in rivers and streams, *e.g.*, pick-up weirs and bandharas and canal distribution systems therefor, (iii) for utilisation of stored or naturally flowing water by lift irrigation, and (iv) for tapping underground water, *e.g.*, tube-wells, bore wells and open wells. Irrigation works may also be classified according to their capital cost and/or the extent of the area to be irrigated by them, into "major", "medium" and "minor" irrigation works. In the current accepted terminology works costing up to 10 lakhs of Rs. approximately are called "minor"; those from 10 lakhs to 5 crores "medium"; those above 5 crores "major".

The State can be divided into the following six regions according to the soil climate complex:—

(1) The coastal strip comprising the districts of Thana, Kolaba and Ratnagiri.

(2) The heavy rainfall area of the Ghats comprising the western talukas of the districts of Nasik, Ahmednagar, Poona, Satara, Sangli and Kolhapur.

(3) The scarcity-affected areas comprising the western talukas of Aurangabad, Bhir and Osmanabad districts, the Sholapur district and the eastern talukas of Ahmednagar, Poona, Satara and Sangli districts.

(4) The paddy-growing area of Bhandara and Chanda districts and the eastern talukas of Nagpur district.

(5) The heavy soil area comprising Dhulia, Jalgaon, Amravati, Akola and Wardha districts, the western talukas of Nagpur district and Parbhani and Nanded districts.

(6) The medium soil areas comprising Buldana and Yeotmal districts and the eastern talukas of Aurangabad, Bhir, Osmanabad, Nasik, Poona, Satara, Sangli and Kolhapur districts.

From the point of view of developing irrigation resources, the circumstances in each of these six regions are as below:—

(1) The country is very badly undulating and very little command can be had under flow irrigation. In parts of Ratnagiri district, the strata being lateritic, tanks percolate heavily and water cannot be stored therein. No irrigation water is required during the Kharif season on account of heavy rainfall. Irrigation is useful during the Rabi season for growing a second crop of paddy or pulses. Fruit growing has good potentialities in parts of this region. Areas near Bombay City provide good scope for growing vegetables and for

poultry farming and milk production on account of their nearness to the market. The rivers in this region are torrential in the monsoon and virtually dry rest of the year. The tail races of hydel stations, however, provide a perennial flow of substantial magnitude in the rivers concerned.

(2) This region receives very heavy rainfall up to 250″ per year. The topography is mountainous and the lands are very slopy except in patches. This region provides good scope for the building of storage reservoirs but very little for the use of the water stored.

(3) The soils in this region vary from medium to heavy. Rainfall average about 20″ but is often badly distributed and sometimes fails altogether. Kharif crops are grown on medium soils and Rabi crops on heavier soils. Water-supply in wells is not copious. If irrigation is available, abundant perennial crops can be grown. However, even with the maximum exploitation possible in the near future, major irrigation works can provide irrigation only to a small portion of this tract. In some of the remaining area, minor irrigation works such as bandharas and tanks can be constructed.

While major irrigation works serving these areas would generally have their catchment in the dependable rainfall zones in the Sahyadris, the catchment of small irrigation tanks and bandharas would be situated in the same areas as their commands. As a result, when the rainfall is adequate, there would be water available in the small works for which there would be no demand ; and on the other hand, when the rains have failed, as they would have failed in the catchment area as well, there would be no run-off and no water available in the minor irrigation work or bandhara to meet the demand for it in the command area. There are, however, seasons during which the precipitation may have been adequate but its distribution may not have been satisfactory. During such seasons when long breaks in the rainfall occur, these works would be serviceable by supplying one or two critical waterings and saving crops at the critical time. Minor irrigation works situated in these tracts have, therefore, to be viewed as a type of "insurance" of this limited application. Their economics has, therefore, to be judged in this context and appropriate yardsticks fixed to decide whether it is worthwhile undertaking their construction.

In this region percolation tanks have proved of some benefit in so far as they increase sub-soil water. Contour bunding has also been undertaken in this area to a fair extent which has proved beneficial in increasing the sub-soil water, as well as for conserving moisture for non-irrigated crops.

(4) The rainfall in this area is assured and comparatively heavy. The soil is deep black along the banks of the various rivers. The predominant crop is paddy. The present irrigation works consist mainly of small *ex*-Malguzari tanks which provide water for the

paddy crop during long breaks, if any, and at the end of a monsoon.

(5) The soils in this area are deep and heavy. The predominant crops are cotton, jowar and oil-seeds. The average rainfall varies from 25" to 40" and is not subject to wide fluctuations. The land is generally level. Construction is difficult on account of deep soil and low water table.

(6) The rainfall in this area varies from 25" to 30". The lands are undulating and are mostly light or medium. Non-irrigated crops are jowar, bajri and oil-seeds. The soil is generally well drained and suitable for irrigation. The region adjoins the Ghat area which is suitable for constructing large reservoirs. This region is, therefore, suitably located for irrigation for major irrigation works.

It is often urged that a particular class or classes of irrigation works should be given priority over other classes, generally or in particular areas. As a general proposition, it is often argued that preference should be given to medium and minor irrigation works over major irrigation works for reasons which are obvious in the context of phased development. Generally speaking major irrigation works take a long time to execute and, therefore, do not yield results as quickly as minor or medium irrigation works would do. Also, it is argued that the benefits of minor irrigation works can be widely distributed whereas those of major irrigation are concentrated.

1.1. *Do you consider that a particular class or classes of irrigation works should be preferred over other classes in any of the six regions described above? If so, state reasons and describe the particular pattern you have in mind for developing irrigation in a particular region.*

1.2. *Should the scarcity-affected areas of the State receive priority in the matter of creation of irrigation facilities? If so, to what extent?*

1.3 *If the reply to question No. 1.2 is in the affirmative, would you recommend relaxation of the standards of financial return on and/or financial yardstick of cost per acre of irrigation schemes in such areas and if so, to what extent?*

1.4. *Should scarcity tracts in region No. 3 be served by major irrigation works or by minor works?*

If by both, to what extent by each respectively and in what specific circumstances?

1.5. *To what extent and in what circumstances it would be preferable to concentrate ameliorative measures on other improvements such as contour bunding, development of small industries, etc.?*

1.6. *Should parts of regions, 1, 2, 4, 5 and 6 which are at present undeveloped or underdeveloped in the matter of irrigation facilities, receive priority over others?*

1.7. *Should scheduled areas inhabited principally by Adiwasis be given special consideration and if so, in what manner?*

1.8. *Do you specially recommend any one or more of the following types of irrigation schemes for any of the regions described above and if so, why?*

(*a*) Large storage reservoirs with assured replenishment (major irrigation schemes).

(*b*) Tanks with fairly dependable replenishment and substantial irrigable commands (medium irrigation schemes).

(*c*) Weirs on rivers with substantial irrigable commands (medium irrigation schemes).

(*d*) Tanks with small commands (minor irrigation schemes).

(*e*) Bandharas on streams having small commands (minor irrigation schemes).

(*f*) Lift irrigation schemes on naturally flowing water
(i) Government operated,
(ii) Co-operatively operated.

(*g*) Improvement and/or renovation of works under (*d*) and (*e*).

(*h*) Drainage (irrigation) water-*cum*-lift irrigation schemes.

(*i*) Sewage and sullage-*cum*-lift irrigation schemes.

(*j*) Lifts on canals in uncommanded areas.

(*k*) Tube wells.

(*l*) Bore wells.

(*m*) Open wells.

(*n*) Improvement and/or renovation of open wells.

(*o*) Power lift on open wells.

(*p*) Use of river and tank beds after recession of water level (Galper-lands).

(*q*) Tail waters of hydel stations.

(*r*) Percolation tanks.

1.9. *Apart from irrigation works to be financed and carried out by Government, is it necessary to promote the undertaking of any one or more of the types of irrigation schemes mentioned in question No. 1.8 by local communities as well as individual farmers?*

1.10. *Have you any suggestions to make regarding how encouragement and promotion to such undertakings may be organised?*

1.11. *In particular have you any recommendations to make regarding helping and encouraging individual landholders to construct new wells or repair old wells in their farm? Have you any views regarding programmes already under implementation in this behalf in the State and in what way they may be altered, modified or amplified?*

1.12. *There is a possibility that, if too large a number of wells is concentrated in a particular area, their yields would suffer and the water table recede. How would you pre-*

vent this happening? Have you any suggestions to make, regarding recharging the sub-soil water table?

1.13. *Have you any suggestions to make to avoid wasteful and infructuous well digging by private farmers with the help of well-subsidy or grant?*

Having regard to the limited water resources available, it has been advocated that a system of compulsory lifts during a part of the year should be enforced for perennial crops in the commands of major irrigation works. Illustratively it has been suggested that such compulsory lift should be enforced during the period from middle of October to middle of April next. Apart from stretching out the available resources of stored water, it is claimed that such an arrangement would eliminate the need to construct drainage works or at least reduce the danger of water-logging.

1.14. *Would you recommend adoption of a system of "compulsory lift" in irrigation commands and if so, for what reasons?*

1.15. *Can you cite any supporting data or state the general experience of irrigators to substantiate the claim that lift irrigation from wells in the irrigable command would eliminate or reduce the danger of water-logging?*

1.16. *Would you advocate the system of "compulsory lift" in respect of only new irrigation works whose commands will hereafter be commissioned or would you advocate such a system for existing irrigation works as well? In the latter case, what further measures would be necessary to change over to this system in already developed irrigation commands?*

1.17. *Have you any particular suggestions to make as to the details of organising lift, etc., under such a system of "compulsory lift" in irrigation commands?*

1.18. *Do you consider it feasible to en-*

courage and extend the use of drainage (irrigation) water by pumping? Is it generally suitable for irrigation?

1.19. *Should maximum limits of capital cost per irrigable acre be fixed for each type of irrigation works mentioned in question No. 1.8? If so, what should be these maxima?*

1.20. *Should the maxima vary from area to area? If so, give the maxima you consider as reasonable for each area.*

1.21. *What relaxations in the maxima should be made in backward tracts, scheduled areas, scarcity areas, etc.?*

1.22. *How far has power pumping replaced the use of animals for lifting water from open wells? Should this trend be encouraged and if so, in what manner and to what extent? To what extent would the economics of power pumping alter if electric power is made available to replace diesel engines?*

1.23. *Having regard to the limits of flow irrigation possibilities in Maharashtra, do you advise special measures for promoting lift irrigation and if so, please state what measures you would recommend?*

Irrigation revenue derived from an irrigation work depends on the crops to which water is supplied, assuming that the rates are generally relatable to the estimated average net profit derived by the cultivator from each crop.

1.24. *In the planning of irrigation works, should the approach be to allow those crops to be grown which are estimated to leave the largest net profit to the irrigator and would give the maximum irrigation revenue to Government? If not, what, in your opi-*

nion, should be the objective in view and why? If you consider that the cropping pattern should be the outcome of a via media *between the policy of maximum revenue and maximum output of food-crops, please state in what proportions, in particular commands or generally, the available watersupply should be utilised for the growing of (i) cash crops, e.g., sugar-cane, bananas, vegetables, cotton, tobacco, oil-seeds, etc., (ii) food-crops, e.g., paddy, wheat, jowar, bajri and pulses, and (iii) fodder and green manuring crops?*

(*N.B.*—In recommending particular *crop* patterns, if you have any reliable data as to the costs and profits of irrigated cultivation, kindly quote it).

The present policy is to undertake only those major irrigation schemes in which the replenishment of the reservoir is certain in three out of every four years, i.e., where the dependability is 75 per cent. It is sometimes urged that there should be no objection to planning further storages in existing schemes or taking up new schemes with a view to making a fuller use of the available water resources for irrigation, even at the risk of non-supply in certain years. Under such storages, a larger proportion of less revenue yielding seasonal crops, to which water supply can be stopped when it becomes necessary to do so, will have to be planned.

1.25. *Do you support this view? If so, up to what lower limit of dependability should schemes be considered?*

1.26. *Reservoirs are built to store the "dependable supply" whatever percentage of dependability is fixed for planning the storage. The result is that in years of copious rainfall, some water flows over waste weirs during and immediately after the monsoon season and is lost to irrigation. It is frequently suggested that this water* *during such periods should be put through the distribution system and made available for irrigation if needed. Would it be feasible and advisable to use this surplus flow for irrigation? If so, in what manner?*

1.27. *Do you consider that the maximum possible coverage is achieved by the irrigation facilities that are available today? If not, state the estimated extent of non-utilisation, mentioning areas and sources of irrigation with reference to which the extent is stated.*

II. Financial aspect of irrigation works.

Normal financial scrutiny requires that Government irrigation works should be self-supporting, i.e., the (i) capital and (ii) recurring costs incurred on it should be paid back to the State by the beneficiaries, especially in Maharashtra where the existing irrigation facilities are restricted to 5 per cent. of the cultivable land and the scope for extending them is also severely limited, being estimated at no more than 20 per cent. of the land in most river basins. It is obvious that those who are so placed as to enjoy the benefits of irrigation must at any rate not be subsidised at the expense of the general tax payer and must at least fully bear all costs of irrigation. Recurring costs can be further subdivided into (a) maintenance charges, *i.e.*, the cost of maintenance staff and annual repairs and (b) interest and depreciation charges. For the recoupment of the capital cost Government has already enacted legal provision for the charging of a "betterment levy" in all new irrigation projects. For the recovery of the maintenance charges an "irrigation cess" is leviable in respect of "land under irrigable command of a canal" (*vide* Section 56-C, Bombay Irrigation Act, 1879). For covering interest and depreciation charges a "water rate" variable according to crops actually grown is being recovered. A number of questions pertaining to principles and practice arise with regard to the assessment and recovery of betterment levy, irrigation cess and water rates which are listed below.

Betterment Levy

The Betterment Levy seeks to appropriate to the public fisc a part of the financial advantage gained by the holder of land by reason of it being placed within command of an irrigation work carried out by expenditure of public funds. The advantage that the land-holder gains could be expressed either in terms of the increased productivity of his land or the reflection thereof in a capital appreciation of the value of his land on getting the facility of irrigation. From a practical point of view, however, it might make a great deal of difference as to which of these two criteria is adopted for fixing the Betterment Levy. It would appear in this connection that the criterion of capital appreciation of land has obvious limitations in the present circumstances when due to tenancy and other laws, there is virtually no "free market" for agricultural lands.

The question of Betterment Levy is also connected with the question of "localisation" of crop pattern of an irrigation project in its command (please *see* note under IV. *Irrigation Management*). As the Betterment Levy would differ according to the crop for which water is given to a particular holding, the Levy would have to vary from year to year depending on the option available to the irrigator for growing a particular crop on a particular piece of land, under the system of "localisation" adopted.

2.1. *Should the betterment levy be so fixed as to recover the entire capital cost incurred on a project or only a portion of it ? If you favour the latter, on what grounds would you justify it ?*

2.2. *What should be the practical basis for assessment of the betterment levy ?*

The two bases possible are (i) a levy on the capital appreciation in the value of land benefiting by the project phased into instalments over a number of years for ease of payment and (ii) a charge on the annual increase in the net profit derivable by the cultivator on account of irrigation facilities provided by the project. Which one of these two, or any other basis, do you recommend as being equitable and workable ?

2.3. *If under any of the bases you recommend the betterment levy is proposed to be assessed on the basic productivity of each piece of land, what should be the method of determining the basic productivity?*

2.4. *Presumably betterment levy should be recovered in instalments over a period of years. If so, what should the period be? Would you favour recovery of the betterment levy compulsorily/optionally in kind,* i.e., *by the holder benefiting by irrigation surrendering a part of his land to the Government? If so, please state how you would organise such arrangement.*

When should the first instalment become due for payment immediately on starting of irrigation or after allowing a short period to elapse within which the full benefits of irrigation will have accrued to the cultivators?

2.5. *Should an irrigation project be undertaken only if a majority (say ⅔rds or ¾ths) of the cultivators concerned give a prior undertaking that they will pay the betterment levy as estimated on the basis of estimates of cost, on completion of the project?*

Irrigation Cess.

2.6. *Should irrigation cess be levied on all land under irrigable command, whether it is actually irrigated or not in a particular year, as the price of the service of "insurance" rendered to all such land? Or should it be levied only on land actually irrigated,* i.e., *virtually as a surcharge on the irrigation rate?*

2.7. *Should the cess be charged at a uniform rate for all lands under a project to which the cess is chargeable or should the rate vary according to the crops grown on each piece of land?*

2.8. *Should the irrigation cess be charged at a uniform rate throughout all the irrigated areas of the State* *by pooling the maintenance charges or should the rate vary for each class and type of irrigation work or for each work ?*

2.9. *If the irrigation cess is based* inter alia *on the principle of providing insurance against the vagaries of the monsoon, should its level be pitched at the water rate for the normal staple food-crop of the area and should waterings be given to it without any additional charge, if and when one or more waterings become necessary ?*

Water Rates.

2.10. *At what rate should interest be calculated on the capital cost of an irrigation work ? Should it be equivalent to the market borrowing rate at the time of sanctioning of a scheme ? Do you recommend an element of subsidy in interest charges in respect of any specific categories of works ? If so, in which and to what extent ?*

2.11. *Should water rates be fixed (i) on the volumetric basis,* i.e., *the volume of water used and the cost per unit of water on an irrigation work or (ii) on the crop rate system,* i.e., *according to the estimated average profit derived from each crop by the cultivator ? If you favour a combination of both the criteria, please state the weights to be given to each of the two factors in the combination.*

2.12. *If you favour the fixing of water rates according to the volume of water used, do you recommend measurement of the water supplied ? If so, suggest the administrative and technical measures to be adopted for correct measurement. If not, would you consider the average water requirements of* *each crop as sufficiently indicative of the volume of water supplied? If you consider measurement of water supplied to each individual irrigator as impracticable, would you recommend measurement of the discharge on each distributary and charging the cost of the water to the irrigators on the distributary as a group, leaving the distribution of the charge between themselves to be decided by them co-operatively? If so, would you recommend any monetary incentives to tempt irrigators to form groups for taking water on volumetric basis?*

2.13. *If you favour a "crop rate" system, for what period should the rates be fixed? What should be the basis for periodical review?*

2.14. *Should the rates vary by types of users,* e.g., *private sugar factories, co-operative sugar factories, other industrial establishments requiring water for growing crops, co-operative farming societies, etc.? If so, why and what should be the amount of surcharge levied or concession given to each type?*

2.15. *What should be the principles for fixing charges for water supplied for industrial or domestic use from an irrigation work?*

2.16. *What part of the capital cost should be recovered from industrial or domestic users? Suggest how this may be done.*

Casual irrigation (i.e., *one or two waterings for a crop normally dependant on rainfall) can be permitted only to the extent firm commitments do not exhaust available supplies in a particular year.*

2.17. *Where casual irrigation is possible* *how should it be organised, on what conditions should it be permitted and what charges levied for it?*

2.18. *Irrespective of the basis adopted for fixing water rates, should certain types of consumers or certain uses be subsidised by way of charging lower than normal rates,* e.g., *small holders or cultivators belonging to categories distinguishable under the Constitution, or for water used for green manuring crops or for creating fuel reserves? If so, what should be the extent of the concession?*

2.19. *Would the system of charging a consolidated water rate* (i.e., *a rate combining irrigation cess and water rate*) *be more appropriate on some class or type of irrigation work? If so, specify the class or type to which the system should be made applicable.*

2.20. *While requiring that the beneficiaries of irrigation works executed at public expense* (*other than perhaps those carried out as famine protection works and treated as "Unproductive"*) *should pay back to the public fisc the full capital and recurring expense incurred on their account, would you suggest that the balance-sheet in this regard be cast—*

(1) (*a*) *separately for each major irrigation work,*

and

(*b*) *collectively for smaller works grouped into regions,*

or

(2) *for all the works in the entire State together? If you do not agree with either alternative, what other division would you propose in this behalf?*

III. Execution of irrigation projects

3.1. *Are any changes required in the administrative and technical procedures laid down for sanctioning of projects with a view to achieving greater accuracy in planning and estimating?*

3.2. *Do you consider that the present set-up for execution of new irrigation projects requires any reorganisation to achieve speedier and more economical execution? If so, state the nature of the reorganisation you propose.*

3.3. *What steps or changes in rules and/or procedures do you suggest for expediting the acquisition of land for construction of irrigation works?*

3.4. *Certain field works are often not done in time with the result that irrigation water, although available at the distributary head, cannot be made use of. Please state whether the following field works should be initially executed by Government and the cost thereof recovered subsequently from the beneficiaries concerned or in the alternative suggest other agencies, if any:—*

(i) construction of field channels,

(ii) levelling of fields,

(iii) construction of field bunds.

If you favour the latter, please state the nature of the agency you propose for the purpose.

3.5. *Should land required for the construction of field channels be acquired and the cost of acquisition recovered from the beneficiaries?*

3.6. *What steps are necessary for securing the unitisation and division of* *land into suitable sized plots, before starting irrigation ?*

3.7. *In view of the dispersed nature of the works and insufficiency of technical staff even for the construction of major works, would you suggest the entrusting of construction of minor works of bandharas, tanks and percolation tanks to some local agency ? If so, what should be that agency ? What should be the basis for its remuneration ? How should its work be administratively and technically supervised ?*

3.8. *In what manner should the cultivators, whose lands get submerged or are otherwise taken over for the construction of an irrigation work, be rehabilitated ?*

3.9. *Have you any other measure to suggest to lessen the discontent amongst the cultivators whose lands are required to be taken over ?*

IV. Irrigation Management

At present the crops and the areas of each crop for which irrigation water is supplied are determined on the basis of the availability of water in each irrigation working in the different seasons, the cost of distribution works relevantly to the discharges planned the need to minimise transmission losses, the desirability of preventing the deterioration of the soil or water-logging, keeping in view a general preference for utilising water for producing foodgrain crops.

On a consideration of these factors a crop pattern for an irrigation command is drawn up. Within the crop pattern of the whole command, the desired distribution of crops on different distributary commands is settled, *e.g.*, *rabi* crops, two-seasonal crops, hot-weather crops, perennials, *etc.* This may be called the "crop pattern for the distributary command". Within the crops prescribed for the crop pattern of the distributary command, there is freedom to the irrigator to apply for water for such crop as he may choose. The resulting scheme of crop-planning and options available to the individual farm are called 'localisation'.

Such 'localisation' has now been achieved historically under the old irrigation projects in the Deccan wherein the available water supply is now almost fully booked. Both the present distribution of crops and the crop pattern which now obtains are in many respects different from the distribution and the crop pattern originally envisaged for these works respectively. While some subsequent variation in crop pattern is recognised as inevitable, unless these is some fixity about the crop distribution in the command of the canal the canal distribution system of the project cannot be planned. On the new irrigation commands to be commissioned hereafter, there has to be an accepted crop pattern and crop distribution within the frame-work of which 'localisation' on individual fields will be settled.

4.1. *Are there any hindrances to adopting the cropping pattern desired by the irrigator on account of the basis for fixing the scale of water rates or on account of any of the existing rules and practices with regard to irrigation management such as dates of commencement and termination of the different irrigation seasons, period of rotation, prescription of crops allowed to be irrigated,* etc. ?

4.2. *Have you any suggestions to make regarding the crop patterns on these projects generally or specifically ? Have you any suggestions to make regarding crop distribution on the distributaries within the crop pattern ?*

Usually, in the commands of major irrigation works in the ex-Bombay areas "blocks" or 6-year contracts are settled between the irrigator and Government.

In Vidarbha, where irrigation works have mostly been for paddy cultivation, in the past, the entire village area in the command is brought under Agreement (for paddy cultivation) if the owners of 75 per cent. of the lands or 95 per cent. of the owners agree to irrigation under Agreements. Such Agreements are normally for 10 years.

In Marathwada, after soil survey of the command, areas suitable for different crops mentioned in the crop pattern of a project are settled: this is called 'localisation'. 'Localisation' covers the entire area under potential irrigable command. According to the localisation consolidated tax (land revenue *plus* water rates) is fixed for the localised areas and is recovered irrespective of whether water is actually taken or not.

4.3. (1) *Have you any suggestions to make regarding—*

(*a*) The option or options available to the irrigator in respect of choice of crops under the different systems;

(*b*) The period of contract that he is required to enter into;

(*c*) Any other particulars relating to the existing terms and conditions of those contracts?

Please give full supporting reasons where any change is recommended.

(2) *Would you advocate a uniform system in all areas for all types of irrigation projects? If not, what should be the different systems to be adopted in different areas for different projects.*

4.4. *Are any modifications necessary with regard to the following irrigation procedures? If so, please state the modifications you recommend and also the difficulties experienced with the existing procedure proposed to be modified and the advantages to be gained by the modification.*

(i) Receipt of water applications.

(ii) Sanctioning of water applications.

(iii) Detection of improper use of water.

(iv) Steps taken against imporper use.

(v) Disposal of general complaints of irrigators.

4.5. *Have you any modifications to suggest in the terms of the existing water contracts?*

4.6. *Have you any suggestions to make for simplification of any of the present procedures, without modifying their content?*

4.7. *Have you any modifications to suggest in the practices at present adopted in water distribution, which will result in greater con-*

venience to irrigators?

4.8. *Wouldit be conductive to efficiency and economy if irrigation management is decentralised by entrusting all or any of the following items of work to local bodies or authorities:—*

(i) Maintenance and repairs of headworks.

(ii) Maintenance and repairs of canals.

(iii) Maintenance and repairs of distributaries.

(iv) Maintenance and repairs of field channels.

(v) Maintenance and repairs of minor irrigation works of tanks and bandharas.

(vi) Allocation of water.

(vii) Distribution of water.

4.9. *If your reply to question No. 4.8 is in the affirmative, please state to which existing body or authority, the task may be assigned. If you suggest that a new body be organised or authority created, please describe the one you have in view. If you are suggesting a co-operative organisation of irrigators, please state in detail its functions and mode of working.*

4.10. *If in your reply to question No. 4.9 you suggest a non-official elected body, please state the degree of control and supervision which should be exercised by the irrigation officers over the working of such bodies.*

4.11. *What measures would you suggest for preventing water-logging?*

4.12. *Should water-logged areas be reclaimed at Government cost? Should the whole or part of the cost be recovered from the landowners?*

4.13. *Have you any suggestion to make*

for speedier execution of drainage works?

4.14. *Should the land-owners be compelled to take measures for preventing water-logging?*

4.15. *Do you suggest any changes in the present irrigation seasons? If so, state the changes you propose and reasons therefor.*

4.16. *Need the seasons be necessarily uniform for all classes or types of irrigation works? If not, should they be fixed for each class of work according to the dates of availability of water, the crops grown,* etc.?

4.17. *Would you recommend the fixing of irrigation seasons uniformly for all crops of that season irrespective of slight differences in the periods of growth? If so, what should be the basis for water charges for giving one or more irrigations during the succeeding irrigation season? If not, do you recommend the fixing of crop rates,* i.e., *a charge per acre for supplying enough irrigations for bringing a particular crop to maturity?*

At present water is let out into distributaries at specified intervals (termed rotation), *e.g.*, ten days, with the result that a crop gets water once every ten, twenty or thirty days. The optimum intervals for particular crops may differ from the intervals possible under a particular rotation.

4.18. *Can you suggest any changes in the present rotation system with a view to achieving the optimum conditions as regards intervals of watering of the different crops?*

4.19. *What are the main causes hindering full utilisation of existing irrigation resources?*

4.20. *To what extent, is it possible to save irrigation water by lessening the quantities of water applied per* *acre, without detrimental effect on yields?*

4.21. *What are the reasons for (i) the excessive use of water and (ii) wastage of water? If any of the management practises, whether on the part of the irrigation officers or the irrigators themselves, are responsible for excessive use or wastage, please state the practices in question and the manner in which they can be altered.*

V. Agricultural Production

5.1. *What is the extent of increase in yield and in gross income per acre due to irrigation? Please support your statements by giving verified or verifiable data. If, however, your reply is based only on the general impressions of cultivators, state the crops and areas in respect of which the comparative yields and incomes are stated.*

5.2. *To what extent and in what manner is the cropping pattern likely to be or should be altered when irrigation facilities are made available? Please reply with reference to specific areas and specific crops.*

5.3. *To what extent is the fullest exploitation of potential benefits of irrigation hampered due to lack of adequate facilities in respect of the following:—*

(*i*) Agricultural Credit.

(*ii*) Roads.

(*iii*) Markets and marketing organisation.

(*iv*) Warehousing.

Please illustrate your reply by reference to concrete situations in existing or prospective irrigated areas.

5.4. *Is the mere lack of desire to*

improve one's own economic position responsible anywhere for a lukewarm reception to the irrigation facilities created? If so, specify the area or the irrigation work and describe the the socio-economic condition of the people concerned.

5.5. *Are the present tenancy laws conducive or otherwise to the fuller utilisation of irrigation facilities? If not, state the changes you would recommend?*

5.6. *Do any of the following hamper fuller utilisation of irrigation facilities:—*

(*i*) Smallness of holdings.

(*ii*) Fragmentation of holdings.

(*iii*) Quantity and quality of agricultural labour.

If so, state the measures which should be taken to facilitate fuller utilisation.

5.7. *Is the fullest exploitation of irrigation facilities hampered anywhere due to lack of knowledge of the practices of irrigated farming or of improvements therein? If so, what steps should, in your opinion, be taken for the expansion and/or reorganisation of the agricultural extension organisation?*

5.8. *Is the supply of agricultural requisites such as improved seeds, manures, fertilizers, insecticides, pesticides,* etc., *adequate in the irrigated area? If not, what steps should be taken to improve the situation?*

5.9. *Is the agricultural research organisation adequate to investigate and solve the problems connected with irrigated crops? If not, in what manner should the organisation be expanded or streamlined?*

5.10. *To what extent can subsidiary,*

ancillary and processing industries of the kind mentioned below be started in the irrigated areas in the different regions of the State? Please specify the areas.

(*i*) Milk production.
(*ii*) Poultry and eggs.
(*iii*) Cattle-breeding.
(*iv*) Fruit preservation.
(*v*) Sugar manufacture.
(*vi*) Paper from bagasse, banana stalks, etc.

To what extent will the setting up of such industries help (*i*) *to bring prosperity to the irrigated areas and* (*ii*) *to bring about a fuller and more profitable use of irrigation water? Please specify the manner in which you recommend the setting up of such units, the type of industrial organisation you would advocate, the possibilities of tapping local equity capital, and also state the steps which must be taken to facilitate and promote such development.*

5.11. *To what extent can irrigation help in afforestation and solving the problem of fuel supply? What steps can be taken to utilise the canal boundary lands for afforestation?*

5.12. *Would you suggest the setting up of an organisation for facilitating an integrated approach to the problem of development of irrigated areas? If so, what should be the nature of such an organisation at the different levels,* viz., *the village and the commanded area of a project. Should the functions of such an organisation be supervisory, advisory or executive?*

5.13. *Should the work of ancillary and complementary development in respect of agriculture, industry,* *co-operation, communications,* etc., *be planned and commenced simultaneously with the work in the engineering sector ? If so, what kind of administrative and technical organisation would be needed at the planning stage of irrigation projects ?*

APPENDIX C

List of persons who sent replies to the questionnaire

(A) Officers and Associations having jurisdiction over the entire Maharashtra State.

1. The Director of Agriculture, Poona.
2. The Registrar of Co-operative Societies, Poona.
3. The Additional Industries Commissioner, Bombay.
4. The Superintending Engineer (R. & B.), Central Designs Organisation, Bombay.
5. The Superintending Engineer (Hydro), Central Designs Organisation, Bombay.
6. The Superintending Engineer, Water Resources Investigation Circle, Poona.
7. The Deccan Agricultural Association, Poona.
8. The Deccan Sugar Technologists' Association, Poona.

(B) Officers having jurisdiction over administrative divisions.

BOMBAY DIVISION

9. The Superintending Engineer, Deccan Irrigation Circle III.

POONA DIVISION

10. The Superintending Engineer, Central Circle (R. & B.), Poona.
11. The Superintending Engineer, Western Public Health Circle, Poona.
12. The Superintending Engineer, Deccan Irrigation Circle I.

AURANGABAD DIVISION

13. The Executive Engineer, Marathwada Minor Irrigation Division, Aurangabad.
14. The Executive Engineer, Marathwada Irrigation Projects Construction Division, Aurangabad.
15. The Executive Engineer, Canal Designs Division, Aurangabad.
16. The Superintending Agricultural Officer, Aurangabad.
17. The Principal, Agricultural College, Parbhani.

NAGPUR DIVISION

18. The Superintending Engineer, Akola Irrigation Circle, Akola.
19. The Executive Engineer, Public Health Project Division, Nagpur.
20. The Superintending Engineer, Nagpur Irrigation Circle, Nagpur.
21. The Superintending Agricultural Officer, Nagpur.

(*C*) *Officers and Associations whose jurisdiction does not extend beyond the district and other persons from each district in the State.*

BOMBAY DIVISION

Greater Bombay.

22. Shri B. Y. Pendse, 316 E Hemrajwadi, Thakurdwar, Bombay-2.
23. Shri B. R. Rane, 430, Katrak Road, Bombay-31.
24. Shri S. K. Athley, 304/3, Laxmi Building, Thakurdwar Naka, Bombay-2.
25. Shri B. V. Tambe, Tambe Private Ltd., Sanzgiri Sadan, 171, Girgaon Road, Bombay-4.
26. M/s. Voltas Limited, Bombay.

Thana District.

27. Shri Jagannath Rao Deolikar, Sarpanch of Paya, taluka Bhiwandi.
28. Shri P. S. Deshmukh, Vice-Chairman, District Development Board, Thana.

Kolaba District.

29. Shri G. R. Deshmukh, President, Karjat Taluka Congress Committee, Karjat.

Ratnagiri District.

30. The Collector of Ratnagiri.
31. The Executive Engineer, Ratnagiri Division, Ratnagiri.
32. The Prant Officer, Dapoli.
33. The Mamlatdar, Deorukh.
34. The Mamlatdar, Guhagar.
35. The Mamlatdar, Malwan.
36. The Mamlatdar, Deogad.
37. Shri R. M. Phadke, Rajapur.
38. Shri R. V. Virkar, Vir, Taluka Chiplun.
39. Shri R. G. Nimkar, Asore (*via* Saitaware).

Nasik District.

40. The District Deputy Registrar of Co-operative Societies, Nasik.
41. Shri M. D. Pol, Assistant Research Officer, Maharashtra Engineering Research Institute, Nasik.
42. The Girna Sahakari Sakhar Karkhana, Malegaon, District Nasik.
43. Shri Suklal Narayan Sharma, Talwade, Taluka Malegaon.
44. Shri M. S. Somvanshi, Mohadi, Taluka Nasik.
45. Shri D. S. Potnis, 797, Raviwarpeth, Nasik City.
46. Shri Chintaman Santuji Patil, 4483/84, Khandve Sadan, Puria Road, Panchwati, Nasik.
47. Shri H. P. Sanap, Shiv Smriti, Sundar Narayan, Nasik City.
48. The Director, Bharat Sevak Samaj, Nasik District, Nasik.
49. Shri N. G. Oke, Nasik.
50. Dr. V. R. Gosavi, 37, Main Road, Nasik.
51. Shri Sevkisan Sarda, Sinnar.
52. Shri Laxman Vithal Patil, Sonwani, Post Satana.

53. Shri Nagnath Bhima Shankar Mahname, Peint.
54. Shri Raghunath Barku Iper, Kasari, Taluka Nandgaon.
55. The President, Shetkari Sahakari Sangh, Limited, Kalvan.
56. Gram Panchayat, Deola, Taluka Kalvan.
57. Shri N. G. Patil, Jambutake, Taluka Dindori.
58. Shri D. R. Kulkarni, Nagarsul, District Nasik.

Dhulia District.

59. The Mamlatdar of Nandurbar.
60. The Mamlatdar of Taloda.
61. The Mamlatdar of Sakri.
62. Shri K. S. Deore, Vice-Chairman, N. E. S. Block, Sakri.
63. Shri M. K. Sisodia, Chairman, Takerkheda Co-operative Lift Irrigation Society.
64. Shri G. S. Badgiyar, Pleader, 8th Lane, Old Town, Dhulia.
65. The Chairman, Fes Co-operative Lift Irrigation Society, Limited.
66. Shri Nathu Algi Patil, Chichked, Post Ner, Taluka Sakri.
67. The Chairman, Nawari Co-operative Collective Farming Society, Ltd.
68. Shri Nanasaheb Vishwasrao Deore, Chairman, Lift Irrigation Society, Deur (Bk.).

Jalgaon District.

69. The Collector of Jalgaon.
70. The District Deputy Registrar of Co-operative Societies, Jalgaon.
71. Shri J. S. Patil, Vice-Chairman, District Development Board, Jalgaon.
72. Shri Damu Khushal Patil, Kurhekhurd, Post Sarbete, Taluka Jalgaon.
73. Shri Ramdas Nimbe Bendale, Sawda.
74. Shri O. P. Patil, Tube Well Co-operative Irrigation Society, Rajore, Taluka Yaval.
75. Shri Vasudeo Laxman Zambre, Bamnod, Taluka Yaval.
76. Shri Motiram Nathu Patil, Hatle, Taluka Chalisgaon.
77. Shri Ramrao Dagdu Patil, Umbarkhede, Taluka Chalisgaon.
78. Shri Vishwanath Sonaji Patil, Hingane (Bk.), Post Kadgaon.
79. Shri Haribhau Dagdu Jaware, Chairman, Bodwad Co-operative Supervising Union Limited, Shelwad, Taluka Bhusaval.
80. Shri Ashok D. Phadke, Vadoda.
81. Shri Shrikrishna Shantiram Vaidya, Vaidya Lane, Amalner.
82. Shri Namdeo Godha, Police Patil, Bharwasu, Taluka Amalner.
83. Shri Shivram Nagmahajan Bagaitdar, Adgaon, Taluka Erandole.
84. Shri D. S. Patil, Block Development Officer, Erandole.
85. Shri Madhukar Nilkanth Sane, Shendurni.
86. The Chairman, Shetkari Sahakari Sangh, Limited, Chalisgaon.

Poona Division

Ahmednagar District.

87. Shri Bhaskarrao Durve, Secretary, District Praja Socialist Party and Member, District Vikas Mandal, Sangamner.
88. Shri B. S. Thorat, Chairman, Sangamner Shetki Sahakari Sangh, Limited, Sangamner.
89. The Chairman, Rahuri Sahakari Sakhar Karkhana, Limited, Shri Shivaji Nagar, Rahuri.
90. Shri G. C. Palekar, Tilaknagar, Taluka Ahmednagar.
91. Shri Nivriti Narayan Bankar, Patil, Padegaon, Taluka Shrirampur.
92. Shri Ramchandra Baliram Maharaj, Shrirampur.
93. Shri Janardan Keshavrao Kapse, Takali Bhan, Taluka Shrirampur.
94. Shri S. B. Labade, Bhatodi, Taluka Ahmednagar.
95. Dr. B. S. Deswandikar, Ashvi.
96. Shri Raghunath Rao Dandekar, Napte, Taluka Ahmednagar.
97. Shri D. H. Nagarkar, Napte, Taluka Ahmednagar.
98. Shri Ramchandra Shankar Neurgaonkar, Farm Manager, Changdeo Sugar Mills, Ltd., Changdeo Nagar.
99. The Maharashtra Sugar Mills, Ltd., Tilak Nagar.
100. Shri Dagdu Ghanashyam Borkar, Nevasa Budruk, Taluka Nevasa.
101. Shri B. G. Chougule, Bel-Pimpalgaon, Taluka Nevasa.
102. Shri B. S. Deochake, Nevasa.
103. Shri Pandharinath Jijaba Ambre, Patil, Ganore, Taluka Akola.
104. Shri Somaji Deoji Jokhar, AKola.
105. Shri Appa Saheb Shankarrao Dhanawate, Puntambe, Taluka Kopargaon.

Poona District.

106. The Executive Engineer, Irrigation Projects Division (Central), Poona.
107. The Executive Engineer, Khadakwasla Canal Division No. I, Poona.
108. Shri S. M. Upalekar, Managing Director. Poona District Co-operative Purchase and Sale Union, Ltd., Poona.
109. Shri S. N. Ranade, 540, Shanwar Peth, Poona-2.
110. Shri P. N. Soman, Walchandnagar.
111. Shri Ramchandra Sadashiv Panse, Shivaji Nagar, 1103-A/15, Poona-5.
112. Shri S. R. Sathe, Tilak Sanshodhan Mandir, 418, Narayan Peth, Poona-2.
113. Shri B. R. Borawake, Raghav Niwas, Poona-5.
114. Shri N. G. Apte, 754, Shukrawar, Poona-2.
115. Shri N. K. Dabdage, Karanje Bungalow, Hol Athafata, Taluka Baramati.

116. Shri G. A. Avate and Shri M. G. Joshi, Indapur (Jointly).
117. Shri G. B. Bapat, Poona.
118. Shri Krishnaji Yeshwant Ranasing, Nimsakhar, Taluka Indapur.
119. Shri G. S. Shete, Poona.
120. The Chairman, Shri Hanuman Hatvalan Sahakari Pani Purvatha Mandali, Limited, Hatvalan, Post Nandgaon, Taluka Dhond.
121. The Chairman, Shri Nandaji Sahakari Pani Purvatha Mandali, Ltd., Saswad.

Satara District.

122. Shri S. P. Ambike, Vadus, Taluka Khatav.
123. Shri Bhausaheb Pawar, Chilti, Taluka Khatav.
124. Shri Chintaman Raghunath Kulkarni, Borkhal, Mahuli, Taluka Satara.
125. The Deputy Registrar of Co-operative Societies, Satara.
126. Shri T. A. Jadhav, Pusegaon, Taluka Satara.
127. Shri Vyankat Mugutrao Shinde, Ranand, Taluka Man.
128. Shri R. S. Dani, Phaltan.

Sangli District.

129. Shri Swami Ramanand Bharati, Vice-Chairman, District Development Board, Sangli.
130. Shri Hari Gopal Patwardhan, Miraj.
131. Shri M. S. Virole, President, Miraj Taluka Congress Committee, Miraj.
132. Shri Narsinha Mahadeo Watve, Miraj.
133. Shri G. B. Honrao, Dighanchi, Taluka Sangli.

Sholapur District.

134. Shri D. G. Kulkarni, Dongaon, Taluka North Sholapur.
135. Shri G. A. Dev, Malshiras.
136. The Secretary, Malshiras Taluka Seva Mandal, Chitalenagar.
137. Shri B. A. *alias* Baban Badve, Pandharpur.
138. Shri R. V. Gurjar, Pandharpur.

Kolhapur District.

139. Shri B. S. Mirje, Pathan Kodoki.
140. The Secretary, Publuj-Porle Kasari Nadi Sahakari Dharan Society, Ltd., Yauluz, Taluka Panhala.
141. The daily "Pudhari", Kolhapur.
142. Shri B. M. Hajarnis, Cane Development Officer, Kolhapur Sugar Mill, Ltd.
143. The Executive Engineer, Kolhapur Irrigation Division, Kolhapur.
144. The Managing Director, Bhogawati Sahakari Sakhar Karkhana, Ltd., Shahu Nagar, Post Parile, Taluka Karwir.

Aurangabad Division

Aurangabad District.

145. Shri Ramchandra Patil, Nagadkar, Chairman, Aurangabad District Central Co-operative Bank, Ltd., Aurangabad.
146. Shri Annasaheb Patil, Deputy Chairman, B. D. C., Jafrabad, Post Khasgaon.
147. Shri M. S. Anvikar.

Parbhani District.

148. Shri Kishanrao Chavan, Yeldari Camp.

Osmanabad District.

149. Shri N. A. Chaudhari, District Agricultural Officer, Osmanabad.
150. The Executive Engineer, Osmanabad Irrigation Division, Osmanabad.
151. Shri Yeshwant Ramkrishna Wawikar, Wawi, Taluka Kalamb.
152. Shrimati Tarabai Mansing, M.L.A., Bhoom.
153. Shri Ganeshrao Venkatrao Kulkarni, Hadolti, Taluka Ahmedpur.

Bhir District.

154. Shri N. L. Kulkarni, President, Shetki Sangh, Taluka Ashti.
155. Shri Asrajirao Raoji Jagtap, Vice-Chairman, Bhir Local Board.

Nanded District.

156. The Collector and Chairman, District Development Board, Nanded.
157. Shri Anand Devidas Deshmukh, Jamb Budruk, Taluka Nanded.
158. Shri Manekrao Ganpatrao Patil (Pawar), Member, Manar Project East, Rehabilitation Samiti, Loha.

Nagpur Division

Buldhana District.

159. Shri Appasaheb Karhale, President, Lift Irrigation Society, Raheri (B. K.), Taluka Mehkar.
160. Shri Shriram Sitaram Bhonde, President, Jalgaon Taluka Congress Committee.
161. Shri B. G. Gupta, Vice-Chairman, Buldhana Co-operative Central and L. M. Bank, Ltd., Buldhana.
162. The District Agricultural Officer, Buldhana.
163. Shri G. M. Bhide, Executive Engineer, Nalganga Division, Malkapur.
164. Shri Trimbak Sheoram Savji, Mehkar.
165. Shri V. K. Soman, Mehkar.
166. Shri Namdeo Anand Patil, Pimpri Gavali, Taluka Malkapur.

Akola District.

167. The Collector of Akola, Akola.
168. Shri Ratanlal Goenka, Sawatram Krishi Karya Pvt., Ltd., Dahihande.
169. Dr. W. R. Korpe, Ak.

Amravati District.

170. The Collector and Chairman, District Development Board, Amravati.
171. Shri G. T. Kherde, Shendurjane (Ghat).
172. Shri B. P. Patil, Achalpur.

Yeotmal District.

173. The Chief Executive Officer, Janapada Sabha, Wani.
174. The District Agricultural Officer, Yeotmal.
175. Shri M. B. Patil, M.L.A., Digras.

Nagpur District.

176. The Executive Engineer, Bor Project Division, Nagpur.
177. The Secretary, Nag Vidarbha Chamber of Commerce, Nagpur.
178. Shri Appaji Ramchandra Tijare, Kala Pardi, Taluka Ramtek.
179. The Executive Engineer, Nagpur Irrigation Division, Nagpur.

Bhandara District.

180. The Collector of Bhandara.
181. The Executive Engineer, Minor Irrigation Division, Bhandara.
182. Shri D. D. Dhote, M.L.A., Bhandara.
183. Shri Narayan Mohabansi, Member, Block Development Committee and Vice-Chairman, Project Implementation Committee, Salekasa, Taluka Gondia.
184. Shri Wasudeo Wasishat, Member, Gram Panchayat, Salekasa, Taluka Gondia.
185. Shri Sureshchandra Jain, Tawepar.
186. Shri Lahanoo Adkooji Kendar, Kolara.
187. Shri Sahadeo Gujbhiye, Sarpanch, Shahpur, Taluka Bhandara.
188. Shri Nathuji Tarone, Sadak Pimpalgaon.
189. Shri Narayanrao Hardikar, Bhandara.
190. Shri N. R. Joshi, Vice-President, Co-operative Central Bank, Bhandara.

Chanda District.

191. The Collector of Chanda, Chanda.
192. The Executive Engineer, Minor Irrigation Division, Chanda.
193. The Superintendent of Fisheries, Chanda.
194. Shri M. N. Pawade, Warora.
195. Shri S. P. Sawanwar, Secretary, Wainganga Bandhara Yojana Samiti, Savli.
196. Shri L. G. Jani, Bramhapuri.

Wardha District.

197. Shri Vyankatrao Raghoba Gode, Gode Kharangana, Taluka Wardha.

APPENDIX D

Itinerary of Tours

Itinerary of tours undertaken by the Maharashtra State Irrigation Commission

Date	Names of places visited
11-2-61	Patas, Poona district. Baramati, Poona district.
12-2-61	Phaltan: Shriram Sahakari Sakhar Karkhana, Satara district. Padegaon, Satara district. Malsiras, Sholapur district.
13-2-61	Nira Right Bank Canal Branch I—Distributary No. 9, Sholapur district. Akluj: Saswad Mali Sugar Factory, Sholapur district. Pandharpur, Sholapur district.
14-2-61	Poona.
17-3-61	Chanda.
18-3-61	Mul, Ghorajheri and Rajoli Tanks, Chanda district. Extension Training Centre and Agricultural Research Farm, Sindewahi Saoli, Chanda district.
19-3-61	Ramtek Canal, Nagpur district. Shri Hardikar's Farm, Bhandara district. Bhandara. Manegaon Tank, Bhandara district.
20-3-61	Nagpur. Shri S. K. Wankhede's Farm at Metpanjari, Nagpur district. Katol, Nagpur district. Warud, Amravati district.
21-3-61	Amravati. Akola.

Date	Names of places visited
30-3-61	Nanded. Parbhani.
31-3-61	Yeldari Dam of Purna Project, Parbhani district. Aurangabad.
1-4-61	Bendsura Tank, Bhir district. Bhir.
2-4-61	Osmanabad.
9-5-61	Koynanagar, Satara district.
10-5-61	Ratnagiri.
11-5-61	Kolhapur. Weir on Bhogawati River at Rashiwade, Kolhapur district. Dam at Radhanagari, Kolhapur district.
12-5-61	Weir on Panchaganga at Shirol, Kolhapur district. Sangli.
13-5-61	Karad, Satara district.
16-5-61	Bhandardara Dam, Ahmednagar district. Sangamner, Ahmednagar district.
17-5-61	Pravaranagar, Ahmednagar district. Estates of the Maharashtra and Belapur Sugar Factories, Ahmednagar district. Mula Dam, Ahmednagar district. Rahuri Co-operative Sugar Factory, Ahmednagar district.
18-5-61	Irrigation Drainage Work in Kopergaon taluka, Ahmednagar district. Brahmangaon Phalbag Co-operative Joint Farming Society, Ahmednagar district. Farm of the Taluka Development Board, Kopergaon, Ahmednagar district. Kopergaon Sahakari Sakhar Karkhana, Kolpewadi, Ahmednagar district.

Date	Names of places visited
18-5-61	Godavari-Pravara Canal Sale-Purchase Union, Kopergaon, Ahmednagar district. Nasik.
19-5-61	Maharashtra Engineering Research Institute, Nasik.
11-6-61	Thana. Pen, Kolaba district.
17-6-61	Wardha. Yeotmal.
18-6-61	Pus Project Site, Yeotmal district. Buldhana.
19-6-61	Nalganga Project Site, Buldhana district.
20-6-61	Jalgaon. Dhulia.
21-6-61	Purmepada Dam on Bori River, Dhulia district. Girna Sahakari Sakhar Karkhana, Malegaon, Nasik district. Satana : Phad System of Irrigation, Nasik district.

Places visited by the Maharashtra State Irrigation Commission during its study tour in Uttar Pradesh, Punjab, Kerala and Mysore States

UTTAR PRADESH

26-4-61	Jhansi. Betwa Canal area. Head-works at Paricha and outlet of a distributary.
30-4-61	Roorkee Engineering University. Irrigation Research Institute, Roorkee. Field section of the Irrigation Research Institute at Bahadrapur. Hardwar. Head-works of the Upper Ganga Canal at Bhimgonda, Kankhal Spur in the bed of the Ganga river. Khandsari Sugar Factory near Rishikesh.

Date	Names of places visited
2-5-61	Lucknow. Central Sugar-cane Research Institute, Lucknow.
	PUNJAB STATE
27-4-61	Ambala. Chandigarh. Kotla Power House near Nangal.
28-4-61	Bhakra Dam Site and Power House. Sirhind Canal. Rajasthan Canal. Head-Works at Harike. Amritsar.
29-4-61	Field Research Station of the Irrigation Department near Amritsar. Chandigarh. Ambala.
	KERALA STATE
24-5-61	Mangalore.
25-5-61	Malampuzha. Malampuzha Dam and Irrigated area thereunder.
26-5-61	Peechi Dam and the Kerala Irrigation Research Institute. Lift Irrigation Scheme on the Periyar River near Alwaye.
27-5-61	Periyar Barrage and the barrage at Thannirmukkom on the back-water between Cochin and Alleppey.
28-5-61	Thottapally cut. Trivandrum.
	MYSORE STATE
29-5-61	Bangalore. Hebbal Tank : Experiment of desilting-*cum*-Reclamation.
30-5-61	Krishnarajsagar Dam and irrigated area under the project. Mandya.

Date	Names of places visited
30-5-61	Marconahally Reservoir.
31-5-61	Gayathri Reservoir and Vani Vilas Sagara in Hariyar Taluka of Chitradurga district.
1-6-61	Munirabad: Tungabhadra Project Dam and irrigated command on the left and right bank canals. A village of rehabilitated cultivators.
2-6-61	Bhadra Project site.
3-6-61	Bangalore: National Dairy Research Institute and the Lalbag Gardens—Department of Horticulture.

APPENDIX E

List of witnesses examined by the Commission

Date	Name
	AT AURANGABAD
6-10-61	(1) Shri R. G. Salvi, Commissioner, Aurangabad Division.
	(2) Dr. M. N. Desai, Collector of Aurangabad.
	(3) Shri D. K. Datey, Superintending Engineer, Marathwada Project, Circle II, Aurangabad.
	(4) Shri S. R. Chopde, Superintending Agricultural Officer, Aurangabad.
	(5) Shri D. K. Dhekne, Deputy Director of Agriculture (Engineering), Aurangabad.
	(6) Shri Ramchandra Patil, Chairman, Central Co-operative Bank, Aurangabad.
	(7) Shri Sakharam Patil, Panchayat Mandal, Aurangabad.
	(8) Rani Tara Raje, M.L.A., Osmanabad.
7-10-61	(9) Shri Shamrao, S. Kadam, Nanded.
	(10) Shri Mukundrao Pedgaonkar, Parbhani.
	(11) Shri V. D. Deshpande, M.L.A., Nanded.
	(12) Shri Venkatrao Deshmukh Tarodkar, Nanded.
	(13) Shri Yeshwantrao R. Bawikar, Osmanabad.
	(14) Shri Shankarrao Kale, District Farmers' Union, Aurangabad.
	AT BOMBAY
13-10-61	(15) Shri D. S. Borkar, Superintending Engineer, Bombay Circle.
	(16) Dr. M. V. Hate, Managing Director, Maharashtra State Co-operative Land Mortgage Bank.
	(17) Dr. C. D. Datey, Managing Director, Maharashtra State Co-operative Bank.
	(18) Shri M. R. Anand Rao, Joint Registrar of Co-operative Societies, Bombay Division.
	(19) Shri B. R. R. Iyengar, Superintending Engineer (Hydro).

Date	Name
13-10-61	(20) Shri S. V. Natu, Superintending Engineer, Designs Circle.
	(21) Shri D. H. Jadhav, Karjat, Kolaba district.
14-10-61	(22) Shri Hari Singh, Superintending Engineer, Deccan Irrigation Circle III.
	(23) Shri M. S. Somvanshi, Mohadi, Nasik district.
	(24) Shri H. P. Sanap, Nasik.
	(25) Shri Naval Ananda Patil, Dhulia.
	(26) Shri D. S. Potnis, Nasik.
	(27) Shri N. M. Sonavne, M.L.A., Satana, Nasik.
	(28) Shri Vasantrao S. Ratnaparakhi, Amalner, Jalgaon district.
	(29) Shri N. G. Zodge, Bramhangaon, Nasik district.
	AT POONA
22-10-61	(30) Dr. M. B. Ghatge, Director of Agriculture.
	(31) Shri V. K. Paranjpe, Superintending Engineer, Western Public Health Circle.
	(32) Shri A. G. Maydeo, retired Chief Engineer.
	(33) Shri V. M. Shinde, Satara district.
	(34) Shri S. N. Jachak, Maharashtra Rajya Sahakari Sakhar Karkhana Sangh, Ltd., Poona.
	(35) Shri S. A. Ghatge, Maharashtra Rajya Sahakari Sakhar Karkhana Sangh, Ltd., Poona.
	(36) Shri D. S. Wagh, M.L.A., Nasik.
	(37) Shri N. G. Apte, Poona.
	(38) Shri K. Y. Ranasing, Nimsakhar, Poona district.
23-10-61	(39) Shri L. N. Bongirwar, Registrar of Co-operative Societies.
	(40) Shri M. G. Wagh, Anti-Corruption Bureau (formerly Executive Engineer, Irrigation Projects Division), Poona.
	(41) Shri G. B. Kanagalekar, Executive Engineer, Khadakwasla Division II.
	(42) Shri R. S. Panse, Poona-5.
	(43) Shri Rajabhau Unde, Baramati, Poona district.
	(44) Shri Tulsidas Jadhav, Vice-Chairman, District Development Council, Sholapur.

Date	Name
23-10-61	(45) Shri P. M. Govitrikar, Saswad Mali Sugar Factory. (46) Shri Abasaheb Nimbalkar, Vice-Chairman, District Development Board, Ahmednagar. (47) Shri R. L. Phansalkar, retired Executive Engineer.
24-10-61	(48) Dr. K. G. Joshi, Superintending Agricultural Officer, Poona. (49) Shri H. G. Patwardhan, Miraj. (50) Shri N. M. Watwe, Miraj. (51) Shri M. V. Divekar, Bhogawati Sugar Factory. (52) Shri B. M. Hazarnis, Kolhapur Sugar Works.
25-10-61	(53) Shri Abasaheb Deshpande, Poona. (54) Shri R. P. Bildikar, Godavari Sugar Mills. (55) Shri R. S. Neurgaonkar, Changdeo Sugar Co. (56) Shri Chandrabhan R. Dakhale, Shrirampur, Ahmednagar district. (57) Shri Ramrao Chavan, Secretary, District Development Board, Ahmednagar. (58) Shri Vithalrao E. Vikhe Patil, Pravara Sahakari Sakhar Karkhana. (59) Shri Baburao Kadu, Rahta Sahakari Sakhar Karkhana. (60) Shri P. K. Bhapkar, M.L.A., Ahmednagar district. (61) Shri Appasaheb Dhanvate, Puntambe, Ahmednagar district. (62) Shri Vasantrao Patil, Shetkari Sahakari Sakhar Karkhana, Sangli. (63) Shri N. N. Bankar Patil, Padhegaon, Ahmednagar district. (64) Shri D. R. Thorat, Ashok Co-operative Sugar Factory, Ahmednagar district. (65) Shri S. D. Kale, Kolpewadi, Ahmednagar district. (66) Shri K. B. Rohmare, Kopergaon, Ahmednagar district. (67) Shri B. M. Pandhare, Kopergaon, Ahmednagar district. (68) Shri U. B. Kulkarni, Kopergaon, Ahmednagar district. (69) Shri D. S. Rohmare, Pohegaon, Ahmednagar district. (70) Shri C. F. Awhad, Kopergaon, Ahmednagar district.

Date	Name
25-10-61	(71) Shri P. B. Kadu, Pravara Co-operative Sugar Factory.
	AT NAGPUR
2-11-61	(72) Dr. A. U. Shaikh, Commissioner, Nagpur Division.
	(73) Shri M. C. Sarwate, Superintending Engineer, Akola Irrigation Circle.
	(74) Shri V. H. Kelkar, Superintending Engineer, Nagpur Irrigation Circle.
	(75) Dr. R. L. Nagpal, Superintending Agricultural Officer, Nagpur.
	(76) Shri N. S. Kulkarni, Joint Registrar of Co-operative Societies, Nagpur.
	(77) Shri J. Innocent, Collector of Bhandara.
3-11-61	(78) Shri P. A. Thakar, Executive Engineer, Irrigation Projects Investigation Circle.
	(79) Shri G. R. Kulkarni, Executive Engineer, Public Health Works Division.
	(80) Shri D. A. Paranjape, Executive Engineer, Water Resources Division, Nagpur.
	(81) Shri A. G. Kale, Executive Engineer, Minor Irrigation Division, Chanda.
	(82) Shri S. D. Gedam, M.L.A., Honorary Secretary, Divisional Development Council.
	(83) Shri V. R. Gode, Wardha.
	(84) Shri Ramrao Balbudhe, M.L.C., Nagpur.
	(85) Shri Sevakaramjisingh Thakur, Indora, Nagpur district.
	(86) Dr. M. G. Sawarkar, Amravati district.
	(87) Shri G. T. Kherde, Amravati district.
4-11-61	(88) Shri Madangopal Agarwal, Deputy Minister for Public Health.
	(89) Shri Q. A. Ahmed, Collector of Chanda.
	(90) Shri G. K. Bhide, Executive Engineer, Malguzari Tanks.
	(91) Shri P. B. Bhadre, Executive Engineer, Minor Irrigation Division, Bhandara.
	(92) Shri P. V. Pendharkar, Deputy Engineer, Ramtek Sub-Division.

Date	Name
4-11-61	(93) Shri Narayanrao Hardikar, Bhandara.
	(94) Shri M. N. Pawade, Warora, Chanda district.
	(95) Shri D. A. Naik, Nagpur.
	(96) Shri N. G. Deshpande, Nagpur.
	(97) Shri L. V. Deshpande, Nagpur.
	AT POONA
7-12-61	(98) Shri N. V. Khursale, Superintending Engineer, Deccan Irrigation Circle I.
	(99) Shri V. W. Gothoskar, Superintending Engineer, Irrigation and Power Department.
	(100) Shri S. G. Hiremath, Superintending Engineer, (Mechanical).
	AT BOMBAY
9-12-61	(101) Shri B. S. Apte, Superintending Engineer, Water Resources Investigation Circle.
	(102) Shri E. C. Saldanha, Superintending Engineer, Central Designs Organisation (I).

APPENDIX F′

Statistical Tables

TABLE No. 1

MEAN MONTHLY TEMPERATURES IN MAHARASHTRA, BY DISTRICTS

[Figures in degrees centigrade]

Serial No.	Name of district	Name of station	1960			1961								
			Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Region I													
1	Thana	Dahanu	N. A.	26·3	24·9	22·1	21·4	25·4	27·7	29·7	29·4	27·3	27·4	27·1
2	Kolaba	Alibag	27·2	26·3	24·8	23·8	22·5	25·6	27·3	28·9	28·0	26·6	27·1	27·1
3	Ratnagiri	Ratnagiri	27·1	27·5	26·1	25·9	24·5	27·2	28·7	28·8	26·6	26·2	26·7	26·7
	Region II													
4	Nasik	Nasik	24·6	22·5	21·4	20·7	19·9	26·3	28·5	28·8	26·1	N. A.	N. A.	N. A.
5	Ahmednagar	Ahmednagar	25·2	22·7	22·1	22·0	22·3	28·4	31·2	30·1	27·1	24·8	27·6	25·1
6	Poona	Poona	25·1	23·1	22·3	22·1	21·7	27·6	29·9	29·1	26·9	24·4	24·8	24·5
7	Satara	Mahabaleshwar	19·6	19·8	19·9	19·6	19·7	24·9	25·7	23·9	19·1	17·9	17·9	17·7
8	Sangli	Miraj	25·5	23·7	22·8	22·9	22·9	28·3	30·3	28·3	26·1	24·1	24·9	24·9
9	Kolhapur	Kolhapur	25·2	24·1	22·9	22·7	23·3	28·4	30·3	28·1	25·3	23·3	23·9	23·9

	Region III													
10	Jalgaon	Jalgaon	N. A.	23·4	23·0	22·7	22·1	29·6	33·5	34·9	31·4	27·7	27·6	26·7
11	Aurangabad	Aurangabad	25·5	23·9	22·9	23·1	23·1	29·5	32·3	31·5	28·0	25·3	25·4	25·2
12	Bhir	Bhir	25·3	N. A.	N. A.	N. A.	N. A.	N. A.	32·1	N. A.	N. A.	26·4	26·3	N. A.
13	Sholapur	Sholapur	26·7	24·5	23·5	23·7	24·7	30·3	32·4	30·7	27·6	25·9	26·4	26·6
	Region IV													
14	Buldhana	Buldhana	24·6	22·8	22·4	22·1	21·6	28·7	31·2	31·3	N. A.	N. A.	N. A.	N. A.
15	Parbhani	Parbhani	25·3	22·5	21·7	22·3	22·8	29·5	32·1	32·5	29·1	26·5	26·4	26·0
16	Amravati	Amravati	26·2	23·8	23·1	23·4	23·1	30·0	33·1	34·3	29·9	26·1	26·3	N. A.
17	Akola	Akola	25·6	23·0	22·6	23·2	22·3	29·5	33·1	34·8	31·3	27·3	27·3	N. A.
18	Yeotmal	Yeotmal	25·4	22·5	22·6	23·5	N. A.	30·5	32·9	33·7	27·1	23·5	23·6	22·8
19	Nanded	Nanded	26·9	24·5	23·9	N. A.	N. A.	N. A.	N. A.	N. A.	28·2	25·9	25·4	26·3
20	Bhandara	Gondia	25·7	21·6	21·4	21·6	21·2	N. A.	N. A.	35·1	35·7	27·1	26·9	N. A.
21	Chanda	Chanda	26·0	21·8	21·5	23·1	23·3	30·2	33·8	35·3	30·9	27·2	27·3	26·6

Note.—N. A. means not available.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 2

NORMAL MONTHLY RAINFALL IN MAHARASHTRA, BY DISTRICTS

[Figures in inches]

Serial No.	Name of district	January	February	March	April	May	June	July	August	September	October	November	December	Annual
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	Thana	0·13	0·06	0·04	0·03	0·57	17·50	33·56	20·55	11·85	3·18	0·44	0·08	87·99
2	Kolaba	0·07	0·05	0·03	0·13	0·70	24·56	45·43	29·76	15·90	4·29	0·70	0·08	121·70
3	Ratnagiri	0·09	0·03	0·04	0·27	1·37	31·04	42·70	24·78	13·43	4·77	1·12	0·15	119·79
4	Dhulia	0·20	0·08	0·07	0·07	0·35	4·87	7·95	5·01	4·76	1·31	0·59	0·20	25·47
5	Jalgaon	0·29	0·13	0·15	0·10	0·47	5·26	7·90	5·69	5·79	1·42	0·74	0·21	28·15
6	Nasik	0·13	0·06	0·07	0·16	0·82	6·90	13·20	9·38	7·43	2·51	0·84	0·18	41·68
7	Ahmednagar ..	0·19	0·09	0·13	0·31	0·76	4·55	3·78	2·82	6·23	2·36	1·14	0·28	22·64
8	Poona	0·08	0·06	0·09	0·41	0·92	6·21	10·99	7·12	6·32	3·05	1·09	0·22	36·54
9	Sholapur	0·16	0·11	0·17	0·46	0·85	3·85	3·12	3·28	6·79	2·95	1·30	0·35	23·39
10	Satara	0·11	0·07	0·16	0·75	1·24	7·40	16·72	11·35	7·48	3·65	1·31	0·26	50·50
11	Sangli	0·09	0·05	0·20	1·09	1·50	3·52	4·85	3·51	4·62	3·63	1·19	0·22	24·47
12	Kolhapur ..	0·05	0·05	0·23	1·18	1·30	13·18	24·76	15·72	8·00	5·04	1·41	0·20	71·12
13	Aurangabad ..	0·20	0·14	0·11	0·21	0·87	6·70	6·05	4·56	6·23	1·27	0·89	0·24	27·47
14	Parbhani	0·24	0·26	0·22	0·48	0·70	6·81	8·62	7·08	6·49	1·54	0·83	0·25	33·54

15	Nanded	0·22	0·53	0·30	0·48	0·73	6·60	9·10	7·01	7·00	1·40	0·75	0·24	34·42
16	Bhir	0·20	0·26	0·20	0·33	0·90	5·44	7·10	4·94	6·45	1·73	0·90	0·20	28·65
17	Osmanabad ..	0·24	0·22	0·24	0·61	1·16	5·78	5·80	5·18	7·47	1·79	0·91	0·27	29·67
18	Buldhana ..	0·35	0·31	0·25	0·28	0·46	5·98	8·30	5·75	5·99	1·92	0·89	0·38	30·86
19	Akola	0·37	0·37	0·32	0·30	0·44	5·97	9·47	6·64	5·94	1·72	0·87	0·40	32·81
20	Amravati	0·42	0·44	0·32	0·26	0·51	6·32	10·36	7·61	6·27	1·82	0·77	0·35	35·45
21	Yeotmal	0·34	0·47	0·47	0·40	0·58	6·31	11·29	8·46	7·01	1·89	0·88	0·28	38·85
22	Wardha	0·41	0·46	0·40	0·45	0·60	7·05	12·70	8·94	7·24	2·16	0·65	0·35	41·41
23	Nagpur	0·35	0·77	0·54	0·58	0·61	7·79	13·58	11·22	7·46	2·15	0·64	0·33	46·02
24	Bhandara ..	0·32	0·97	0·52	0·58	0·42	8·59	19·44	15·61	8·32	2·12	0·51	0·27	57·67
25	Chanda	0·36	0·83	0·56	0·65	0·51	8·61	18·35	14·42	8·72	2·36	0·66	0·24	56·27

Note.—Figures for the Marathwada districts are based on the records of the former Hyderabad State.

Source.—Memoirs of the India Meteorological, Department Vol. XXVII, Part V; averages based on records up to 1940.

TABLE No. 3

AVERAGE NUMBER OF RAINY DAYS DURING EACH MONTH RECORDED AT RAIN GAUGE STATIONS IN EACH ISOHYETIC REGION IN MAHARASHTRA

Serial No.	Description of isohyetic region	Range of average annual rainfall in inches	Average number of rainy days during												
			Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	High rainfall zone ..	Above 75″ ..	0·2	0·1	0·1	0·4	1·3	18·1	27·3	25·8	16·6	5·5	1·3	0·2	96·9
2	Moderately high rainfall zone in the west.	50″ to 75″ ..	0·1	0·1	0·3	0·9	1·4	12·3	22·9	19·7	10·9	4·4	1·4	0·3	74·7
3	Assured rainfall zone in the west.	25″ to 50″ ..	0·2	0·2	0·3	1·0	1·6	8·1	16·7	13·7	8·6	4·0	1·3	0·4	56·1
4	Low rainfall zone ..	25″ to 30″ ..	0·5	0·4	0·4	0·5	1·1	7·2	11·0	8·9	8·0	2·6	1·5	0·5	42·6
5	Low rainfall zone ..	20″ to 25″ ..	0·3	0·2	0·3	0·9	1·6	6·6	8·2	6·4	7·7	3·8	1·5	0·5	38·0
6	Low rainfall zone ..	Below 20″ ..	0·3	0·2	0·3	0·8	1·6	6·0	6·3	4·8	7·1	3·8	1·6	0·4	33·2
7	Assured rainfall zone in the east.	30″ to 50″ ..	0·7	0·8	0·8	0·9	1·2	8·5	13·2	10·8	8·6	2·6	1·1	0·7	49·9
8	Moderately high rainfall zone in the east.	50″ to 75″ ..	0·6	1·4	1·2	1·4	1·2	9·1	17·4	15·5	10·4	3·0	0·9	0·5	62·6

Source.—Memoirs of the India Meteorological Department, Vol. XXVII, Part V; monthly and annual normals of rainfall and of rainy days based on records up to 1940.

TABLE No. 4

PATTERN OF LAND UTILISATION IN MAHARASHTRA, BY REGIONS

(Average for the period 1956-57 to 1958-59)

[Figures in hundred acres]

Serial No.	Name of region	Geographical area by village papers	Forest	Barren and unculturable land	Land put to non-agricultural use	Culturable waste	Permanent pastures and other grazing lands	Land under miscellaneous tree crops and groves not included in the area sown
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Konkan	73,11,4 (100)	13,41,4 (19)	13,94,0 (19)	72,8 (1)	7,44,5 (10)	1,75,6 (2)	1,84,9 (3)
2	Western Maharashtra	2,92,08,3 (100)	45,50,6 (16)	24,39,4 (8)	2,69,2 (1)	5,26,6 (2)	10,39,9 (4)	40,6 (—)
3	Marathwada	1,63,22,5 (100)	6,95,7 (5)	2,23,5 (1)	4,35,6 (3)	2,20,3 (1)	6,61,7 (4)	56,8 (—)
4	Vidarbha	2,36,41,7 (100)	68,15,7 (28)	6,25,2 (3)	9,77,6 (4)	6,85,1 (3)	17,95,9 (8)	2,20,5 (1)
	Total—State ..	7,64,83,9 (100)	1,34,03,4 (17)	46,82,1 (6)	17,55,2 (2)	21,76,5 (3)	36,73,1 (5)	5,02,8 (1)

TABLE No. 4—*concld.*

Serial No.	Name of region	Current fallows	Other fallow land	Net sown area	Area sown more than once	Gross cropped area	Net irrigated area	Gross irrigated area
(1)	(2)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	Konkan	3,24,0 (4)	9,03,8 (12)	21,70,4 (30)	71,6 (1)	22,42,0 (31)	46,6 (2)	48,9 (2)
2	Western Maharashtra	6,58,0 (2)	9,77,3 (3)	1,87,06,7 (64)	10,95,0 (4)	1,98,01,7 (68)	13,14,7 (7)	15,95,0 (8)
3	Marathwada	14,32,7 (9)	8,21,0 (5)	1,17,75,2 (72)	4,16,3 (3)	1,21,91,5 (75)	3,15,0 (3)	3,75,7 (3)
4	Vidarbha	2,80,3 (1)	7,44,6 (3)	1,14,96,8 (49)	5,01,0 (2)	1,19,97,8 (51)	6,44,7 (6)	6,47,2 (5)
	Total—State ..	26,95,0 (4)	34,46,7 (5)	4,41,49,1 (57)	20,83,9 (3)	4,62,33,0 (60)	23,21,0 (5)	26,66,8 (6)

Notes.—(1) Figures in brackets in columns (4) to (14) indicate percentages to column (3).

(2) Figures in brackets in columns (15) and (16) indicate percentages to columns (12) and (14), respectively.

(3) Dash denotes negligible percentage.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE No. 5

AREA UNDER PRINCIPAL CROPS IN MAHARASHTRA, BY DISTRICTS

(Average for the period 1956-57 to 1958-59)

[Figures in hundred acres]

Serial No.	Name of district	Geographical area by village papers	Gross cropped area	Rice	Wheat	Jowar	Bajri	Gram	Sugar-cane	Cotton	Ground-nut	Other crops
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	Thana	23,92,4	7,87,2 (33)	3,84,3 (49)	1 (—)	1,3 (—)	— (—)	2,7 (—)	2 (—)	— (—)	— (—)	3,98,6 (51)
2	Greater Bombay ..	88,1	22,3 (25)	7,3 (33)	(—) (—)	(—) (—)	(—) (—)	(—) (—)	(—) (—)	(—) (—)	(—) (—)	15,0 (67)
3	Kolaba	16,96,4	5,42,5 (32)	3,27,0 (60)	(—) (—)	(—) (—)	(—) (—)	1,2 (—)	1 (—)	(—) (—)	(—) (—)	2,14,2 (40)
4	Ratnagiri	31,34,5	8,90,0 (28)	3,17,1 (36)	— (—)	— (—)	— (—)	— (—)	2 (—)	— (—)	2 (—)	5,72,5 (64)
	Total—Konkan ..	73,11,4	22,42,0 (31)	10,35,7 (46)	1 (—)	1,3 (—)	— (—)	3,9 (—)	5 (—)	— (—)	2 (—)	12,00,3 (54)

TABLE No. 5—*cont.*

Serial No. (1)	Name of district (2)	Geographical area by village papers (3)	Gross cropped area (4)	Rice (5)	Wheat (6)	Jowar (7)	Bajri (8)	Gram (9)	Sugar-cane (10)	Cotton (11)	Ground-nut (12)	Other crops (13)
5	Dhulia	39,79,9	19,52,8 (49)	84,4 (4)	1,13,7 (6)	4,50,6 (23)	3,48,9 (18)	38,1 (2)	4,3 (—)	2,18,7 (11)	3,06,9 (16)	3,87,2 (20)
6	Jalgaon	28,76,3	20,98,0 (73)	13,6 (1)	78,0 (4)	3,96,7 (19)	2,07,0 (10)	14,4 (1)	2,8 (—)	5,56,6 (27)	3,34,6 (16)	4,94,3 (22)
7	Nasik	38,45,8	24,14,0 (63)	88,7 (4)	2,40,2 (10)	1,78,6 (7)	8,78,5 (36)	77,6 (3)	22,2 (1)	22,1 (1)	1,94,1 (8)	7,12,0 (30)
8	Ahmednagar	42,05,2	32,56,3 (77)	22,2 (1)	1,26,7 (4)	13,69,6 (42)	7,67,5 (24)	74,6 (2)	70,2 (2)	99,1 (3)	97,2 (3)	6,29,2 (19)
9	Poona	38,44,7	26,35,8 (68)	1,21,1 (5)	56,3 (2)	9,73,0 (37)	5,02,7 (19)	71,4 (3)	24,5 (1)	12,1 (—)	50,8 (2)	8,23,9 (31)
10	Sholapur	37,05,5	29,73,1 (80)	21,1 (1)	58,1 (2)	18,36,2 (62)	2,33,2 (8)	63,4 (2)	21,1 (1)	36,2 (1)	2,13,1 (7)	4,90,7 (16)
11	Satara	26,08,2	18,18,7 (70)	58,0 (3)	33,5 (2)	4,93,7 (27)	4,03,1 (22)	43,1 (2)	15,5 (1)	4,3 (—)	1,45,8 (8)	6,21,7 (35)
12	Sangli	21,28,4	16,36,2 (77)	27,4 (2)	33,5 (2)	6,16,4 (37)	3,46,7 (21)	41,9 (3)	11,5 (1)	21,1 (1)	1,93,3 (12)	3,44,4 (21)
13	Kolhapur	20,14,3	10,16,8 (50)	2,20,2 (22)	5,3 (—)	1,40,2 (14)	7,8 (1)	9,2 (1)	58,3 (6)	10,5 (1)	1,15,8 (11)	4,49,5 (44)
	Total—Western Maharashtra. ..	2,92,08,3	1,98,01,7 (68)	6,56,7 (3)	7,45,3 (4)	64,55,0 (32)	36,95,4 (19)	4,33,7 (2)	2,30,4 (1)	9,80,7 (5)	16,51,6 (9)	49,52,9 (25)

14	Aurangabad	40,20,8	32,40,3 (80)	12,4 (—)	2,07,3 (6)	8,77,1 (27)	4,28,3 (13)	1,06,4 (3)	14,8 (—)	5,30,7 (16)	1,92,5 (6)	8,70,8 (29)
15	Parbhani	30,90,6	23,20,4 (75)	27,7 (1)	1,26,8 (5)	9,01,5 (39)	8,2 (—)	93,1 (4)	3,8 (—)	5,12,7 (22)	1,09,3 (5)	5,37,3 (24)
16	Nanded	29,84,9	19,87,1 (67)	48,8 (2)	66,1 (3)	7,65,8 (39)	3,0 (—)	71,8 (4)	4,4 (—)	5,10,4 (26)	55,3 (3)	4,61,5 (23)
17	Bhir	27,60,0	20,40,2 (74)	19,4 (1)	1,08,5 (5)	7,31,4 (35)	2,47,4 (12)	87,1 (4)	3,7 (—)	1,78,1 (9)	1,75,8 (8)	4,88,8 (26)
18	Osmanabad	34,66,2	26,03,5 (75)	71,2 (3)	1,35,1 (5)	9,40,3 (36)	54,3 (2)	1,34,3 (5)	10,6 (—)	1,53,8 (6)	2,90,2 (11)	8,13,7 (32)
	Total—Marathwada	1,63,22,5	1,21,91,5 (75)	1,79,5 (1)	6,43,8 (5)	42,16,1 (35)	7,41,2 (6)	4,92,7 (4)	37,3 (—)	18,85,7 (16)	8,23,1 (7)	31,72,1 (26)
19	Buldhana	24,14,6	17,09,3 (71)	5,9 (—)	99,1 (6)	5,69,5 (34)	14,3 (1)	21,5 (1)	2,1 (—)	6,33,9 (37)	91,9 (5)	2,71,1 (16)
20	Akola	26,09,4	19,04,5 (73)	17,5 (1)	1,21,8 (6)	5,90,3 (31)	14,6 (1)	29,8 (2)	4 (—)	7,85,3 (41)	1,08,0 (6)	2,36,8 (12)
21	Amravati	30,13,9	16,69,2 (55)	12,8 (1)	91,2 (5)	4,59,9 (27)	13,7 (1)	19,8 (1)	2 (—)	8,09,9 (49)	47,3 (3)	2,14,4 (13)
22	Yeotmal	33,40,7	18,18,6 (54)	22,7 (1)	44,0 (2)	6,69,1 (37)	2,50 (1)	21,3 (1)	5 (—)	6,94,0 (38)	72,7 (4)	2,69,3 (16)
23	Wardha	15,53,7	10,04,5 (65)	4,2 (—)	1,01,8 (10)	3,28,8 (33)	1,4 (—)	8,6 (1)	1 (—)	3,75,4 (38)	4,1 (—)	1,80,1 (18)
24	Nagpur	24,43,1	13,21,9 (54)	48,5 (4)	1,84,6 (14)	5,57,5 (42)	8 (—)	23,9 (2)	1 (—)	1,64,8 (13)	14,0 (1)	3,27,7 (24)

TABLE No. 5—*concld.*

Serial No.	Name of district	Geographical area by village papers	Gross cropped area	Rice	Wheat	Jowar	Bajri	Gram	Sugarcane	Cotton	Groundnut	Other crops
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
25	Bhandara	22,83,1	12,15,5 (53)	6,22,7 (52)	75,8 (6)	97,7 (8)	— (—)	30,2 (2)	2,2 (—)	— (—)	1,6 (—)	3,85,3 (32)
26	Chanda	59,83,2	13,54,3 (23)	4,53,6 (34)	82,1 (6)	3,77,0 (28)	2 (—)	25,3 (2)	1,1 (—)	37,9 (3)	5 (—)	3,76,6 (27)
	Total—Vidarbha ..	2,36,41,7	1,19,97,8 (51)	11,87,9 (10)	8,00,4 (7)	36,49,8 (30)	70,0 (1)	1,80,4 (2)	6,7 (—)	35,01,2 (29)	3,40,1 (3)	22,61,3 (18)
	Total—State ..	7,64,83,9	4,62,33,0 (60)	30,59,8 (7)	21,89,6 (5)	1,43,22,2 (31)	45,06,6 (10)	11,10,7 (2)	2,74,9 (1)	63,67,6 (13)	28,15,0 (6)	1,15,86,6 (25)

Notes.—(i) Figures in brackets in columns (5) to (13) show percentages to column (4) and those in brackets in column (4) show percentage to column (3).

(ii) Dash denotes negligible area or percentage.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE No. 6

PERCENTAGE SHARES OF STATES IN THE TOTAL AREA UNDER PRINCIPAL CROPS IN INDIA

(Average for the period 1951-52 to 1956-57)

Serial No.	Name of State	Rice	Wheat	Jowar	Bajri	Total Cereals	Total Pulses	Ground-nut	Cotton	Tobacco	Sugar-cane
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	West Bengal	14·12	0·56	0·01	—	5·36	3·26	—	—	4·33	1·25
2	Bihar	15·90	5·59	0·02	0·04	8·23	9·67	—	0·06	3·79	7·98
3	Andhra Pradesh	8·12	0·19	14·80	5·82	8·60	6·43	23·01	6·24	37·56	3·82
4	Madhya Pradesh	12·35	21·56	11·66	1·70	12·25	15·78	5·13	11·59	1·62	2·10
5	Madras	6·57	—	4·28	5·19	5·07	1·98	13·51	5·14	4·98	2·41
6	Orissa	12·49	0·04	0·04	0·04	4·78	2·09	0·46	0·14	1·19	1·34
7	Uttar Pradesh	11·87	33·04	5·50	10·01	15·50	20·01	2·28	0·87	5·30	59·46
8	Assam (Ex. NEFA)	5·55	0·02	—	—	2·04	0·31	—	0·20	2·38	1·46
9	**Maharashtra**	**3·74**	**6·96**	**32·69**	**16·41**	**11·66**	**11·44**	**19·52**	**34·40**	**7·90**	**4·99**
10	Mysore	2·70	2·52	14·68	4·37	6·41	5·64	15·92	12·94	11·47	2·60
11	Kerala	2·38	—	0·02	—	0·89	0·13	0·24	0·10	—	0·23
12	Gujarat	1·56	3·63	8·98	18·04	5·85	2·66	18·17	19·77	16·88	0·71
13	Punjab	0·85	15·92	1·68	9·70	4·78	9·99	1·00	5·85	0·65	10·01
14	Jammu and Kashmir	0·60	0·94	—	0·13	0·59	0·02	—	—	—	—
15	Rajasthan	0·22	7·66	5·56	28·37	7·19	10·55	0·76	2·58	1·62	1·31
16	Other Territories	0·98	1·37	0·08	0·18	0·80	0·24	—	0·12	0·33	0·33
	Total—India	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Note.—Dash denotes negligible percentage.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 7

DISTRIBUTION OF IRRIGATED AREA BY PRINCIPAL CROPS IN MAHARASHTRA, BY DISTRICTS

(Average for the period 1956-57 to 1958-59)

[Figures in hundred acres]

Serial No.	Name of district	Geographical area by village papers	Gross sown area	Gross irrigated area	Rice	Wheat	Jowar
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Thana	23,92,4	7,87,2 (33)	11,6 (1·5)	3 (2·6)	— (—)	— (—)
2	Greater Bombay	88,1	22,3 (25)	1,0 (4·5)	— (—)	— (—)	— (—)
3	Kolaba	16,96,4	5,42,5 (32)	4,9 (0·9)	2 (4·1)	— (—)	— (—)
4	Ratnagiri	31,34,5	8,90,0 (28)	31,4 (3·5)	10,9 (34·8)	— (—)	— (—)
	Total—Konkan ..	73,11,4	22,42,0 (31)	48,9 (2·2)	11,4 (23·5)	— (—)	— (—)
5	Dhulia	39,79,9	19,52,8 (49)	94,4 (4·8)	4,3 (4·5)	35,2 (37·3)	1,3 (1·3)

6 Jalgaon	28,76,3	20,98,0 (73)	93,0 (4·4)	7,8 (8·4)	31,7 (34·1)	— (—)
7 Nasik	38,45,8	24,14,0 (63)	1,48,6 (6·1)	9,2 (6·3)	40,3 (27·2)	4 (—)
8 Ahmednagar	42,05,2	32,56,3 (77)	3,28,5 (10·1)	3,8 (1·1)	33,9 (10·3)	1,22,0 (37·1)
9 Sholapur	37,05,5	29,73,1 (80)	3,00,4 (10·1)	6,3 (2·1)	33,4 (11·1)	1,38,8 (46·2)
10 Satara	26,08,2	18,18,7 (70)	2,16,8 (11·9)	22,5 (10·4)	26,6 (12·3)	92,7 (42·7)
11 Sangli	21,28,4	16,36,2 (77)	1,00,4 (6·1)	5,1 (5·1)	17,1 (17·0)	19,3 (19·2)
12 Kolhapur	20,14,3	10,16,8 (50)	78,0 (7·7)	5,7 (7·3)	4,0 (5·1)	— (—)
13 Poona	38,44,7	26,35,8 (68)	2,34,9 (8·9)	7,1 (3·0)	21,1 (9·0)	79,0 (33·6)
Total—Western Maharashtra ..	2,92,08,3	1,98,01,7 (68)	15,95,0 (8·1)	71,8 (4·5)	2,43,3 (15·2)	4,53,5 (28·4)
14 Aurangabad	40,20,8	32,40,3 (80)	1,26,9 (3·9)	1,3 (1·0)	27,6 (21·7)	39,7 (31·3)
15 Parbhani	30,90,6	23,20,4 (75)	38,8 (1·7)	3,4 (8·8)	10,0 (25·7)	6,2 (15·9)
16 Nanded	29,84,9	19,87,1 (67)	19,1 (0·9)	4,4 (23·0)	1,3 (6·8)	— (—)

TABLE No. 7—*contd.*

Serial No.	Name of district	Geographical area by village papers	Gross sown area	Gross irrigated area	Rice	Wheat	Jowar
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
17	Bhir	27,60,0	20,40,2 (74)	91,2 (4·5)	3,5 (3·8)	16,4 (17·9)	40,0 (43·8)
18	Osmanabad	34,66,2	26,03,5 (75)	99,7 (3·8)	2,5 (2·5)	22,0 (22·0)	37,2 (37·2)
	Total—Marathwada ..	1,63,22,5	1,21,91,5 (75)	3,75,7 (3·1)	15,1 (4·0)	77,3 (20·5)	1,23,1 (32·8)
19	Buldhana	24,14,6	17,09,3 (71)	19,8 (1·1)	1 (0·5)	7,5 (37·8)	1,2 (6·1)
20	Akola	26,09,4	19,04,5 (73)	6,5 (0·3)	— (—)	3 (4·6)	— (—)
21	Amravati	30,13,9	16,69,2 (55)	15,1 (0·9)	— (—)	8 (5·3)	— (—)
22	Yeotmal	33,40,7	18,18,6 (54)	6,1 (0·3)	2 (3·3)	4 (6·5)	— (—)
23	Wardha	15,53,7	10,04,5 (65)	11,0 (1·1)	1 (0·9)	9 (8·2)	— (—)

24	Nagpur	24,43,1	13,21,9 (54)	62,2 (4·7)	26,2 (42·1)	4,6 (7·4)	— (—)
25	Bhandara	22,83,1	12,15,5 (53)	3,06,9 (25·2)	2,94,4 (95·9)	3 (—)	— (—)
26	Chanda	59,83,2	13,54,3 (23)	2,19,6 (16·2)	2,11,9 (96·4)	2 (—)	— (—)
	Total—Vidarbha	2,36,41,7	1,19,97,8 (51)	6,47,2 (5·3)	5,32,9 (82·3)	1,50 (2·3)	1,2 (0·2)
	Total—State	7,64,83,9	4,62,33,0 (60)	26,66,8 (6)	6,31,2 (24)	3,35,6 (13)	5,77,8 (22)

TABLE No. 7—*contd.*

Serial No.	Name of district	Bajri	Gram	Tur	Sugarcane	Cotton	Groundnut	Other crops
(1)	(2)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	Thana	— (—)	1 (0·9)	— (—)	2 (1·7)	— (—)	— (—)	11,0 (94·8)
2	Greater Bombay	— (—)	— (—)	— (—)	— (—)	— (—)	— (—)	1,0 (100·0)
3	Kolaba	— (—)	— (—)	— (—)	— (—)	— (—)	— (—)	4,7 (95·9)
4	Ratnagiri	— (—)	— (—)	— (—)	3 (0·9)	— (—)	— (—)	20,2 (64·3)
	Total—Konkan ..	— (—)	1 (—)	— (—)	5 (1·0)	— (—)	— (—)	36,9 (75·5)
5	Dhulia	— (—)	2,2 (2·4)	— (—)	4,1 (4·3)	4 (0·5)	— (—)	46,9 (49·7)
6	Jalgaon	— (—)	4,6 (4·9)	— (—)	2,8 (3·0)	1,2 (1·3)	— (—)	44,9 (48·3)

7 Nasik	— (—)	12,4 (8·5)	— (—)	22,1 (14·8)	1,7 (1·1)	3,1 (2·1)	59,4 (40·0)
8 Ahmednagar	17,3 (5·3)	13,9 (4·4)	— (—)	69,9 (21·3)	10,2 (3·1)	8,4 (2·5)	49,1 (14·9)
9 Sholapur	10,3 (3·4)	4,6 (1·5)	1,4 (0·5)	21,1 (7·0)	12,9 (4·3)	7,4 (2·5)	64,2 (21·4)
10 Satara	16,5 (7·6)	17,0 (7·8)	9 (0·4)	15,5 (7·2)	4,2 (1·9)	1,4 (0·8)	19,5 (8·9)
11 Sangli	2,1 (2·1)	5,8 (5·8)	— (—)	11,3 (11·4)	3,5 (3·6)	2 (—)	36,0 (35·8)
12 Kolhapur	— (—)	4 (—)	— (—)	58,3 (74·7)	— (—)	— (—)	9,6 (12·9)
13 Poona	23,1 (9·8)	17,9 (7·6)	4,7 (2·0)	24,5 (10·4)	7,5 (3·2)	4,8 (2·2)	45,2 (19·2)
Total—Western Maharashtra ..	69,3 (4·3)	78,8 (4·9)	7,0 (0·4)	2,29,6 (14·4)	41,6 (2·6)	25,3 (1·6)	3,74,8 (23·7)
14 Aurangabad	1,0 (0·7)	11,3 (8·9)	2 (—)	14,8 (11·6)	1,7 (1·3)	2 (—)	29,1 (23·5)
15 Parbhani	— (—)	— (—)	— (—)	3,8 (9·8)	1 (—)	— (—)	15,3 (39·8)
16 Nanded	— (—)	— (—)	2 (1·0)	4,4 (23·0)	— (—)	— (—)	8,8 (46·2)
17 Bhir	4,2 (4·6)	4,9 (5·4)	— (—)	3,7 (4·0)	7 (0·8)	8 (0·9)	17,0 (18·8)

TABLE No. 7—*concld.*

Serial No. (1)	Name of district (2)	Bajri (9)	Gram (10)	Tur (11)	Sugarcane (12)	Cotton (13)	Groundnut (14)	Other crops (15)
18	Osmanabad	— (—)	3,5 (3·5)	— (—)	10,6 (10·6)	5 (0·5)	2 (0·2)	23,2 (23·5)
	Total—Marathwada ..	5,2 (1·4)	19,7 (5·2)	4 (0·1)	37,3 (9·9)	3,0 (0·8)	1,2 (0·3)	93,4 (25·0)
19	Buldhana	— (—)	4 (2·0)	— (—)	2,1 (10·6)	5 (2·5)	— (—)	8,0 (40·5)
20	Akola	— (—)	— (—)	— (—)	4 (6·1)	— (—)	— (—)	5,8 (89·3)
21	Amravati	— (—)	2 (1·3)	— (—)	2 (1·3)	2 (1·3)	— (—)	13,7 (90·8)
22	Yeotmal	— (—)	— (—)	— (—)	5 (8·2)	1 (1·6)	— (—)	4,9 (80·4)
23	Wardha	— (—)	— (—)	— (—)	1 (0·9)	4 (3·6)	— (—)	9,5 (86·4)
24	Nagpur	— (—)	1,9 (3·1)	— (—)	1 (—)	7 (1·1)	— (—)	28,7 (46·3)

25 Bhandara	— (—)	— (—)	— (—)	2,2 (0·7)	— (—)	— (—)	10,0 (3·4)
26 Chanda	— (—)	— (—)	— (—)	1,0 (0·4)	— (—)	— (—)	6,5 (3·2)
Total—Vidarbha ..	— (—)	2,5 (0·4)	— (—)	6,6 (1·0)	1,9 (0·3)	— (—)	87,1 (13·5)
Total—STATE ..	74,5 (3)	1,01,1 (4)	7,4 (4)	2,74,0 (10)	46,5 (2)	26,5 (1)	5,92,2 (21)

Note.—(i) Figures in brackets in cols. (6) to (15) show percentage to column (5).
Figures in brackets in col. (5) show percentage to column (4).
Figures in brackets in col. (4) show percentage to column (3).

(ii) Dash indicates negligible area or percentage.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE No. 8

DISTRIBUTION OF IRRIGATED AREA BY CROPS IN THE STATES IN INDIA

(Average for the period 1956-57 to 1958-59)

[Figures in thousand acres]

Serial No.	Name of State	Rice	Wheat	Bajri	Jowar	Total cereals	Gram	Tur	Total pulses
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Andhra Pradesh	67,55 (79·9)	9 (0·1)	1,74 (2·1)	99 (1·2)	75,49 (89·3)	2 (—)	5 (—)	57 (0·7)
2	Assam	13,50 (97·4)	— (—)	— (—)	— (—)	13,52 (97·5)	— (—)	— (—)	5 (0·4)
3	Bihar	38,91 (82·4)	2,51 (5·3)	— (—)	— (—)	42,70 (90·4)	30 (0·6)	— (—)	1,82 (3·9)
4	**Maharashtra**	**6,31** (23·6)	**3,36** (12·6)	**74** (2·8)	**5,78** (22·0)	**N. A.** (N. A.)	**1,01** (3·8)	**7** (0·3)	**N. A.** (N. A.)
5	Jammu and Kashmir	4,68 (59·3)	88 (11·2)	2 (0·3)	— (—)	6,79 (86·1)	2 (0·3)	— (—)	18 (2·3)
6	Kerala	8,14 (67·9)	— (—)	— (—)	2 (0·2)	8,23 (68·6)	— (—)	— (—)	32 (2·7)
7	Madhya Pradesh	12,09 (54·6)	4,24 (19·2)	— (—)	— (—)	17,48 (79·0)	79 (3·6)	— (—)	87 (3·9)
8	Madras	51,90 (70·9)	1 (—)	1,78 (2·4)	4,11 (5·6)	62,93 (86·0)	— (—)	2 (—)	20 (0·3)
9	Mysore	13,19 (66·3)	25 (1·3)	4 (0·2)	60 (3·0)	15,39 (77·3)	3 (0·1)	2 (0·1)	16 (0·8)

10	Gujarat	1,47 (9·6)	4,82 (31·6)	73 (4·8)	72 (4·7)	N. A. (N. A.)	15 (1·0)	2 (0·1)	N. A. (N. A.)
11	Orissa	24,25 (86·0)	9 (0·3)	— (—)	1 (—)	24,62 (87·3)	1 (—)	4 (0·1)	86 (3·0)
12	Punjab	5,94 (6·4)	24,94 (26·9)	2,62 (2·8)	1,90 (2·0)	42,32 (45·7)	12,45 (13·4)	— (—)	13,42 (14·5)
13	Rajasthan	22 (0·5)	13,87 (33·2)	60 (1·4)	54 (1·3)	26,85 (64·3)	3,94 (9·4)	— (—)	4,14 (9·9)
14	Uttar Pradesh	10,85 (8·3)	41,80 (32·1)	12 (0·1)	28 (0·2)	76,76 (59·0)	9,17 (7·0)	4 (—)	22,91 (17·6)
15	West Bengal	28,73 (89·0)	54 (1·7)	— (—)	— (—)	29,51 (91·5)	— (—)	— (—)	1,02 (3·2)
	Total—INDIA ..	2,89,78 (44·5)	98,31 (15·1)	8,39 (1·3)	14,80 (2·3)	4,70,52 (72·2)	27,92 (4·3)	26 (—)	48,26 (7·4)

TABLE No. 8—*concld.*

Serial No.	Name of State	Sugarcane	Chillies and condiments and spices	Total food crops	Groundnut	Cotton	Total irrigated area
(1)	(2)	(11)	(12)	(13)	(14)	(15)	(16)
1	Andhra Pradesh	1,76 (2·1)	1,60 (1·9)	80,70 (95·5)	1,30 (1·5)	5 (—)	84,51 (100·0)
2	Assam	— (—)	— (—)	13,58 (98·0)	— (—)	— (—)	13,86 (100·0)
3	Bihar	88 (1·9)	2 (—)	47,03 (99·5)	— (—)	— (—)	47,25 (100·0)
4	**Maharashtra**	**2,74 (10·0)**	— (—)	**24,42 (91·0)**	**26 (1·0)**	**47 (1·9)**	**26,67 (100·0)**
5	Jammu and Kashmir	2 (0·3)	3 (0·4)	7,34 (93·30)	— (—)	1 (0·1)	7,89 (100·0)
6	Kerala	11 (0·9)	— (—)	10,69 (89·2)	— (—)	— (—)	11,99 (100·0)
7	Madhya Pradesh	1,05 (4·7)	98 (4·4)	21,61 (97·8)	— (—)	9 (0·4)	22,13 (100·0)
8	Madras	1,30 (1·8)	95 (1·3)	67,43 (92·2)	1,78 (2·4)	2,51 (3·4)	73,20 (100·0)
9	Mysore	1,34 (6·7)	— (—)	18,23 (91·6)	— (—)	20 (1·0)	19,91 (100·0)
10	Gujarat	35 (2·3)	— (—)	10.45 (68·5)	16 (1·0)	1,59 (10·4)	15,26 (100·0)

11	Orissa	59 (2·1)	— (—)	27,33 (96·9)	— (—)	6 (0·2)	28,20 (100·0)
12	Punjab	3,66 (3·9)	68 (0·7)	61,38 (66·2)	14 (0·2)	14,01 (15·1)	92,68 (100·0)
13	Rajasthan	67 (1·6)	1,64 (3·9)	33,82 (81·0)	2 (—)	3,59 (8·6)	41,73 (100·0)
14	Uttar Pradesh	18,86 (14·5)	58 (0·4)	1,23,17 (94·7)	— (—)	1,42 (1·1)	1,30,13 (100·0)
15	West Bengal	28 (0·9)	— (—)	31,99 (99·1)	— (—)	— (—)	32,27 (100·0)
	Total—INDIA	33,72 (5·2)	6,51 (1·0)	5,83,00 (89·5)	3,67 (0·6)	24,00 (3·7)	6,51,66 (100·0)

Notes.— (i) Figures in brackets indicate percentages to the total irrigated area.
(ii) Dash denotes negligible area or percentage.
(iii) Figures for Maharashtra are taken from the Statistician, Agriculture Department, Maharashtra State.
(iv) N. A. means not available.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 9

AREA IRRIGATED AS PERCENTAGE OF NET SOWN AREA IN THE STATES IN INDIA

(Average for the years 1956-57 to 1958-59)

[Figures in thousand acres]

Serial No.	Name of State	Net irrigated area	Net sown area	Percentage of column (3) to (4)
(1)	(2)	(3)	(4)	(5)
1	Jammu and Kashmir	7,40	16,23	45·47
2	Punjab	74,04	1,82,22	40·63
3	Madras	55,26	1,42,53	38·77
4	Assam (excl. NEFA)	13,86	†51,18	27·08
5	Uttar Pradesh	1,19,20	4,18,55	28·48
6	Andhra Pradesh	69,59	2,75,43	25·26
7	West Bengal	31,78	1,28,71	24·69
8	Bihar	47,25	1,89,42	24·94
9	Kerala	8,53	45,52	18·74
10	Orissa	24,14	*1,38,54	17·42
11	Rajasthan	35,44	3,05,71	11·59
12	Mysore	18,76	2,50,41	7·49
13	Gujarat	13,90	2,29,84	6·05
14	Madhya Pradesh	21,86	3,82,68	5·71
15	**Maharashtra**	**23,21**	**4,41,49**	**5·25**
	Total—INDIA	5,67,49	32,14,69	17·65

†Relates to 1953-54.

*Relates to 1954-55.

Note.—Figures are provisional.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 10

DISTRIBUTION OF NET IRRIGATED AREA BY SOURCES IN MAHARASHTRA, BY DISTRICTS

(Average for the period 1956-57 to 1958-59)

[Figures in hundred acres]

Serial No.	Name of district	Gross sown area	Gross irrigated area	Net irrigated area	Govern-ment canals	Private canals	Tanks	Wells	Other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Thana	7,87,2	11,6 (1·5)	10,6 (91)	— (—)	— (—)	3 (3)	9,3 (88)	1,0 (9)
2	Greater Bombay	22,3	1,0 (4·5)	9 (90)	— (—)	— (—)	— (—)	9 (100)	— (—)
3	Kolaba	5,42,5	4,9 (0·9)	4,8 (98)	2 (4)	— (—)	— (—)	3,6 (75)	1,0 (21)
4	Ratnagiri	8,90,0	31,4 (3·5)	30,3 (96)	6 (2)	11,5 (38)	1,5 (5)	11,9 (39)	4,8 (16)
	Total—Konkan ..	22,42,0	48,9 (2·2)	46,6 (95)	8 (2)	11,5 (24)	1,8 (4)	25,7 (55)	6,8 (15)
5	Dhulia	19,52,8	94,4 (4·8)	85,8 (91)	29,6 (34)	2,4 (3)	8 (1)	53,0 (62)	— (—)
6	Jalgaon	20,98,0	93,0 (4·4)	75,4 (81)	6,1 (8)	— (—)	1 (—)	68,5 (91)	7 (1)
7	Nasik	24,14,0	1,48,6 (6·1)	97,5 (66)	40,3 (41)	1,7 (2)	1 (—)	55,2 (57)	2 (—)
8	Ahmednagar	32,56,3	3,28,5 (10·1)	2,84,8 (87)	1,08,3 (39)	3,9 (1)	7 (—)	1,71,4 (60)	5 (—)

TABLE No. 10—*concld.*

Serial No.	Name of district	Gross sown area	Gross irrigated area	Net irrigated area	Govern-ment canals	Private canals	Tanks	Wells	Other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
9	Poona	26,35,8	2,34,9 (8·9)	2,00,6 (85)	1,01,1 (51)	6,3 (3)	2,7* (1)	88,4 (44)	2,1 (1)
10	Sholapur	29,73,1	3,00,4 (10·1)	2,47,4 (82)	59,7 (24)	2 (—)	3,4 (1)	1,84,1 (75)	— (—)
11	Satara	18,18,7	2,16,8 (11·9)	1,63,6 (75)	52,7 (32)	35,9 (22)	1,5 (—)	72,0 (46)	1,5 (—)
12	Sangli	16,36,2	1,00,4 (6·1)	83,4 (83)	3,5 (4)	2,7 (3)	— (—)	74,0 (89)	3,2 (4)
13	Kolhapur	10,16,8	78,0 (7·7)	76,2 (98)	3,8 (5)	1 (—)	1,3 (2)	26,8 (35)	44,2 (58)
	Total—Western Maharashtra ..	1,98,01,7	15,95,0 (8·1)	13,14,7 (82)	4,05,1 (31)	53,2 (4)	10,6 (—)	7,93,4 (61)	52,4 (4)
14	Aurangabad	32,40,3	1,26,9 (3·9)	95,0 (75)	— (—)	— (—)	— (—)	95,0 (100)	— (—)
15	Parbhani	23,20,4	38,8 (1·7)	38,4 (99)	— (—)	— (—)	1 (—)	38,3 (100)	— (—)
16	Nanded	19,87,1	19,1 (0·9)	15,9 (83)	— (—)	— (—)	2,0 (13)	13,9 (87)	— (—)
17	Bhir	20,40,2	91,2 (4·5)	75,5 (83)	— (—)	— (—)	7,3 (10)	66,4 (88)	1,8* (2)

18	Osmanabad	26,03,5	99,7 (3·8)	90,2 (90)	5,4 (6)	— (—)	4 (—)	81,8 (91)	2,6 (3)
	Total—Marathwada ..	1,21,91,5	3,75,7 (3·1)	3,15,0 (84)	5,4 (2)	— (—)	9,8 (3)	2,95,4 (94)	4,4 (1)
19	Buldhana	17,09,3	19,8 (1·1)	19,4 (98)	— (—)	— (—)	2 (1)	19,0 (98)	2 (1)
20	Akola	19,04,5	6,5 (0·3)	6,4 (98)	— (—)	— (—)	1 (1)	6,3 (99)	— (—)
21	Amravati	16,69,2	15,1 (0·9)	15,1 (100)	1 (1)	— (—)	— (—)	14,8 (98)	2 (1)
22	Yeotmal	18,18,6	6,1 (0·3)	5,7 (93)	2 (3)	— (—)	— (—)	5,4 (95)	1 (2)
23	Wardha	10,04,5	11,0 (1·1)	10,8 (98)	— (—)	— (—)	— (—)	10,7 (99)	1 (1)
24	Nagpur	13,21,9	62,2 (4·7)	62,2 (100)	10,4 (17)	— (—)	14,5 (23)	33,3 (53)	4,0 (7)
25	Bhandara	12,15,5	3,06,9 (25·2)	3,06,2 (100)	50,9 (17)	— (—)	2,43,3 (79)	6,4 (2)	5,6 (2)
26	Chanda	13,54,3	2,19,6 (16·2)	2,18,9 (100)	37,6 (17)	— (—)	1,71,2 (78)	3,5 (2)	6,6 (3)
	Total—Vidarbha ..	1,19,97,8	6,47,2 (5·3)	6,44,7 (100)	99,2 (15)	— (—)	4,29,3 (67)	99,4 (15)	16,8 (3)
	Total—State ..	4,62,33,0	26,66,8 (5·8)	23,21,0 (87)	5,10,5 (22)	64,7 (3)	4,51,5 (19)	12,13,9 (52)	80,4 (4)

Notes.—(i) Figures in brackets in columns (6) to (10) are percentages of column (5). Figures in brackets in column (4) are percentages of column (3). Figures in brackets in column (5) are percentages of column (4).

(ii) *Figures are provisional.

(iii) Dash denotes negligible area or percentage.

Source.—The Statistician, Agriculture Department, Maharashtra State.

TABLE No. 11

DISTRIBUTION OF IRRIGATED AREA BY SOURCES IN THE STATES IN INDIA

(Average for the period 1956-57 to 1958-59)

[Figures in thousand acres]

Serial No.	Name of State	Canals			Tanks	Wells	Other sources	Total
		Government	Private	Total				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Andhra Pradesh	30,73 (44·2)	32 (0·5)	31,05 (44·7)	28,69 (41·2)	7,55 (10·9)	2,30 (3·2)	69,59 (100·0)
2	Assam	1·68 (12·1)	6,31 (45·5)	7,99 (57·6)	6 (0·4)	N.A. (N.A.)	5,81 (42·0)	13,86 (100·0)
3	Bihar	10,50 (22·2)	4,79 (10·1)	15,29 (32·3)	7,58 (16·0)	6,38 (13·6)	18,00 (38·1)	47,25 (100·0)
4	Gujarat	1,31 (9·4)	N.A. (N.A.)	1,31 (9·4)	61 (4·4)	11,70 (84·2)	28 (2·0)	13,90 (100·0)
5	Jammu and Kashmir	1,42 (19·2)	5,63 (76·2)	7,05 (95·4)	3 (0·4)	7 (0·9)	25 (3·3)	7,40 (100·0)
6	Kerala	3,60 (42·2)	72 (8·4)	4,32 (50·6)	78 (9·2)	31 (3·6)	3,12 (36·6)	8,53 (100·0)
7	Madhya Pradesh	9,65 (44·1)	7 (0·3)	9,72 (44·4)	3,84 (17·6)	7,36 (33·7)	94 (4·3)	21,86 (100·0)
8	Madras	20,29 (36·7)	2 (0·0)	20,31 (36·7)	21,01 (38·0)	13,03 (23·6)	91 (1·7)	55,26 (100·0)

9	**Maharashtra**	**5,10 (22·0)**	**65 (2·8)**	**5,75 (24·8)**	**4 52 (19·5)**	**12 14 (52.2)**	**80 (3·5)**	**23,21 (100·0)**
10	Mysore	4,25 (22·7)	12 (0·6)	4,37 (23·3)	8,32 (44·4)	3,13 (16·7)	2,94 (15·6)	18,76 (100·0)
11	Orissa	4,87 (20·2)	69 (2·9)	5,56 (23·1)	12,23 (50·7)	94 (3·8)	5,41 (22·4)	24,14 (100·0)
12	Punjab	48,31 (65·3)	1,53 (2·0)	49,84 (67·3)	15 (0·2)	23,68 (32·0)	37 (0·5)	74,04 (100·0)
13	Rajasthan	7,62 (21·5)	N.A. (N.A.)	7,62 (21·5)	5,97 (16·8)	21,36 (60·3)	49 (1·4)	35,44 (100·0)
14	Uttar Pradesh	44,98 (37·7)	26 (0·2)	45,24 (37·9)	10,22 (8·6)	56,98 (47·8)	6,76 (5·7)	1,19,20 (100·0)
15	West Bengal	7,93 (25·0)	9,35 (29·4)	17,28 (54·4)	9,36 (29·5)	39 (1·2)	4,75 (14·9)	31,78 (100·0)
	Total—India	2,02,58 (35·7)	31,93 (5·6)	2,34,51 (41·3)	1,13,40 (20·0)	1,65,43 (29·2)	54,15 (9·5)	5,67,49 (100·0)

Notes.—(i) Figures in brackets indicate percentages to column (9).

(ii) N. A. means figures are not separately available.

(iii) Figures for Maharashtra are taken from the Statistician, Agriculture Department, Maharashtra State.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE

PERCENTAGE OF IRRIGATED AREA TO SOWN AREA UNDER

(Average for the period

Serial No.	Name of district	Rice	Wheat	Jowar
(1)	(2)	(3)	(4)	(5)
1	Thana	0·1	—	—
2	Kolaba	—	—	—
3	Ratnagiri	3·4	—	—
	Konkan	1·1	—	—
4	Dhulia	5·1	30·9	0·3
5	Jalgaon	57·3	40·6	—
6	Nasik	10·4	16·8	0·2
7	Ahmednagar	17·1	26·8	8·9
8	Sholapur	29·9	57·5	7·6
9	Satara	38·8	79·4	18·8
10	Sangli	18·6	51·0	3·1
11	Kolhapur	2·6	75·5	—
12	Poona	5·9	37·5	8·1
	Western Maharashtra	10·9	32·6	7·0
13	Aurangabad	10·5	13·3	4·5
14	Parbhani	12·3	7·9	0·7
15	Nanded	9·0	2·0	—
16	Bhir	18·0	15·1	5·5
17	Osmanabad	3·5	16·3	3·9
	Marathwada	8·4	12·0	2·9
18	Buldhana	1·7	7·6	0·2
19	Akola	—	—	—
20	Amravati	—	0·8	—
21	Yeotmal	0·9	0·9	—
22	Wardha	2·4	0·9	—
23	Nagpur	54·0	2·5	—
24	Bhandara	46·9	—	—
25	Chanda	46·7	—	—
	Vidarbha	44·8	1·9	—
	Total—STATE	20·6	15·3	4·0

Note.—Dash denotes

Source.—Statistician, Agriculture

No. 12

EACH PRINCIPAL CROP IN MAHARASHTRA, BY DISTRICTS

1956-57 to 1958-59)

Bajri	Gram	Sugarcane	Cotton	Groundnut	Other crops	Gross irrigated area as percentage of gross sown area
(6)	(7)	(8)	(9)	(10)	(11)	(12)
—	3·7	100·0	—	—	2·8	1·5
—	—	—	—	—	2·2	0·9
—	—	100·0	—	—	3·5	3·5
—	2·6	100·0	—	—	3·1	2·2
—	5·8	95·3	0·2	—	12·1	4·8
—	31·9	100·0	0·2	—	9·1	4·4
—	16·0	100·0	7·7	1·6	8·3	6·1
2·2	18·6	99·6	10·3	8·6	7·8	10·1
4·4	7·2	100·0	35·6	3·5	13·1	10·1
4·1	39·4	100·0	97·7	1·0	3·1	11·9
0·6	13·8	98·3	16·6	0·1	10·4	6·1
—	4·3	100·0	—	—	2·1	7·7
4·6	25·1	100·0	62·0	9·4	5·5	8·9
1·9	18·2	99·6	4·2	1·5	7·6	8·1
0·2	10·6	100·0	0·3	0·1	3·3	3·9
—	—	100·0	—	—	2·8	1·7
—	—	100·0	—	—	1·9	0·9
1·7	5·6	100·0	0·4	0·4	3·5	4·5
—	2·6	100·0	0·3	—	2·9	3·8
0·7	4·0	100·0	0·1	0·1	2·9	3·1
—	1·9	100·0	—	—	2·9	1·1
—	—	100·0	—	—	2·4	0·3
—	1·0	100·0	—	—	6·5	0·9
—	—	100·0	—	—	1·8	0·3
—	—	100·0	—	—	5·3	1·1
—	7·9	100·0	0·4	—	8·7	4·7
—	—	100·0	—	—	2·6	25·2
—	—	90·9	—	—	1·7	16·2
—	1·4	98·5	—	—	3·8	5·3
1·6	9·1	99·7	0·7	0·9	5·1	5·8

negligible percentage.

Department, Maharashtra State.

TABLE No. 13

PERCENTAGE OF IRRIGATED AREA TO SOWN AREA UNDER EACH PRINCIPAL CROP IN THE STATES IN INDIA

(Average for the period 1956-57 to 1958-59)

Serial No. (1)	Name of State (2)	Rice (3)	Wheat (4)	Jowar (5)	Bajri (6)	Gram (7)	Cotton (8)	Sugarcane (9)	Groundnut (10)
1	Andhra Pradesh	95	17	2	11	1	—	98	3
2	Assam	31	—	—	—	—	—	—	—
3	Bihar	31	17	—	—	2	—	22	—
4	Jammu and Kashmir	N.A.	26	—	5	12	N.A.	67	—
5	Kerala	43	—	33	—	—	—	52	—
6	**Maharashtra.. .. .. ..**	**21**	**15**	**4**	**2**	**9**	**1**	**100**	**1**
7	Gujarat..	12	42	2	2	4	3	N.A.	—
8	Madhya Pradesh	12	6	—	—	2	—	94	—
9	Madras	92	25	23	13	—	21	99	10
10	Mysore	59	3	1	—	1	1	N.A.	—
11	Orissa	26	64	6	—	2	26	100	—
12	Punjab	75	48	25	11	20	95	73	9
13	Rajasthan	11	47	2	1	11	62	94	1
14	Uttar Pradesh	11	43	1	—	14	79	64	—
15	West Bengal	27	42	—	—	—	—	47	—
	Total—INDIA ..	36	31	3	3	12	12	68	3

Notes.—(i) Dash denotes negligible percentage.
(ii) N. A. means not available.

Source.—(i) Statistical Abstracts of India 1956-57 to 1958-59.
(ii) Bureau of Economics and Statistics, Government of Gujarat.
(iii) Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 14

NET SOWN AREA AND AREA IRRIGATED BY SOURCES IN MAHARASHTRA BY TALUKAS

(Average for the period from 1956-57 to 1958-59)

[Figures in hundred acres]

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Bassein	40,6	4,5 (11·1)	—	4,1	4
2	Bhivandi	63,4	— (—)	—	—	—
3	Dahanu	90,8	2,1 (2·3)	—	2,0	1
4	Jawhar	65,1	— (—)	—	—	—
5	Kalyan	60,2	6 (1·0)	—	—	6
6	Mokhada	41,2	— (—)	—	—	—
7	Murbad	74,6	— (—)	—	—	—
8	Palghar	98,4	1,9 (1·9)	—	1,9	—
9	Shahapur	76,5	— (—)	—	—	—
10	Umbergaon	95,9	1,0 (1·0)	—	9	1
11	Wada	32,3	— (—)	—	—	—
12	Thana	31,2	5 (1·6)	—	4	1
	Total—Thana	7,70,2	10,6 (1·4)	—	9,3	1,3

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Borivli	10,9	3 (2·7)	—	3	—
2	Andheri	10,4	6 (5·8)	—	6	—
	Total—Greater Bombay	21,3	9 (4·2)	—	9	—
1	Alibag	63,2	1,7 (2·7)	—	1,7	—
2	Karjat	31,5	— (—)	—	—	—
3	Khalapur	45,0	3 (0·7)	—	—	3
4	Mahad	46,8	— (—)	—	—	—
5	Mangaon	58,8	— (—)	—	—	—
6	Mhasala	23,3	— (—)	—	—	—
7	Murud	17,1	7 (4·1)	1	6	—
8	Panvel	55,4	1,6 (2·9)	1	1,1	4
9	Pen	42,5	2 (0·5)	—	—	2
10	Poladpur	18,9	— (—)	—	—	—
11	Roha	43,4	1 (0·2)	—	—	1
12	Shrivardhan	24,1	— (—)	—	—	—
13	Sudhagad	22,8	— (—)	—	—	—
14	Uran	21,5	2 (0·9)	—	2	—
	Total—Kolaba ..	5,14,3	4,8 (0·9)	2	3,6	1,0

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Chiplun	1,11,7	2 (0·2)	1	—	1
2	Dapoli	93,0	2,1 (2·3)	4	9	8
3	Devgad	33,5	2,0 (6·0)	1,0	1,0	—
4	Guhagar	33,8	9 (2·7)	3	3	3
5	Kankavali	47,6	5 (1·1)	1	4	—
6	Khed	54,6	— (—)	—	—	—
7	Kudal	53,0	2,1 (4·0)	—	1,2	9
8	Lanja	61,0	3 (0·5)	—	—	3
9	Malvan	46,5	3,3 (7·1)	9	1,4	1,0
10	Mandangad	28,9	2 (0·8)	—	—	2
11	Rajapur	78,4	1,2 (1·5)	—	5	7
12	Ratnagiri	69,2	1,2 (1·7)	—	8	4
13	Sangameshwar	65,3	9 (1·4)	—	3	6
14	Sawantwadi	58,9	9,4 (15·9)	9,1	—	3
15	Vengurla	29,2	6,0 (20·5)	2	5,1	7
	Total—Ratnagiri ..	8,64,6	30,3 (3·5)	12,1	11,9	6,3

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Akkalkuwa	69,6	1 (0·1)	—	1	—
2	Akrani	46,3	— (—)	—	—	—
3	Dhulia	2,85,8	18,0 (6·3)	10,7	6,7	6
4	Nandurbar	2,34,1	23,0 (9·8)	4,7	18,1	2
5	Nawapur	1,70,4	9 (0·5)	5	4	—
6	Sakri	2,86,1	14,7 (5·1)	10,1	4,6	—
7	Shahada	1,90,0	13,4 (7·1)	4,3	9,1	—
8	Shirpur	1,29,3	8 (0·6)	—	8	—
9	Sindkheda	2,33,1	12,1 (5·2)	1,7	10,4	—
10	Taloda	85,0	2,8 (3·3)	—	2,8	—
	Total—Dhulia ..	17,29,7	85,8 (5·0)	32,0	53,0	8
1	Amalner	1,71,2	9,7 (5·7)	1,2	8,4	1
2	Bhadgaon	86,3	3,8 (4·4)	2,2	1,6	—
3	Bhusawal	1,50,7	4,3 (2·8)	2	4,0	1
4	Chalisgaon	2,10,9	7,6 (3·6)	1,2	6,3	1
5	Chopda	1,50,3	1,4 (0·9)	—	1,3	1
6	Edlabad	89,5	1,6 (1·8)	—	1,6	—

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
7	Erandol	1,89,3	6,0 (3·2)	—	5,9	1
8	Jalgaon	1,42,7	3,1 (2·2)	—	3,0	1
9	Jamner	2,42,9	4,3 (1·8)	—	4,3	—
10	Pachora	1,60,3	5,0 (3·1)	8	4,1	1
11	Parola	1,30,3	7,9 (6·1)	5	7,3	1
12	Raver	1,30,9	12,1 (9·2)	—	12,1	—
13	Yaval	1,28,3	8,6 (6·7)	—	8,6	—
	Total—Jalgaon ..	19,83,6	75,4 (3·8)	6,1	68,5	8
1	Baglan	2,17,8	9,9 (4·5)	6,5	3,4	—
2	Chandor	1,72,4	8,7 (5·0)	1,9	6,8	—
3	Dindori	2,03,8	7,6 (3·7)	3,8	3,8	—
4	Igatpuri	1,29,9	4 (0·3)	—	4	—
5	Kalwan	1,50,0	5,6 (3·7)	2,4	3,2	—
6	Malegaon	2,97,0	16,0 (5·4)	10,1	5,8	1
7	Nandgaon	1,51,5	3,1 (2·0)	—	3,0	1
8	Nasik	1,71,6	8,2 (4·8)	2,7	5,5	—
9	Niphad	2,15,0	18,0 (8·4)	8,5	9,5	—

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	Peint	68,8	— (—)	—	—	—
11	Sinnar	2,39,5	12,1 (5·0)	4,6	7,5	—
12	Surgana	80,3	— (—)	—	—	—
13	Yeola	2,01,8	7,9 (3·9)	1,5	6,3	1
	Total—Nasik	22,99,4	97,5 (4·2)	42,0	55,2	3
1	Ahmednagar	2,72,7	29,4 (10·8)	2,6	26,7	1
2	Akola	2,08,7	1,6 (0·8)	8	8	—
3	Jamkhed	1,79,0	11,7 (6·5)	—	11,7	—
4	Karjat	2,55,9	17,7 (6·9)	4	16,2	1,1
5	Kopergaon	2,22,0	58,1 (26·2)	44,4	13,7	—
6	Newasa	2,77,4	9,9 (3·6)	1,5	8,4	—
7	Parner	3,23,2	16,4 (5·1)	1,7	14,7	—
8	Pathardi	2,27,1	10,7 (4·7)	—	10,7	—
9	Rahuri	1,69,0	30,2 (17·9)	17,8	12,4	—
10	Sangamner	2,62,3	14,4 (5·5)	3,8	10,6	—
11	Shevgaon	2,32,9	7,0 (3·0)	—	7,0	—
12	Shrigonda	2,96,8	24,2 (8·1)	1,9	22,3	—
13	Shrirampur	1,65,0	53,5 (32·4)	37,3	16,2	—
	Total—Ahmednagar ..	30,92,0	2,84,8 (9·2)	1,12,2	1,71,4	1,2

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Poona City	7,4	1,4 (18·9)	7	7	—
2	Haveli	1,96,4	16,7 (8·5)	12,8	3,2	7
3	Bhor	97,4	2,2 (2·2)	5	1,7	—
4	Khed	2,68,3	13,8 (5·1)	5	13,3	—
5	Baramati	2,40 8	56,5 (23·5)	41,9	14,1	5
6	Purandhar	1,92,2	12,7 (6·6)	3,4	9,0	3
7	Maval	1,64,4	3 (0·2)	—	3	—
8	Mulshi	81,5	5 (0·6)	2	3	—
9	Junnar	2,27,5	14,7 (6·5)	4,4	10,0	3
10	Dhond	2,14,7	16,3 (7·6)	3,3	10,8	2,2
11	Indapur	2.54,8	55,2 (21·7)	39,2	15,2	8
12	Velhe	60,1	— (—)	—	—	—
13	Ambegaon	1,53,9	4,5 (2·9)	5	4,0	—
14	Shirur	2,58,7	5,8 (2·2)	—	5,8	—
	Total—Poona	24,18,1	2,00,6 (8·3)	1,07,4	88,4	4,8

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Akkalkot	2,99,6	19,5 (6·5)	—	19,5	—
2	Barsi	3,63,3	19,9 (5·5)	—	18,3	1,6
3	Karmala	3,01,4	16,0 (5·3)	1,8	14,2	—
4	Madha	3,13,1	22,5 (7·2)	—	22,5	—
5	Malshiras	2,24,1	62,7 (28·0)	41,6	21,1	—
6	Mangalvedha	2,38,5	12,3 (5·1)	—	12,1	2
7	Mohol	2,60,8	20,3 (7·8)	4	19,9	—
8	North Sholapur	1,34,6	10,0 (7·4)	3,9	6,1	—
9	Pandharpur	2,44,5	22,8 (9·3)	9,3	13,5	—
10	Sangola	2,59,4	30,4 (11·7)	2,9	26,7	8
11	South Sholapur	2,67,6	11,0 (4·1)	—	10,2	8
	Total—Sholapur ..	29,06,9	2,47,4 (8·5)	59,9	1,84,1	3,4
1	Jaoli	79,8	6,2 (7·8)	5,3	9	—
2	Karad	1,89,9	16,2 (8·5)	4,9	10,1	1,2
3	Khandala	80,3	7,3 (9·1)	2,0	5,3	—
4	Khatav	2,75,0	18,9 (6·9)	6,8	12,0	1

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	Koregaon	1,73,3	9,0 (5·2)	3,6	5,4	—
6	Mahabaleshwar	10,2	1,4 (13·7)	1,3	1	—
7	Man	2,60,6	16,7 (6·4)	2,2	12,9	1,6
8	Patan	1,48,7	7,9 (5·3)	6,7	1,1	1
9	Phaltan	2,18,5	60,2 (27·5)	43,7	16,5	—
10	Satara	1,78,4	10,5 (5·9)	6,5	4,0	—
11	Wai	74,2	9,3 (12·5)	5,6	3,7	—
	Total—Satara	16,88,9	1,63,6 (9·7)	88,6	72,0	3,0
1	Jath	4,04,6	19,1 (4·7)	—	18,9	2
2	Khanapur	3,71,4	19,0 (5·1)	2,2	16,8	—
3	Miraj	3,24,0	19,3 (5·9)	5	18,6	2
4	Shirala	1,10,2	3,8 (3 4)	1	1,2	2,5
5	Tasgaon	2,20,6	12,0 (5·4)	1,7	10,1	2
6	Walwa	1,61,9	10,2 (6·3)	1,7	8,4	1
	Total—Sangli	15,92,7	83,4 (5·2)	6,2	74,0	3,2

TABLE No. 14—*cont.*

Serial No. (1)	Name of taluka (2)	Net sown area (3)	Net irrigated area (4)	Area irrigated by canals (5)	Area irrigated by wells (6)	Area irrigated by other sources (7)
1	Ajra	74,1	9 (1·2)	—	2	7
2	Bavda	29,3	1,1 (3·7)	—	1	1,0
3	Bhudargad	61,8	4,5 (7·3)	—	3	4,2
4	Chandgad	84,3	3,6 (4·3)	1	1,1	2,4
5	Hatkanangale	1,16,8	14,1 (12·1)	2	10,6	3,3
6	Gadhinglaj	1,02,1	3,8 (3·7)	—	2,4	1,4
7	Kagal	1,06,4	5,3 (5·0)	—	1,6	3,7
8	Karveer	1,10,7	15,6 (14·1)	—	3,1	12,5
9	Panhala	72,3	7,1 (9·9)	—	1,9	5,2
10	Radhanagari	65,4	7,2 (11·0)	3,6	5	3,1
11	Shahuwadi	66,4	6,2 (9·3)	—	3	5,9
12	Shirol	1,05,8	6,8 (6·4)	—	4,7	2,1
	Total—Kolhapur ..	9,95,4	76,2 (7·6)	3,9	26,8	45,5
1	Aurangabad	2,52,4	16,5 (6·5)	—	16,5	—
2	Paithan	2,99,9	9,6 (3·2)	—	9,6	—
3	Gangapur	2,79,0	8,7 (3·1)	—	8,7	—

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4	Vaijapur	3,39,6	9,9 (2·9)	—	9,9	—
5	Kannad	2,46,7	5,2 (2·1)	—	5,2	—
6	Khuldabad	77,8	5,6 (7·2)	—	5,6	—
7	Sillod	2,88,0	6,9 (2·4)	—	6,9	—
8	Bhokardan	2,43,5	3,5 (1·4)	—	3,5	—
9	Jafferabad	1,37,8	2,2 (1·6)	—	2,2	—
10	Jalna	3,80,7	16,5 (4·3)	—	16,5	—
11	Ambad	4,76,8	9,7 (2·0)	—	9,7	—
12	Soegaon	79,8	7 (0·9)	—	7	—
	Total—Aurangabad ..	31,02,0	95,0 (3·1)	—	95,0	—
1	Parbhani	2,79,1	5,9 (2·1)	—	5,9	—
2	Gangakhed	2,69,7	2,5 (0·9)	—	2,5	—
3	Pathri	3,26,8	7,6 (2·3)	—	7,6	—
4	Partur	2,87,8	4,3 (1·5)	—	4,3	—
5	Jintur	2,76,6	3,0 (1·1)	—	2,9	1
6	Hingoli	2,89,3	2,3 (0·8)	—	2,3	—
7	Kalamnuri	2,33,2	4,2 (1·8)	—	4,2	—
8	Basmath	2,72,0	8,6 (3·2)	—	8,6	—
	Total—Parbhani ..	22,34,5	38,4 (1·7)	—	38,3	1

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Nanded	2,04,5	3,7 (1·8)	—	3,5	2
2	Biloli	3,08,9	3,6 (1·2)	—	3,2	4
3	Degloor	1,44,0	5 (0·3)	—	3	2
4	Mukhed	1,66,2	6 (0·4)	—	5	1
5	Kandhar	2,90,8	4,6 (1·6)	—	4,4	2
6	Hadgaon	2,44,9	1,1 (0·4)	—	1,1	—
7	Bhokar	1,76,1	1,0 (0·6)	—	8	2
8	Kinwat	2,29,1	4 (0·2)	—	1	3
9	Rajura	1,85,4	4 (0·2)	—	..	4
	Total—Nanded ..	19,49,9	15,9 (0·8)	—	13,9	2,0
1	Bhir	2,45,9	15,9 (6·5)	—	11,7	4,2
2	Patoda	2,16,2	10,2 (4·7)	—	10,2	—
3	Ashti	2,53,8	28,0 (11·0)	—	23,1	4,9
4	Georai	3,12,3	7,1 (2·3)	—	7,1	—
5	Manjlegaon	3,01,2	4,0 (1·3)	—	4,0	—
6	Mominabad	3,01,0	3,6 (1·2)	—	3,6	—
7	Kaij	3,15,4	6,7 (2·1)	—	6,7	—
	Total—Bhir ..	19,45,8	75,5 (3·9)	—	66,4	9,1

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Osmanabad	2,18,7	10,4 (4·7)	—	10,2	2
2	Tuljapur	2,50,8	16,2 (6·4)	—	15,3	9
3	Parenda	2,08,5	11,6 (5·5)	5,4	6,1	1
4	Bhoom	1,50,2	9,2 (6·1)	—	9,2	—
5	Kalam	2,03,7	13,0 (6·4)	—	12,0	1,0
6	Latur	1,97,8	2,7 (1·4)	—	2,7	—
7	Owsa	2,37,7	3,8 (1·6)	—	3,8	—
8	Omerga	2,83,2	10,5 (3·7)	—	9,7	8
9	Udgir	2,30,4	1,3 (0·6)	—	1,3	—
10	Nilanga	2,62,8	8,8 (3·3)	—	8,8	—
11	Ahmedpur	2,99,2	2,7 (0·9)	—	2,7	—
	Total—Osmanabad ..	25,43,0	90,2 (3·5)	5,4	81,8	3,0
1	Malkapur	3,25,2	4,8 (1·5)	—	4,8	—
2	Chikhali	4,00,2	8,3 (2·1)	—	8,3	—
3	Mehkar	4,37,2	4,1 (0·9)	—	3,7	4
4	Jalgaon	1,93,5	8 (0·4)	—	8	—
5	Khamgaon	3,13,6	1,4 (0·5)	—	1,4	—
	Total—Buldhana ..	16,69,7	19,4 (1·2)	—	19,0	4

TABLE No. 14—*cont.*

Serial No.	Name of taluka	Net sown area	Net irrigated area	Area irrigated by canals	Area irrigated by wells	Area irrigated by other sources
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Balapur	2,41,9	6 (0·3)	—	6	—
2	Washim	4,53,4	1,9 (0·5)	—	1,9	—
3	Akot	3.07,2	1,4 (0·5)	—	1,3	1
4	Murtajapur	2,97,4	1,0 (0·3)	—	1,0	—
5	Akola	3,52,4	7 (0·2)	—	7	—
6	Mangrulpir	2,37,9	8 (0·3)	—	8	—
	Total—Akola ..	18,90,2	6,4 (0·3)	—	6,3	1
1	Melghat	72,9	.. (—)	—	..	—
2	Amravati	4,28,1	2,4 (0·6)	—	2,3	1
3	Chandur	3,27,7	2,5 (0·8)	—	2,5	—
4	Morsi	2,88,4	6,1 (2·1)	1	6,0	—
5	Daryapur	2,88,9	9 (0·3)	—	9	—
6	Achalpur	2,53,8	3,2 (1·3)	—	3,1	1
	Total—Amravati ..	16,59,8	15,1 (0·9)	1	14,8	2
1	Pusad	4,03,7	1,5 (0·6)	—	1,5	—
2	Yeotmal	3,21,4	1,3 (0·2)	—	1,2	1
3	Wani	3,02,7	7 (0·2)	2	5	—
4	Kelapur	3,59,2	9 (0·2)	—	9	—
5	Darwha	4,18,9	1,3 (0·3)	—	1,3	—
	Total—Yeotmal ..	18,05,9	5,7 (0·3)	2	5,4	1

TABLE No. 14—*concld.*

Serial No. (1)	Name of taluka (2)	Net sown area (3)	Net irrigated area (4)	Area irrigated by canals (5)	Area irrigated by wells (6)	Area irrigated by other sources (7)
1	Hinganghat	3,40,6	1,3 (0·4)	—	1,2	1
2	Wardha	3,81,8	4,7 (1·2)	—	4,7	—
3	Arvi	2,76,9	4,8 (1·7)	—	4,8	—
	Total—Wardha ..	9,99,3	10,8 (1·1)	—	10,7	1
1	Ramtek	2,63,2	19,6 (7·5)	10,4	2,8	6,4
2	Katol	2,40,5	13,8 (5·7)	—	13,8	—
3	Nagpur	2,84,5	8,2 (2·9)	—	7,4	8
4	Umrer	3,20,4	12,4 (3·9)	—	1,1	11,3
5	Saoner	1,94,4	8,2 (4·2)	—	8,2	—
	Total—Nagpur ..	13,03,0	62,2 (4·8)	10,4	33,3	18,5
1	Gondia	3,25,0	1,22,4 (37·7)	31,1	1,5	89,8
2	Bhandara	3,12,3	75,6 (24·2)	19,3	3,0	53,3
3	Sakoli	2,88,1	1,08,2 (37·6)	5	1,9	1,05,8
	Total—Bhandara ..	9,25,4	3,06,2 (33·1)	50,9	6,4	2,48,9
1	Chanda	2,80,5	55,9 (19·9)	17,6	4	37,9
2	Warora	4,14,6	29,0 (7·0)	1	4	28,5
3	Brahmapuri	1,87,3	79,1 (42·3)	17,9	4	60,8
4	Sironcha	1,05,3	4,2 (4·0)	5	2	3,5
5	Gadhchiroli	2,55,8	50,7 (19·8)	1,5	2.1	47,1
	Total—Chanda	12,43,5	2,18,9 (17·6)	37,6	3,5	1,77,8
	Total—STATE ..	4,41,49	23,21,0 (5·2)	5,75,2	12,13,9	5,31,9

Notes—(*i*) Figures in brackets in column (4) denote percentages to column (3).
(*ii*) Dash denotes negligible area or percentage.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE

CULTURABLE AREA AND AREAS IRRIGATED BY SOURCES

(Average for the period 1956-57

[Figures in

Serial No.	Name of district	Geographical area	Culturable area
(1)	(2)	(3)	(4)
1	Greater Bombay	58,1	43,0
2	Thana	23,92,4	11,45,3
3	Kolaba	16,96,4	8,57,1
4	Ratnagiri	31,34,5	20,97,3
5	Jalgaon	28,76,3	20,58,3
6	Dhulia	39,79,9	18,94,2
7	Nasik	38,45,8	24,63,3
8	Ahmednagar	42,05,2	32,77,2
9	Poona	38,44,7	28,12,9
10	Sholapur	37,05,5	32,78,5
11	Satara	26,08,2	19,10,1
12	Sangli	21,28,4	18,43,3
13	Kolhapur	20,14,3	13,30,8
14	Aurangabad	40,20,8	34,46,6
15	Parbhani	30,90,6	28,03,0
16	Nanded	29,84,9	22,26,9
17	Bhir	27,60,0	25,12,3
18	Osmanabad	34,66,2	32,60,4
19	Buldhana	24,14,6	18,52,0
20	Akola	26,09,4	20,61,0
21	Amravati	30,13,9	18,74,1
22	Yeotmal	33,40,7	21,24,5
23	Wardha	15,53,7	11,22,3
24	Nagpur	24,43,1	14,97,1
25	Bhandara	22,83,1	10,61,3
26	Chanda	59,83,2	16,14,5
	Total—STATE	7,64,83,9	5,24,67,3

No. 15

IN THE DIFFERENT BASINS AND SUB-BASINS IN MAHARASHTRA

to 1958-59)

hundred acres]

Net area irrigated		Krishna basin (proper)			
				Net area irrigated	
By surface sources	By underground sources	Geographical area	Culturable area	By surface sources	By underground sources
(5)	(6)	(7)	(8)	(9)	(10)
..	9	..	..	..	..
1,3	9,3	..	..	..	..
1,2	3,6	..	..	..	..
18,4	11,9	..	..	..	..
6,9	68,5	..	..	..	..
32,8	53,0	..	..	..	..
42,3	55,2	..	..	..	..
1,13,4	1,71,4	..	..	..	..
1,12,2	88,4	..	..	..	..
63,3	1,84,1	..	..	..	..
91,6	72,0	18,15,3	13,12,5	42,1	37,3
9,4	74,0	15,73,2	13,48,6	9,2	55,1
49,4	26,8	20,14,3	13,30,8	49,4	26,8
..	95,0	..	..	..	..
1	38,3	..	..	..	..
2,0	13,9	..	..	..	..
9,1	66,4	..	..	..	..
8,4	81,8	..	..	..	..
4	19,0	..	..	..	..
1	6,3	..	..	..	..
3	14,8	..	..	..	..
3	5,4	..	..	..	..
1	10,7	..	..	..	..
28,9	33,3	..	..	..	..
2,99,8	6,4	..	..	..	..
2,15,4	3,5	..	..	..	..
11,07,1	12,13,9	54,02,8	39,91,9	1,00,7	1,19,2

TABLE

Serial No.	Name of district	Bhima	
		Geographical area	Culturable area
(1)	(2)	(11)	(12)
1	Greater Bombay	..	..
2	Thana	..	..
3	Kolaba	..	..
4	Ratnagiri	..	..
5	Jalgaon	..	..
6	Dhulia	..	..
7	Nasik	..	..
8	Ahmednagar	18,14,7	14,23,4
9	Poona	38,44,7	28,12,9
10	Sholapur	37,05,5	32,78,5
11	Satara	7,92,9	5,97,6
12	Sangli	5,55,2	4,94,7
13	Kolhapur	..	..
14	Aurangabad	..	..
15	Parbhani	..	..
16	Nanded	..	..
17	Bhir	3,63,4	3,26,7
18	Osmanabad	8,56,5	8,05,0
19	Buldhana	..	..
20	Akola	..	..
21	Amravati	..	..
22	Yeotmal	..	..
23	Wardha	..	..
24	Nagpur	..	..
25	Bhandara	..	..
26	Chanda	..	..
	Total	1,19,32,9	97,38,8

No. 15—*cont.*

sub-basin		Godavari basin (proper)			
Net area irrigated		Geographical area	Culturable area	Net area irrigated	
By surface sources	By under-ground sources			By surface sources	By under-ground sources
(13)	(14)	(15)	(16)	(17)	(18)
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	19,83,4	14,31,2	23,1	39,8
6,9	92,4	23,90,5	18,53,8	1,06,5	79,0
1,12,2	88,4	..	..	..	..
63,3	1,84,1	..	..	..	..
49,5	34,7	..	..	..	..
2	18,9	..	..	..	..
..	..	..	..	..	..
..	..	38,86,2	33,55,7	..	94,3
..	..	22,73,2	20,95,3	1	31,8
..	..	16,95,5	13,63,8	1,3	12,7
4,9	23,1	23,96,6	21,85,6	4,2	43,3
6,4	30,6	26,09,7	24,55,4	2,0	51,2
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
2,43,4	4,72,2	1,72,35,1	1,47,40,8	1,37,2	3,52,1

TABLE

Serial No.	Name of district	Wainganga sub-basin: Geographical area	Culturable area	Net area irrigated: By surface sources	By underground sources
(1)	(2)	(19)	(20)	(21)	(22)
1	Greater Bombay	..	..	..	..
2	Thana	..	..	..	..
3	Kolaba	..	..	..	..
4	Ratnagiri	..	..	..	..
5	Jalgaon	..	..	..	..
6	Dhulia	..	..	..	..
7	Nasik	..	..	..	..
8	Ahmednagar	..	..	..	..
9	Poona	..	..	..	..
10	Sholapur	..	..	..	..
11	Satara	..	..	..	..
12	Sangli	..	..	..	..
13	Kolhapur	..	..	..	..
14	Aurangabad	..	..	..	..
15	Parbhani	8,17,4	7,07,7	..	6,5
16	Nanded	12,89,4	8,63,1	7	1,2
17	Bhir	..	..	..	..
18	Osmanabad	..	..	..	..
19	Buldhana	12,39,8	9,43,1	4	12,0
20	Akola	10,68,0	7,79,9	..	2,7
21	Amravati	8,42,8	6,86,6	1	8,5
22	Yeotmal	33,40,7	21,24,5	3	5,4
23	Wardha	15,53,7	11,22,3	1	10,7
24	Nagpur	24,43,1	14,97,1	28,9	33,3
25	Bhandara	22,83,1	10,61,3	2,99,8	6,4
26	Chanda	59,83,2	16,14,5	2,15,4	3,5
	Total	2,08,61,2	1,14,00,1	5,45,7	90,2

Notes.—(i) Culturable area excludes

(ii) Distribution of talukas of

Source.—Statistician, Agriculture

No. 15—*concld.*

Tapi basin				Basins of west flowing rivers in Konkan			
Geographical area †	Culturable area	Net area irrigated		Geographical area	Culturable area	Net area irrigated	
		By surface sources	By under-ground sources			By surface sources	By under-ground sources
(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
..	..	..	..	88,1	43,0	..	9
..	..	..	..	23,92,4	11,45,3	1,3	9,3
..	..	..	..	16,96,4	8,57,1	1,2	3,6
..	..	..	..	31,34,5	20,97,3	18,4	11,9
28,76,3	20,58,3	6,9	68,5	..	..	..	..
39,79,9	18,94,2	32,8	53,0	..	..	..	..
14,31,1	8,61,8	19,2	15,4	4,31,3	1,70,3	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
1,34,6	90,9	..	7	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
11,74,8	9,08,9	..	7,0	..	..	..	..
15,41,4	12,81,1	1	3,6	..	..	..	..
21,71,1	11,87,5	2	6,3	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
1,33,09,2	82,82,7	59,2	1,54,5	77,42,7	43,13,0	20,9	25,7

land under trees.

districts which extend to more than one basin is shown in the appended note.

Department, Maharashtra State.

NOTES TO

DISTRIBUTION OF TALUKAS BY BASINS IN RESPECT

Serial No.	Name of district	Total No. of talukas in district	Krishna basin		Bhima sub-basin		Godavari basin	
			Name of taluka	Total No.	Name of taluka	Total No.	Name of taluka	Total No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Nasik ..	13	..	..	..	..	Yeola .. Igatpuri. Chandor. Nasik. Sinnar. Niphad. Dindori.	7
2	Ahmednagar	13	..	..	Shrigonda Karjat. Jamkhed. Ahmednagar. Parner.	5	Kopergaon Shrirampur. Rahuri. Akola. Sangamner. Shevgaon. Newasa. Pathardi.	8
3	Satara ..	11	Satara Karad. Jaoli. Patan. Koregaon. Wai. Mahabaleshwar. Khatav.	8	Phaltan Khandala. Man.	3	..	..
4	Sangli ..	6	Tasgaon Shirala. Khanapur. Walwa. Miraj.	5	Jath	1	..	..
5	Aurangabad ..	12	..	..	..	..	Aurangabad Paithan. Gangapur. Vaijapur. Kannad. Khuldabad. Sillod. Bhokardan. Jafferabad. Jalna. Ambad.	11

TABLE No. 15

OF DISTRICTS WHICH COVER MORE THAN ONE BASIN

Wainganga sub-basin		Tapi basin		Basins of west flowing rivers in Konkan	
Name of taluka	Total No.	Name of taluka	Total No.	Name of taluka	Total No.
(10)	(11)	(12)	(13)	(14)	(15)
..	..	Malegaon Nandgaon. Kalwan. Baglan.	4	Peint Surgana.	2
..	..	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
..	..	Soegaon	1	..	..

NOTES TO

DISTRIBUTION OF TALUKAS BY BASINS IN RESPECT

Serial No.	Name of district	Total No. of talukas in district	Krishna basin		Bhima sub-basin		Godavari basin	
			Name of taluka	Total No.	Name of taluka	Total No.	Name of taluka	Total No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
6	Parbhani ..	8	..	..	..	..	Parbhani Jintur. Pathri. Partur. Gangakhed. Basmath.	6
7	Nanded ..	9	..	..	..	..	Nanded Biloli. Degloor. Mukhed. Kandhar. Bhokar.	6
8	Bhir ..	7	..	..	Ashti	1	Bhir Georai. Patoda. Kaij. Mominabad. Manjlegaon.	6
9	Osmanabad ..	11	..	..	Parenda Bhoom. Tuljapur.	3	Osmanabad Kalam. Latur. Owsa. Omerga. Udgir. Nilanga. Ahmedpur.	8
10	Buldhana ..	5	..	..	..	..	..	..
11	Akola ..	6	..	..	..	..	..	..
12	Amravati ..	6	..	..	..	..	..	..

TABLE No. 15—*concld.*

OF DISTRICTS WHICH COVER MORE THAN ONE BASIN

Wainganga sub-basin		Tapi basin		Basin of west flowing rivers in Konkan	
Name of taluka	Total No.	Name of taluka	Total No.	Name of taluka	Total No.
(10)	(11)	(12)	(13)	(14)	(15)
Hingoli Kalamnuri.	2	..	..	..	..
Hadgaon Kinwat. Raura	3	..	..	..	..
..	..	..	..	..	..
..	..	..	..	..	..
Mehkar Chikhali.	2	Malkapur Jalgaon. Khamgaon.	3	..	..
Washim Mangrulpir	2	Akola Akot. Balapur. Murtijapur.	4	..	..
Chandor Morsi.	2	Amravati Daryapur. Achalpur. Melghat.	4	..	..

TABLE No. 16

PERCENTAGE DISTRIBUTION BY CROPS OF AREA IRRIGATED BY (A) GOVERNMENT CANALS AND (B) OTHER SOURCES, IN WESTERN MAHARASHTRA

(Average for the period 1955-56 to 1957-58)

Serial No.	Name of crop	Government canals	Other sources
(1)	(2)	(3)	(4)
1	Rice	3	5
2	Wheat	8	18
3	Jowar	31	27
4	Bajri	9	3
5	Gram	6	5
6	Sugarcane	21	12
7	Cotton	5	2
8	Groundnut	6	—
9	Other crops	11	28
	Total	100	100

Notes.—(i) Data in column (3) are in respect of works mentioned in Table No. 31, for which alone cropwise distribution is available.

(ii) Figures in column (4) have been calculated by deducting areas corresponding to the figures in column (3) from the total irrigated areas under the respective crops.

(iii) Dash denotes negligible percentage.

Source.—(i) Statistician, Agriculture Department, Maharashrta State.

(ii) Irrigation Administration Reports, Government of Maharashtra.

TABLE No. 17

EFFECT OF MAJOR IRRIGATION ON THE CROPPING PATTERN

(Average for the period 1957-58 to 1958-59)

PART A [Area figures in hundred acres]

Serial No.	Item	Baramati taluka (Poona district)	Dhond taluka (Poona district)	Shriram-pur taluka (Ahmed-nagar district)	Sangam-ner taluka (Ahmed-nagar district)
(1)	(2)	(3)	(4)	(5)	(6)
1	Geographical area	3,41,6	3,18,7	2,01,9	4,15,9
2	Net sown area	2,35,9	2,15,7	1,64,6	2,59,4
3	Percentage of item 2 to item 1 ..	69·06	67·68	81·52	62·37
4	Net irrigated area	56,0	16,6	54,3	14,8
5	Percentage of item 4 to item 2 ..	23·74	7·69	32·99	5·70
6	Area irrigated by canals	41,3	2,6	38,7	3,7
7	Percentage of item 6 to item 2 ..	17·51	1·20	23·51	1·43

Source.—Statistician, Agriculture Department, Maharashtra State.

PART B

TABLE No. 17—*concld.*

Serial No.	Crop pattern	Baramati		Dhond		Shrirampur		Sangamner	
		Total area	Percentage distribution	Total area	Percentage distribution	Total area	Percentage distribution	Total area	Percentage distribution
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Rice	2,9	1·18	5	0·22	4	0·23	5	0·18
2	Bajri	29,9	12·14	17,3	7·80	33,7	19·75	1,68,4	62·09
3	*Kharif* jowar	—	—	4,0	1·80	—	—	—	—
4	*Rabi* jowar	1,62,6	66·02	1,64,5	74·20	66,4	38·92	30,4	11·21
5	Wheat	4,3	1·74	3,2	1·44	8,6	5·04	3,3	1·22
6	Gram	4,9	1·99	3,0	1·35	4,6	2·70	1,9	0·70
7	Tur	2,7	1·10	6	0·27	6	0·35	2	0·07
8	Groundnut	8	0·32	8	0·36	8,0	4·69	30,1	11·10
9	Cotton	5,2	2·11	1,8	0·81	2,2	1·29	3	0·11
10	Sugarcane	10,6	4·30	1,4	0·63	29,5	17·29	3,2	1·20
11	Other crops	22,4	9·10	24,6	11·12	16,6	9·74	32,9	12·12
	Gross cropped area ..	2,46,3	100·00	2,21,7	100·00	1,70,6	100·00	2,71,2	100·00

Note.—Dash denotes negligible acreage or percentage.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE No. 18

PERCENTAGE DISTRIBUTION BY CROPS OF AREA IRRIGATED BY NEW WELLS *IN MAHARASHTRA, BY DIVISIONS

(1958-59)

Name of crop (1)	Bombay Division (2)	Poona Division (3)	Aurangabad Division (4)	Nagpur Division (5)
Rice	4·83	1·21	6·87	4·28
Wheat	44·48	10·27	26·33	12·57
Jowar	1·72	43·20	16·79	1·14
Bajri	—	7·85	—	—
Pulses	1·72	3·62	1·53	3·14
Vegetables	11·03	6·34	4·20	19·43
Fruits	2·07	1·21	15·65	28·28
Sugarcane	1·38	7·55	5·72	2·57
Condiments and spices	17·93	6·34	15·27	18·57
Total food crops	85·52	88·82	92·37	90·57
Cotton	—	3·32	1·53	9·43
Groundnut	2·76	2·11	3·05	—
Total—Non-food crops	14·48	11·18	7·63	9·43
Total for all crops	100·00	100·00	100·00	100·00
Average irrigated area per new well	2·90	3·31	2·62	3·50

*Constructed under 'tagai' during the period 1947-48 to 1957-58.

Notes.—(i) Dash denotes negligible percentage.

(ii) Figures in column (2) are for the Bombay Division including Surat district.

Source.—Statistician, Agriculture Department, Maharashtra State.

TABLE No. 19

PERCENTAGE OF AREA IRRIGATED BY WELLS TO GEOGRAPHICAL AREA, AND THE NUMBER OF IRRIGATION WELLS IN MAHARASHTRA, BY TALUKAS

(1957-58)

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Bassein	3·1	4,447	129
2	Bhiwandi	—	—	46
3	Dahanu	0·9	531	12
4	Jawhar	0·3	77	3
5	Kalyan	—	39	9
6	Murbad	—	—	24
7	Mokhada	—	—	—
8	Palghar	0·7	897	59
9	Shahapur	—	—	—
10	Thana	0·5	120	40
11	Umbergaon	0·5	325	32
12	Wada	—	—	—
	Total—Thana	0·4	6,436	354
1 2	Andheri Borivli	0·8	546	90
	Total—Greater Bombay	0·8	546	90
1	Alibag	1·4	2,023	192
2	Pen	—	31	—
3	Panvel	0·6	979	40
4	Karjat	—	—	13
5	Khalapur	—	—	32
6	Roha	—	—	29

Table No. 19—*cont.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
7	Mahad	—	—	—
8	Mangaon	—	—	16
9	Uran	0·4	163	41
10	Sudhagad	—	—	7
11	Poladpur	—	—	1
12	Murud	1·1	519	8
13	Mhasala	—	—	10
14	Shrivardhan	—	—	20
	Total—Kolaba ..	0·2	3,715	409
1	Dapoli	0·4	1,098	44
2	Mandangad	—	128	10
3	Khed	—	2	85
4	Chiplun	—	33	59
5	Guhagar	0·1	804	77
6	Sangameshwar	—	40	45
7	Ratnagiri	0·4	3,207	597
8	Lanja	—	98	59
9	Rajapur	0·2	224	178
10	Devgad	0·6	2,487	290
11	Kankavali	0·2	545	149
12	Malvan	0·9	1,095	53
13	Vengurla	8·1	1,807	21
14	Kudal	0·3	249	15
15	Savantwadi	—	—	—
	Total—Ratnagiri ..	0·4	11,817	1,682

Table No. 19—*cont.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Amalner	3·7	3,882	291
2	Bhadgaon	1·8	1,220	842
3	Bhusawal	1·8	2,799	943
4	Chalisgaon	1·8	4,017	152
5	Chopda	0·6	3,509	3,405
6	Edlabad	1·3	1,379	131
7	Erandol	2·8	3,151	854
8	Jalgaon	1·4	1,940	152
9	Jamner	1·4	2,737	980
10	Pachora	2·2	2,410	1,297
11	Parola	3·7	2,474	1,146
12	Raver	5·6	2,776	408
13	Yaval	3·4	2,726	872
	Total—Jalgaon	2·4	35,020	11,473
1	Dhulia	1·3	1,006	65
2	Shindkheda	3·1	2,947	353
3	Shirpur	0·2	343	177
4	Sakri	0·8	1,405	135
5	Nandurbar	6·3	391	297
6	Nawapur	0·1	215	192
7	Shahada	3·1	1,873	112
8	Taloda	2·6	596	40
9	Akkalkuwa	—	125	23
10	Akrani	—	20	—
	Total—Dhulia	1·4	8,921	1,394

Table No. 19—*cont.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Surgana	—	4	24
2	Peint	—	2	12
3	Baglan	0·8	4,880	395
4	Yeola	2·5	7,286	402
5	Kalwan	0·8	2,120	325
6	Malegaon	1·2	5,740	610
7	Igatpuri	0·2	252	81
8	Chandor	2·8	5,155	222
9	Nasik	1·7	3,970	320
10	Sinnar	2·2	6,640	275
11	Niphad	3·6	6,446	178
12	Nandgaon	1·1	2,722	623
13	Dindori	1·1	2,265	208
	Total—Nasik ..	1·4	47,482	3,675
1	Ahmednagar	7·1	6,310	143
2	Parner	2·8	5,752	811
3	Shrigonda	5·4	4,698	461
4	Karjat	4·5	3,769	481
5	Jamkhed	4·4	4,089	60
6	Rahuri	5·2	3,487	323
7	Newasa	2·3	4,423	538
8	Shevgaon	2·8	3,779	153
9	Pathardi	3·8	4,425	538
10	Sangamner	2·6	4,300	340
11	Akola	0·3	1,244	65
12	Kopergaon	3·1	3,218	445
13	Shrirampur	7·7	4,169	346
	Total—Ahmednagar ..	3·9	53,663	4,704

Table No. 19—*cont.*

Serial No. (1)	Name of taluka (2)	Percentage of area irrigated by wells to geographical area (3)	Number of irrigation wells in use (4)	Number of wells not in use (5)
1	North Sholapur	3·5	1,049	58
2	South Sholapur	3·4	2,351	74
3	Barsi	4·7	4,184	147
4	Madha	6·3	5,120	255
5	Karmala	3·6	2,660	617
6	Pandharpur	4·0	3,552	72
7	Sangola	6·7	5,483	840
8	Malshiras	5·2	2,572	162
9	Mohol	4·5	3,427	716
10	Mangalwedha	4·4	2,089	11
11	Akkalkot	3·7	13,447	88
	Total—Sholapur	4·7	45,934	3,040
1	Poona City	0·9	338	199
2	Haveli	1·3	3,007	957
3	Bhor	0·7	207	59
4	Khed	1·8	3,394	312
5	Baramati	5·2	2,444	522
6	Purandhar	2·0	3,795	432
7	Mawal	0·1	167	83
8	Mulshi	0·1	168	55
9	Junnar	1·5	8,108	803
10	Dhond	3·5	5,170	278
11	Indapur	3·2	3,506	975
12	Velhe	—	1	26
13	Ambegaon	1·4	5,042	477
14	Shirur	1·5	3,579	236
	Total—Poona	1·9	38,926	5,414

Table No. 19—*cont.*

Serial No. (1)	Name of taluka (2)	Percentage of area irrigated by wells to geographical area (3)	Number of irrigation wells in use (4)	Number of wells not in use (5)
1	Satara	1·9	1,961	551
2	Karad	3·9	4,159	119
3	Jaoli	0·3	453	30
4	Patan	0·3	990	265
5	Koregaon	2·4	3,762	490
6	Man	3·5	4,303	812
7	Wai	2·9	1,457	518
8	Khandala	4·3	1,116	26
9	Phaltan	17·5	2,821	294
10	Mahabaleshwar	—	54	11
11	Khatav	4·0	7,061	1,590
	Total—Satara	2·8	28,137	4,706
1	Tasgaon	3·5	5,004	1,510
2	Shirala	0·8	1,303	223
3	Khanapur	3·0	7,947	875
4	Walwa	4·4	3,758	730
5	Miraj	4·5	6,125	406
6	Jath	2·8	5,651	782
	Total—Sangli	3·3	29,788	4,526
1	Ajra	0·1	221	69
2	Bavda	—	47	15
3	Bhudargad	—	140	12
4	Chandgad	0·5	665	62
5	Gadhinglaj	2·1	1,301	52

Table No. 19—*cont.*

Serial No. (1)	Name of taluka (2)	Percentage of area irrigated by wells to geographical area (3)	Number of irrigation wells in use (4)	Number of wells not in use (5)
6	Hatkanangale	7·2	2,586	455
7	Kagal	1·1	1,056	197
8	Karveer	1·9	1,305	149
9	Panhala	1·3	650	104
10	Radhanagari	0·1	346	35
11	Shahuwadi	0·1	168	43
12	Shirol	2·9	1,338	162
	Total—Kolhapur ..	1·3	9,623	1,355
1	Aurangabad	4·3	2,430	300
2	Paithan	2·7	2,656	390
3	Gangapur	2·7	510	470
4	Vaijapur	2·5	2,850	318
5	Kannad	1·3	2,938	60
6	Khuldabad	4·2	2,228	108
7	Sillod	1·8	2,630	500
8	Bhokardan	1·1	2,313	328
9	Jafferabad	1·2	1,328	105
10	Jalna	3·5	6,290	590
11	Ambad	1·8	635	159
12	Soegaon	0·5	210	43
	Total—Aurangabad ..	2·4	27,018	3,371
1	Parbhani	1·7	3,087	—
2	Gangakhed	0·8	1,203	—
3	Pathri	1·9	1,073	—

Table No. 19—*cont.*

Serial No. (1)	Name of taluka (2)	Percentage of area irrigated by wells to geographical area (3)	Number of irrigation wells in use (4)	Number of wells not in use (5)
4	Partur	1·4	N.A.	N.A.
5	Jintur..	0·7	1,708	289
6	Hingoli	0·8	1,309	38
7	Kalamnuri	0·4	1,157	—
8	Basmath	2·3	2,129	745
	Total—Parbhani ..	1·2	11,666*	1,072*
1	Nanded	1·3	1,478	227
2	Biloli	0·5	712	250
3	Degloor	0·1	189	120
4	Mukhed	0·2	148	105
5	Kandhar	1·0	1,015	140
6	Hadgaon	0·3	1,402	—
7	Bhokar	0·3	488	227
8	Kinwat	—	256	169
9	Rajura	N.A.	NA.	N.A.
	Total—Nanded ..	0·5	5,688†	1,238†
1	Bhir	3·0	2,140	650
2	Georai	2·3	2,315	215
3	Ashti	6·1	3,133	140
4	Patoda	3·0	2,160	105
5	Mominabad	1·2	2,710	25
6	Kaij	1·5	12,800	169
7	Manjlegaon	1·0	1,575	825
	Total—Bhir ..	2·5	26,833	2,129

*Excludes figures for Partur taluka. †Excludes figures for Rajura taluka.

Table No. 19—*cont.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Osmanabad	3·3	1,937	56
2	Tuljapur	4·2	2,560	81
3	Paranda	1·8	2,214	62
4	Bhoom	4·4	742	483
5	Kalam	5·0	1,798	875
6	Latur	1·1	1,613	29
7	Owsa	0·6	1,130	287
8	Omerga	3·0	1,293	89
9	Udgir..	0·6	529	120
10	Nilanga	2·7	1,176	177
11	Ahmedpur	0·5	901	225
	Total—Osmanabad ..	2·4	15,893	2,484
1	Mehkar	0·7	3,399	1,562
2	Malkapur	1·2	3,434	1,076
3	Khamgaon	0·3	1,363	2,027
4	Jalgaon	0·3	637	838
5	Chikhali	1·4	4,777	1,335
	Total—Buldhana ..	0·8	13,610	6,838
1	Akola	0·1	239	691
2	Akot	0·4	880	2,006
3	Balapur	0·1	183	263
4	Washim	0·3	962	1,623
5	Mangrulpir	0·2	291	91
6	Murtajapur	0·2	425	608
	Total—Akola ..	0·2	2,980	5,282

Table No. 19—*cont.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Amravati	0·5	1,735	1,805
2	Chandur	0·6	2,094	571
3	Morsi..	1·6	6,352	73
4	Daryapur	0·3	995	952
5	Achalpur	1·0	1,062	883
6	Melghat	..	5	11
	Total—Amravati ..	0·5	12,243	4,295
1	Yeotmal	0·2	877	801
2	Darwha	0·2	1,964	995
3	Pusad..	0·2	740	353
4	Kelapur	0·2	617	611
5	Wani	0·1	120	88
	Total—Yeotmal ..	0·2	4,318	2,848
1	Wardha	0·9	2,424	3,677
2	Arvi	0·9	2,660	3,818
3	Hinganghat	0·3	714	3,175
	Total—Wardha ..	0·7	5,798	10,670
1	Nagpur	1·6	3,830	4,239
2	Ramtek	0·7	1,637	1,608
3	Umrer	0·2	772	1,708
4	Katol	4·2	8,080	4,772
5	Saoner	3·1	5,125	3,372
	Total—Nagpur ..	1·7	19,444	15,699

Table No. 19—*concld.*

Serial No.	Name of taluka	Percentage of area irrigated by wells to geographical area	Number of irrigation wells in use	Number of wells not in use
(1)	(2)	(3)	(4)	(5)
1	Bhandara	0·4	2,350	1,345
2	Gondia	0·2	4,541	986
3	Sakoli	0·2	1,804	571
	Total—Bhandara ..	0·3	8,695	2,902
1	Warora	—	1,217	788
2	Chanda	—	1,250	864
3	Brahmapuri	—	980	549
4	Gadhchiroli	0·2	2,698	503
5	Sironcha	—	429	89
	Total—Chanda ..	0·1	6,574	2,793
	Total—State ..	1·5	4,80,768	1,04,443

Notes.—(1) Dash denotes negligible or nil figures.

(2) N. A. means not available.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 20

THE NUMBER OF OIL ENGINES AND ELECTRIC PUMPS USED FOR IRRIGATION IN MAHARASHTRA, BY DISTRICTS

Serial No.	Name of district	Towns electrified up to 1960	Villages electrified up to 1960	Oil engines (1961)	Electric pumps (1961)
(1)	(2)	(3)	(4)	(5)	(6)
1	Greater Bombay	1	Nil	26	29
2	Thana	11	15	806	63
3	Kolaba	4	2	477	7
4	Ratnagiri	6	3	146	12
5	Nasik	8	1	6,349	107
6	Dhulia	4	1	3,826	81
7	Jalgaon	11	9	6,416	292
8	Ahmednagar	6	Nil	9,812	121
9	Poona	12	38	4,219	92
10	Satara	7	29	2,747	39
11	Sangli	6	25	4,405	91
12	Sholapur	5	1	3,807	19
13	Kolhapur	7	60	7,560	203
14	Aurangabad	6	3	3,585	157
15	Parbhani	2	Nil	571	30
16	Bhir	3	Nil	807	31
17	Nanded	1	Nil	636	30
18	Osmanabad	4	Nil	2,730	57
19	Buldhana	9	7	1,080	229
20	Akola	8	60	437	504
21	Amravati	12	89	1,078	1,680
22	Yeotmal	7	36	413	232
23	Wardha	6	84	473	644
24	Nagpur	11	259	1,079	1,714
25	Bhandara	5	24	136	45
26	Chanda	4	18	174	21
	Total—State	**166**	**764**	**63,795**	**6,530**

Note.—All figures are provisional.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 21

YIELDS OF PRINCIPAL CROPS IN MAHARASHTRA, BY DISTRICTS

(Average for the period 1955-56 to 1959-60)

[Figures in pounds per acre]

Serial No.	Name of district	Rice	Wheat	*Rabi* jowar	Bajri	Gram	Groundnut	Cotton (lint)	Sugar-cane (*gur*)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Thana	1,268	..	..	..	296	..	..	1,568
2	Kolaba	1,123	..	..	..	300	..	..	2,240
3	Ratnagiri	975	..	..	..	300	809	..	2,763
4	Kolhapur	983	335	547	218	313	749	132	6,626
5	Satara	817	594	531	263	347	822	173	5,399
6	Sangli	758	407	315	173	358	593	116	5,773
7	Sholapur	502	384	330	67	262	511	98	7,366
8	Poona	793	266	314	298	280	612	142	7,658
9	Ahmednagar	725	326	368	221	305	531	95	7,651
10	Nasik	758	331	293	260	283	490	83	5,799
11	Jalgaon	522	447	478	252	313	605	89	3,640
12	Dhulia	382	451	512	393	336	648	86	3,575
13	Aurangabad	326	294	503	196	228	262	57	3,878
14	Bhir	334	317	522	164	279	515	62	3,470
15	Parbhani	413	372	522	233	288	297	51	3,792
16	Nanded	376	335	471	233	228	411	61	3,573
17	Osmanabad	415	311	505	233	258	599	55	4,530
18	Akola	429	379	..	78	256	378	79	2,688
19	Buldhana	453	362	452	311	254	376	71	2,309
20	Yeotmal	515	309	452	402	242	349	63	2,150
21	Amravati	512	438	452	262	287	417	75	2,240
22	Wardha	453	333	452	..	275	442	50	2,688
23	Nagpur	787	336	338	..	274	521	50	2,688
24	Chanda	810	312	387	..	246	386	32	3,629
25	Bhandara	812	289	418	..	285	442	41	2,746

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 22

YIELDS OF PRINCIPAL CROPS IN THE STATES IN INDIA

(Average for the period 1951-52 to 1956-57)

[Figures in pounds per acre]

Serial No.	Name of State	Rice	Wheat	Jowar	Bajri	Total cereals	Pulses	Ground-nut	Cotton (lint)	Tobacco	Sugar-cane (*gur*)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	West Bengal	918	578	448	N.A.	906	520	N.A.	N.A.	896	4,188
2	Bihar	582	469	280	407	544	396	N.A.	71	703	1,682
3	Andhra Pradesh	1,001	254	405	409	615	196	768	50	716	6,250
4	Madhya Pradesh	644	477	422	377	495	383	449	76	448	2,482
5	Madras	1,101	N.A.	620	473	852	201	983	121	1,120	6,182
6	Orissa	515	560	395	407	508	197	645	31	611	3,721
7	Uttar Pradesh	519	726	553	510	622	621	1,023	119	731	2,452
8	Assam (Ex. NEFA)	868	746	N.A.	N.A.	863	344	N.A.	141	712	2,379
9	**Maharashtra**	**847**	**348**	**417**	**210**	**424**	**332**	**575**	**65**	**425**	**6,390**
10	Mysore	994	211	350	215	460	262	517	59	380	5,085
11	Kerala	923	N.A.	497	N.A.	915	288	1,156	165	N.A.	4,256
12	Gujarat..	510	584	187	211	309	267	442	95	617	4,547
13	Punjab	803	924	186	292	702	618	401	208	373	2,485
14	Jammu and Kashmir	963	629	N.A.	511	769	497	N.A.	N.A.	N.A.	N.A.
15	Rajasthan	843	833	265	172	425	303	571	108	448	1,924
	Total—INDIA	741	649	389	267	566	422	649	84	638	2,955

Note.—N.A. means not available.

Source.—Bureau of Economics and Statistics, Government of Maharashtra.

TABLE No. 23

COMPARISON OF YIELDS OF SUGARCANE IN SOME COUNTRIES

(Acreage for the period 1948 to 1952)

[Figures in tons per acre]

(A) Yields of sugarcane in tropical countries compared with that in Maharashtra.

1.	Trinidad	24.0
2.	Cuba	15.2
3.	Indonesia	30.7
4.	Mauritius	23.3
5.	Hawaii	69.0
6.	Maharashtra	*43.0

(B) Yields of sugarcane in countries in the temperate zone compared with that in Uttar Pradesh.

1.	Spain	30.0
2.	U. S. A.	18.2
3.	China	15.5
4.	Japan	9.4
5.	Pakistan	13.3
6.	Uttar Pradesh	†11.0

*Relates to 1958-59.

†Relates to 1957-58

Source.—(i) Statistical Abstracts of the United Nations.

(ii) The Indian Sugar Industry Annual.

TABLE No. 24

RUN-OFF SERIES AND RELIABLE YIELD OF THE NIRA RIVER

Gauge station : Vir. Catchment area : 700 sq. miles.

Serial No.	Arranged chronologically: Year	Arranged chronologically: Discharge in MCft.	Arranged in descending order: Year	Arranged in descending order: Discharge in MCft.	Degree of dependability
(1)	(2)	(3)	(4)	(5)	(6)
1	1888	75,450	1946 ..	1,47,928	
2	1889	63,486	1896 ..	1,36,826	
3	1890	89,318	1931-32 ..	1,32,376	
4	1891	62,109	1914 ..	1,27,661	
5	1892	94,718	1944 ..	1,25,604	
6	1893	76,362	1954 ..	1,24,739	
7	1894	99,144	1942 ..	1,21,999	
8	1895	65,901	1956 ..	1,16,355	
9	1896 ..	1,36,826	1943 ..	1,15,354	
10	1897	83,364	1903 ..	1,04,423	
11	1898	74,412	1908 ..	1,03,998	
12	1899	22,662	1907 ..	1,02,380	
13	1900	N. A.	1926 ..	1,01,817	
14	1901	75,450	1894 ..	99,144	
15	1902	96,016	1953 ..	98,609	
16	1903	1,04,423	1945 ..	98,510	
17	1904	79,554	1930-31 ..	96,983	
18	1905	61,603	1919 ..	96,745	
19	1906	59,023	1902 ..	96,016	
20	1907	1,02,380	1947 ..	95,386	
21	1908	1,03,998	1892 ..	94,718	
22	1909	83,392	1915 ..	91,370	
23	1910	90,755	1922 ..	90,755	
24	1911	51,956	1910 ..	90,755	

TABLE No. 24—*cont.*

Serial No.	Arranged chronologically — Year	Arranged chronologically — Discharge in MCft.	Arranged in descending order — Year	Arranged in descending order — Discharge in MCft.	Degree of dependability
(1)	(2)	(3)	(4)	(5)	(6)
25	1912	81,890	1920 ..	89,898	
26	1913	82,230	1890 ..	89,318	
27	1914	1,27,661	1933-34 ..	85,763	
28	1915	91,370	1917 ..	85,122	
29	1916	63,950	1909 ..	83,392	
30	1917	85,122	1897 ..	83,364	
31	1918	27,810	1913 ..	82,230	
32	1919	96,745	1912 ..	81,890	
33	1920	89,898	1923 ..	80,926	
34	1921	7,384	1929-30 ..	80,786 80,228	50 per cent.
35	1922	90,755	1955 ..	79,670	
36	1923	80,926	1904 ..	79,554	
37	1924	70,756	1893 ..	76,362	
38	1925	62,421	1888 ..	75,450	
39	1926	1,01,817	1901 ..	75,450	
40	1927-28	73,123	1898 ..	74,412	
41	1928-29	56,790	1952 ..	73,883 73,579	60 per cent.
42	1929-30	80,786	1927-28 ..	73,123	
43	1930-31	96,983	1949 ..	71,541	
44	1931-32	1,32,376	1948 ..	70,993 70,792	65 per cent.
45	1932-33	20,696	1924 ..	70,756	
46	1933-34	85,763	1937-38 ...	69,743	
47	1934-35	9,517	1895 ...	65,901	

TABLE No. 24—*concld.*

Serial No.	Arranged chronologically: Year	Discharge in MCft.	Arranged in descending order: Year	Discharge in MCft.	Degree of dependability
(1)	(2)	(3)	(4)	(5)	(6)
48	1935-36	43,110	1916 ..	63,950	
49	1936-37	40,188	1889 ..	63,486	
50	1937-38	69,743	1925 ..	62,421	
51	1938-39	52,113	1891 ..	62,109	
				61,730	75 per cent.
52	1939-40	33,722	1905 ..	61,603	
53	1940-41	51,555	1906 ..	59,023	
54	1941-42	26,824	1950 ..	58,293	
55	1942	1,21,999	1928-29 ..	56,790	
				56,737	85 per cent.
56	1943	1,15,354	1951 ..	56,522	
57	1944	1,25,604	1957 ..	54,693	
58	1945	98,510	1938-39 ..	52,113	
59	1946	1,47,928	1911 ..	51,956	
60	1947	95,386	1940-41 ..	51,555	
61	1948	70,993	1935-36 ..	43,110	
62	1949	71,541	1936-37 ..	40,188	
				39,541	90 per cent
63	1950	58,293	1939-40 ..	33,722	
64	1951 ..	56,522	1918 ..	27,810	
65	1952	73,883	1941-42 ..	26,824	
66	1953	98,608	1899 ..	22,662	
67	1954	1,24,739	1932-33 ..	20,696	
68	1955	79,670	1934-35 ..	9,517	
69	1956	1,16,355	1921 ..	7,384	
70	1957	54,693			
	Total	53,96,405			
	Annual average	78,209			

Note.—N. A. means not available.

Source.— Master Plan of the Bhima Valley, Water Resources Investigation Circle, Government of Maharashtra.

TABLE No. 25

RUN-OFF SERIES AND RELIABLE YIELD OF THE MUTHA RIVER

Gauge Station: Khadakwasla. Catchment area: 196 sq. miles

Serial No.	Arranged chronologically		Arranged in descending order		Degree of dependability
	Year	Discharge in MCft.	Year	Discharge in MCft.	
(1)	(2)	(3)	(4)	(5)	(6)
1	1906 ..	41,207	1914 ..	78,821	
2	1907 ..	72,086	1907 ..	72,086	
3	1908 ..	67,355	1946-47 ..	72,015	
4	1909 ..	62,324	1908 ..	67,355	
5	1910 ..	53,056	1931-32 ..	63,233	
6	1911 ..	35,976	1909 ..	62,324	
7	1912 ..	52,264	1933-34 ..	60,274	
8	1913 ..	54,800	1945-46 ..	58,156	
9	1914 ..	78,821	1942-43 ..	57,530	
10	1915 ..	38,662	1938-39 ..	56,261	
11	1916 ..	35,483	1954-55 ..	56,124	
12	1917 ..	48,845	1926-27 ..	55,313	
13	1918 ..	17,357	1913 ..	54,800	
14	1919 ..	48,887	1944-45 ..	53,966	
15	1920 ..	46,695	1910 ..	53,056	
16	1921 ..	36,821	1912 ..	52,264	
17	1922 ..	48,048	1953-54 ..	52,203	
18	1923-24 ..	45,436	1930-31 ..	50,778	
19	1924-25 ..	42,296	1932-33 ..	50,396	
20	1925-26 ..	36,070	1937-38 ..	49,760	
21	1926-27 ..	55,313	1943-44 ..	49,756	
22	1927-28 ..	46,480	1919 ..	48,887	
23	1928-29 ..	N. A.	1917 ..	48,845	
24	1929-30 ..	28,832	1940-41 ..	48,652 48,350	50 per cent.

TABLE No. 25—*concld.*

Serial No.	Arranged chronologically		Arranged in descending order		Degree of dependability
	Year	Discharge in MCft.	Year	Discharge in MCft.	
(1)	(2)	(3)	(4)	(5)	(6)
25	1930-31 ..	50,778	1922	48,048	
26	1931-32 ..	63,233	1920	46,695	
27	1932-33 ..	50,396	1952-53	46,636	
28	1933-34 ..	60,274	1927-28	46,480	
29	1934-35 ..	45,369	1955-56	46,334	
				45,795	60 per cent.
30	1935-36 ..	30,916	1923-24	45,436	
31	1936-37 ..	32,770	1934-35	45,369	
				42,757	65 per cent.
32	1937-38 ..	49,760	1924-25	42,296	
33	1938-39 ..	56,261	1906	41,207	
34	1939-40 ..	36,426	1950-51	39,761	
35	1940-41 ..	48,652	1915	38,662	
36	1941-42 ..	36,009	1951-52	38,622	
				37,271	75 per cent.
37	1942-43 ..	57,530	1921	36,821	
38	1943-44 ..	49,756	1939-40	36,426	
39	1944-45 ..	53,966	1925-26	36,070	
				36,058	80 per cent.
40	1945-46 ..	58,156	1941-42	36,009	
41	1946-47 ..	72,015	1911	35,976	
42	1947-48 ..	35,623	1947-48	35,623	
43	1948-49 ..	25,279	1916	35,483	
44	1949-50 ..	26,324	1936-37	32,770	
				32,518	90 per cent.
45	1950-51 ..	39,761	1935-36	30,916	
46	1951-52 ..	38,622	1929-30	28,832	
47	1952-53 ..	46,636	1949-50	26,324	
48	1953-54 ..	52,203	1948-49	25,279	
49	1954-55 ..	56,124	1918	17,357	
50	1955-56 ..	46,334			
	Total ..	23,12,287			
	Annual average ..	47,190			

Note.—N. A. means not available.

Source.—Master Plan of the Bhima Valley, Water Resources Investigation Circle' Government of Maharashtra.

TABLE

ANNUAL DISCHARGES OF

Serial No.	Year		Nira at Karanja C.A. = 86	Yelwandi at Bhatghar C.A. = 128	Gunjawani at Mohari C.A. = 183	Mutha at Khadakwasla C.A. = 196	Bhima at Chaskaman C.A. = 140
(1)	(2)		(3)	(4)	(5)	(6)	(7)
1	1906	..	12,276	30,601	13,301	41,207	9,176
2	1907	..	20,525	43,789	28,151	72,086	18,155
3	1908	..	20,363	40,086	25,039	67,355	24,064
4	1909	..	18,806	35,997	21,851	62,324	13,360
5	1910	..	25,963	38,185	27,081	53,056	31,054
6	1911	..	9,968	21,073	7,704	35,976	21,263
7	1912	..	15,583	34,656	21,449	52,264	37,500
8	1913	..	29,324	35,229	24,506	54,800	50,444
9	1914	..	25,823	45,412	31,344	78,821	31,006
10	1915	..	14,411	26,781	21,549	38,662	16,718
11	1916	..	23,390	23,812	12,704	35,483	18,048
12	1917	..	24,229	42,512	24,716	48,845	14,341
13	1918	..	8,542	19,925	7,425	17,357	5,633
14	1919	..	31,886	42,873	23,917	48,887	18,182
15	1920	..	21,876	37,728	23,905	46,695	9,275
16	1921	..	21,344	35,736	20,410	36,821	12,871
17	1922	..	21,933	42,130	28,916	48,048	12,967
18	1923	..	22,369	40,768	20,970	45,436	12,598
19	1924	..	18,174	24,943	20,399	42,296	15,030
20	1925	..	15,170	27,312	18,280	36,070	12,110
Total yield		..	4,01,955	6,89,546	4,23,617	9,62,483	3,83,795
Average yield		..	20,098	34,477	21,181	48,124	19,190
75 per cent yield		..	15,583	27,312	20,399	38,662	12,871

Note.—C. A. means catchment

Source.—Master Plan of the Bhima Valley, Water

No. 26

RIVERS IN THE BHIMA VALLEY

[Figures in MCft.]

Kukadi at Shirapur C.A. = 464 (8)	Mina at Wadgaon C.A. = 78 (9)	Ghod at Nirgudsar C.A. = 284 (10)	Sina at Hatwalan C.A. = 446 (11)	Adhala Nalla at at Ekruk C.A. = 159 (12)	Man at Mhaswad C.A. = 480 (13)	Total of columns (3) to (13) C.A. = 2644 (14)
13,467	5,592	19,477	3,281	1,983	2,647	153,008
28,943	7,162	39,610	4,724	1,567	2,631	267,337
32,456	2,861	47,852	1,369	1,557	4,185	267,187
32,023	4,260	42,006	3,172	3,811	5,324	242,934
35,123	6,364	53,493	10,364	6,700	13,939	301,322
24,073	5,548	17,948	2,913	709	3,936	151,111
31,733	10,157	57,661	1,489	607	1,278	264,377
41,334	11,042	47,624	7,653	1,238	2,143	305,337
95,228	17,710	45,700	6,855	2,208	2,288	382,395
64,562	9,195	29,744	4,663	3,657	4,039	233,981
84,854	14,814	41,479	12,593	6,117	..	273,294
29,872	6,535	18,125	4,152	3,893	2,010	219,230
9,114	1,999	7,221	131	253	338	77,988
42,425	7,108	27,582	5,858	2,346	5,334	256,398
33,603	3,450	16,804	755	1,532	1,091	196,714
24,199	7,111	22,792	1,638	1,362	2,688	186,972
32,539	5,158	19,989	2,843	268	437	215,228
33,471	10,058	20,553	2,382	1,667	2,401	212,673
40,042	7,506	34,391	1,975	1,395	1,092	207,243
23,961	3,493	16,425	1,556	1,240	763	156,380
7,53,022	1,47,123	6,26,476	80,366	44,110	58,614	4,571,109
37,651	7,356	31,324	4,018	2,205	2,931	228,555
28,943	5,158	19,477	1,638	1,240	1,220	196,714

area in square miles.

Resources Investigation Circle, Government of Maharashtra.

TABLE

ANNUAL DISCHARGES OF RIVERS

Year			Kadwa at Palkhed C.A.=314	Odal at Khadak Ozar C.A.=38	Godavari at Gangapur C.A.=145	Aundha Nalla at Mukane C.A.=52
(1)			(2)	(3)	(4)	(5)
1906	..	..	11,691	1,169	5,531	6,786
1907	..	..	36,383	651	14,590	10,898
1908	..	..	20,214	302	9,893	5,313
1909	..	..	15,685	1,474	10,234	14,971
1910	..	..	19,691	2,179	7,918	11,955
1911	..	..	12,173	1,011	5,394	2,691
1912	..	..	37,186	1,615	17,432	13,521
1913	..	..	26,229	732	21,879	4,285
1914	..	..	62,888	5,043	22,389	9,838
1915	..	..	28,591	4,378	12,635	3,253
1916	..	..	22,949	6,116	12,299	3,703
1917	..	..	36,908	1,000	14,768	3,892
1918	..	..	10,513	290	6,182	1,622
1919	..	..	38,278	2,326	17,160	4,008
1920	..	..	7,335	191	7,678	3,985
1921	..	..	24,125	980	11,577	3,743
1922	..	..	19,053	97	14,644	...
1923	..	..	16,517	590	13,693	7,860
1924	..	..	17,054	921	14,717	11,114
1925	..	..	8,563	191	6,501	2,724
Total yield		..	4,72,026	31,156	2,47,133	1,26,162
Average yield		..	23,601	1,558	12,356	6,308
75 per cent yield		..	15,685	590	7,918	3,733

Note.—C.A. means catchment area in square miles.

Source.—Technical Paper No. 30. A critical study of Run-off and Floods of

No. 27

IN THE GODAVARI VALLEY

[Figures in MCft.]

Darna at Nandgaon C.A.=156 (6)	Karwa at Pimpalgaon C.A.=67 (7)	Pravara at Ozar Weir C.A.=621 (8)	Mula at Rahuri C.A.=900 (9)	Total of column (3) to (10) C.A.=2293 (10)
21,063	3,214	26,059	32,290	1,07,803
36,187	4,880	27,387	36,879	1,67,855
17,378	4,945	38,767	44,090	1,40,902
13,773	4,306	36,011	42,171	1,38,625
24,054	8,632	33,633	49,370	1,57,432
16,358	2,403	17,708	24,564	82,302
28,019	6,172	26,927	35,865	1,66,737
41,044	7,558	29,817	63,688	1,95,232
30,559	14,701	47,085	59,286	2,51,789
19,158	5,976	28,012	41,219	1,43,222
21,893	6,868	40,958	57,028	1,71,814
34,113	3,570	48,354	34,858	1,77,463
9,663	771	13,655	13,748	56,444
27,572	4,149	40,506	48,288	1,82,287
21,381	2,107	30,594	21,511	94.782
25,750	2,708	19,360	40,304	1,28,547
29,189	3,615	1,198	64,555	1,32,370
25,032	3,222	31,359	33,777	1,32,050
21,259	3,950	29,934	33,883	1,32,832
21,217	2,297	25,592	28,405	95,490
4,84,662	96,044	5,92,916	8,05,779	28,55,978
24,233	4,802	29,646	40,289	1,42,799
21,063	3,214	26,059	33,777	1,28,547

catchments of the Bombay Presidency by C. C. Inglis with A. J. DeSouza.

TABLE No. 28

PROGRESS OF IRRIGATION BETWEEN 1947-48 AND 1960-61 DUE TO MAJOR AND MEDIUM IRRIGATION SCHEMES IN THE STATES IN INDIA

[Area figures in lakh acres]

Serial No.	Name of State	Culturable area	Irrigated area in 1947-48	Area to be irrigated when all major and medium schemes taken upto the end of 1960-61 are completed	Percentage of column (4) to column (3)	Percentage of column (5) to column (3)	Difference between column (7) and column (6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Punjab	212·06	39·78	83·29	18·8	39·3	20·5
2	Bihar	275·73	7·73	63·42	2·8	23·0	20·2
3	West Bengal	144·42	N. A.	29·90	N. A.	20·7	N. A.
4	Uttar Pradesh	498·17	54·72	97·34	11·0	19·0	8·0
5	Andhra Pradesh	385·82	27·10	64·30	7·0	16·6	9·6
6	Madras	204·82	22·52	31·42	11·0	15·6	4·6
7	Orissa	203·66	3·53	29·68	1·7	14·5	12·8

8	Gujarat	270·82	0·05	38·14	2·2	14·0	13·8
9	Rajasthan	611·27	N. A.	36·66	N. A.	6·0	N. A.
10	Mysore	295·10	0·30	15·10	0·1	5·1	5·0
11	Madhya Pradesh	551·71	6·48	28·90	1·2	5·2	4·0
12	**Maharashtra**	**524·67**	**4·94**	**17·42**	**1·0**	**3·3**	**2·3**

Note.—N. A. means not available.

Source.—(i) 'Third Five-Year Plan' Government of India, Planning Commission.
(ii) Financial Results, 1947-48. Government of India, Central Water and Power Commission.
(iii) Statistical Abstract of India, 1957-58. Government of India, Central Statistical Organisation.

TABLE

EXTENT OF IRRIGATION, POPULATION AND OUTLAY ON MAJOR
AND THIRD FIVE-YEAR PLANS IN THE

Serial No.	Name of State	Percentage of net sown area irrigated	Population (1961 Census) in lakhs (Provisional)	Estimated outlay on irrigation in the first three F. Y. Plans (in lakh Rs.)
(1)	(2)	(3)	(4)	(5)
1	Punjab	41·2	2,03	122,80
2	Jammu and Kashmir	44·3	36	9,88
3	Kerala	18·3	1,69	33,99
4	Orissa	17·4	1,76	97,10
5	Andhra Pradesh	25·2	3,60	171,71
6	West Bengal	23·5	3,50	76,53
7	Madras	38·3	3,37	66,78
8	Bihar	22·9	4,65	97,82
9	Rajasthan	11·4	2,01	145,15
10	Mysore	7·4	2,35	110,22
11	Gujarat	5·9	2,06	104,37
12	Uttar Pradesh	27·3	7,38	100,28
13	**Maharashtra**	**5·1**	**3,95**	**104,05**
14	Madhya Pradesh	5·3	3,24	79,23
15	Assam	29·9	1,19	3,98
	India	17·3	43,64	1,342,02

Notes.—(i) Figures in columns (3) and
(ii) N. A. means not available.

Source.—(1) Third Five-Year Plan of
(2) "Provisional Figures" issued
(3) Bureau of Economics and

No. 29

AND MEDIUM IRRIGATION PROJECTS IN THE FIRST, SECOND
DIFFERENT STATES IN INDIA.

Outlay *per capita* in Rs. col. (5)/col. (4)	Non-irrigated area in lakh acres	Outlay in Rs. per non-irrigated acre	Estimated increase in irrigated area *per capita* during 1948 and 1965 (acres)
(6)	(7)	(8)	(9)
60	1,06	1,16	0·21
27	9	1,10	N.A.
20	37	92	N.A.
55	1,14	85	0·15
48	2,10	82	0·10
22	98	78	N.A.
20	89	75	0·03
21	1,48	66	0·12
72	2,72	53	N.A.
47	2,31	48	0·06
51	2,16	48	0·18
13	3,04	33	0·06
26	**4,20**	**25**	**0 03**
24	3,63	22	0·05
3	36	11	N.A.
31	26,68	50	N.A.

(7) relate to 1956-57.

India.
by Registrar General, Census Operations, New Delhi.
Statistics, Government of Maharashtra.

TABLE

IRRIGATION POTENTIAL OF THE

Serial No.	Name of river-basin or sub-basin	Total area of the basin in State: Geographical area (Sq. miles.)	Total area of the basin in State: Geographical area (Lakh acres)	Culturable area (Lakh acres)	Area actually irrigated at present by surface sources (Lakh acres)
(1)	(2)	(3)	(4)	(5)	(6)
1	Krishna basin (proper) ..	8,446·4	54·03	39·92 (73·9)	1·01
2	Bhima sub-basin	18,646·7	119·33	97·39 (81·5)	2·43
3	Godavari basin (proper) ..	27,052·6	172·35	147·40 (85·5)	1·37
4	Wainganga sub-basin (including Penganga and Wardha sub-basin).	32,630·5	208·61	114·00 (54·6)	5·46
5	Tapi basin	19,975·2	133·09	82·83 (62·2)	0·59
6	Basins of west flowing rivers in Konkan.	12,200·5	77·43	43·13 (55·7)	0·21
	Total ..	1,18,951·9	764·84	524·67 (68·6)	11·07

Notes.—(i) Figures in col. (13) show the maximum area river valleys. In case the percentage of peren- shown in col. (10.)

(ii) N.A. means not available.

(iii) Figures in brackets are percentages of col. (5) to

(iv) *According to projects envisaged in the Master

(v) Figures in brackets are percentages of col. (13) to

(vi) †Yield available after allowing for the upper

(vii) ‡Yield available after allowing for upper

Source.—Figures in columns (4) to (6) are repeated
Figures in col. (3) are taken from the
Figures in col. (7) to (12) are supplied by

No. 30

RIVER BASINS IN MAHARASHTRA

Water resources 75% dependable (T.M.C.)	Water resources 50% dependable (T.M.C.)	Utilisable quantity out of 75% dependable supply (T.M.C.) *	Culturable commanded area (Lakh acres) *	Area which can be brought under irrigation by water resources in col. 9. By Lift (Lakh acres)	By flow (Lakh acres)	Total (Lakh acres)
(7)	(8)	(9)	(10)	(11)	(12)	(13)
769·54	913·46	512·80	13·84	0·61	9·65	10·26 (25·7)
309·40	415·98	308·42	26·07	2·55	16·07	18·62 (19·2)
403·60	N.A.	363·66	32·34	N.A.	23·67	23·67 (16·1)
†719·12	N.A.	499·63	42·34	N.A.	30·14	30·14 (26·4)
‡228·86	397·68	206·07	16·35	N.A.	12·93	12·93 (15·6)
1,500·00	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
3,930·52						

which can be irrigated with the crop pattern indicated in the relevant Master Plans of the nials is reduced, the irrigable area would be correspondingly increased, limited to the area

col. (4.)

Plans so far prepared by the Water Resources Investigation Circle.

col. (5.)

utilisation of 37·3 T.M.C. in Madhya Pradesh.

utilisation of 132 T.M.C. in Madhya Pradesh.

from Table No. 15.

Statistician, Agriculture Department, Maharashtra State.

Water Resources Investigation Circle, Poona.

TABLE No. 31

DISTRIBUTION OF IRRIGATED AREAS BY CROPS ON IRRIGATION WORKS OF DIFFERENT TYPES IN WESTERN MAHARASHTRA

(Average for the period 1955-56 to 1957-58)

Serial No.	Name of crop	Weir schemes		Small storage schemes		Large storage schemes		Total for storage schemes		Total for all schemes	
		Area (Acres)	Percentage	Area (Acres)	Percentage	Area (Acres)	Percentage	Area (Acres)	Percentage	Area (Acres)	Percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	Sugarcane ..	1,055	5	142	2	66,152	22	66,294	22	67,349	21
2	Wheat ..	7,091	37	848	14	19,496	7	20,344	7	27,435	8
3	Rice	1,253	6	111	2	8,272	3	8,383	3	9,636	3
4	Jowar ..	3,157	16	2,900	49	94,894	32	97,794	32	1,00,951	31
5	Bajri ..	142	1	308	5	28,230	9	28,538	9	28,680	9
6	Gram ..	1,333	7	644	11	18,426	6	19,070	6	20,403	6
7	Tur	1	—	14	—	4,816	2	4,830	2	4,831	1
8	Groundnut ..	60	—	58	1	17,811		17,869	6	17,929	6

9	Cotton	..	366	2	542	9	15,147	5	15,689	5	16,055	5
10	Others	..	5,156	26	401	7	26,224	8	26,625	8	31,781	10
	Total	..	19,614	100	5,968	100	2,99,468	100	3,05,436	100	3,25,050	100

Notes.—(i) Small storage schemes are those with a live storage of less than 500 MCft.

(ii) Large storage schemes are those with a live storage of more than 500 MCft.

(iii) The irrigation works under each group are those listed in Table No. 33.

(iv) Dash denotes negligible percentage.

Source.—Irrigation Administration Reports, Government of Maharashtra.

TABLE

CAPITAL COST OF IRRIGATION PROJECTS TAKEN UP

Serial No.	Name of project	Live storage (MCft.)	Gross annual utilisation (MCft.)	Capital cost (Lakh Rs.)
(1)	(2)	(3)	(4)	(5)
	(I) MAJOR PROJECTS			
	(A) Western Maharashtra			
1	Vir	9,408	14,680	558·01
2	Mula	32,600	34,400	1,517·00
3	Girna	23,000	22,482	1,254·24
4	Ghod	6,030	10,450	499·00
5	Warna	2,800	4,340	154·50
6	Karwand	770	1,250	116·27
7	Kurnoor	1,690	2,740	170·00
8	Khadakwasla	14,700	18,100	1,129.00
9	Gangapur (both stages)	7,200	9,800	490·61
	Total (A) ..	98,198	1,18,242	5,888·63
	(B) Vidarbha			
1	Bor-stage I	3,000	3,500	277·34
2	Itiadoh	16,305	14,300	692·02
3	Dina	1,976	2,800	226·91
4	Nalganga	2,526	2,465	201·32
5	Bagh	6,600	8,800	584·28
6	Katepurna	3,280	2,900	233·32
	Total (B) ..	33,687	34,765	2,215·19

No. 32

IN THE FIRST AND THE SECOND FIVE-YEAR PLANS

Irrigable command (Acres) (6)	Cost per MCft. of live storage (5) divided by (3) (Rs.) (7)	Cost per MCft. of gross annual utilisation (5) divided by (4) (Rs.) (8)	Irrigable command per MCft. of gross annual utilisation (6) divided by (4) (Acres) (9)
1,01,000	5,930	3,805	6·90
2,31,400	4,650	4,410	6·72
1,42,870	5,450	5,575	6·36
62,400	8,270	4,770	5·97
20,000	5,510	3,560	4·61
11,200	15,100	9,300	8·96
15,000	10,060	6,200	5·48
77,000	7,670	6,230	4·26
64,000	6,820	5,010	6·52
7,24,870	5,990	4,980	6·12
26,250	9,240	7,910	7·50
74,500	4,250	4,840	5·21
30,500	11,500	8,100	10·89
24,500	7,950	8,150	9·94
60,000	8,850	6,625	6·82
24,000	7,100	8,030	8·27
2,39,750	6,577	6,374	6·90

TABLE

CAPITAL COST OF IRRIGATION PROJECTS TAKEN UP

Serial No.	Name of project	Live storage (MCft.)	Gross annual utilisation (MCft.)	Capital cost (Lakh Rs.)
(1)	(2)	(3)	(4)	(5)
	(C) Marathwada			
1	Purna	32,529	34,300	1,411.00
2	Manar-stage I	1,455	4,406	192·01
	Total (C) ..	33,984	38,706	1,603·01
	Total for major projects ..	1,65,869	1,91,704	9,706·83
	(II) MEDIUM PROJECTS			
	(A) Western Maharashtra			
1	Ranand Tank	225	225	30·18
	Total (A) ..	225	225	30·18
	(B) Vidarbha			
1	Pindrabodi Tank	464	550	37·50
2	Ekburjee Tank	416	592	42·99
	Total (B) ..	880	1,142	80·49
	(C) Marathwada			
1	Sindphana	382	561	48·78
2	Thirna	301	466	54·06
3	Chandani	537	965	69·86
	Total (C) ..	1,220	1,992	169·70
	Total for medium projects	2,325	3,359	280·37
	Total for major and medium projects	1,68,194	1,95,063	9,987·20

No. 32—*cont.*

IN THE FIRST AND THE SECOND FIVE YEAR PLANS

Irrigable command (Acres)	Cost per MCft. of live storage (5) divided by (3) (Rs.)	Cost per MCft. of gross annual utilisation (5) divided by (4) (Rs.)	Irrigable command per MCft. of gross annual utilisation (6) divided by (4) (Acres)
(6)	(7)	(8)	(9)
1,52,000	4,337	4,113	4·43
25,000	10,320	4,360	5·67
1,77,000	4,718	4,141	4·57
11,41,620	5,852	5,065	5·96
2,700	13,420	13,420	12·00
2,700	13,420	13,420	12·00
5,050	8,081	6,817	9·18
7,500	10,340	7,263	12·70
12,550	9,147	7,050	10·99
7,000	12,770	8,695	12·47
6,000	16,963	10,957	12·87
9,200	13,156	7,240	9·53
22,200	13,910	8,519	11·14
37,450	12,060	8,349	11·15
11,79,070	5,937	5,419	6·04

TABLE

CAPITAL COST OF IRRIGATION PROJECTS TAKEN UP

Serial No.	Name of project	Live storage (MCft.)	Gross annual utilisation (MCft.)	Capital cost (Lakh Rs.)
(1)	(2)	(3)	(4)	(5)
	(III) MINOR WORKS (TANKS)			
1	Guravpimpri	116	109	11·496
2	Daruj	102	80	11·924
3	Saptana	117	90	11·745
4	Chincholi	98	81	14.607
5	Talwar	114	165	14·240
6	Kamli	110	206	19·990
7	Tamve	125	125	10·454
8	Durgaon	73	113	7·769
9	Bahirobawadi	49	53	7·160
10	·Zadi	40	47	8·513
	Total for minor works ..	944	1,069	117·898

Note.—The estimated capital cost mentioned in column (5) is in some cases liable to cost of individual schemes. Changes in the individual cost of schemes would not affect

Source.—(1) Information regarding major and medium projects is supplied by the

(2) Information regarding minor works (tanks) at Sr. Nos. 1 to 7 Legislature, and that regarding works at serial Nos. 8 to 10 supplied

TABLE

FINANCIAL POSITION OF COMMERCIAL

Serial No.	Name of scheme	Capital cost up to 1950-51 (in hundred Rs.)	Live storage (MCft.)
(1)	(2)	(3)	(4)
(A) Large storage scheme			
1	Ekrur Tank	13,40,4	2,349
2	Chankapur Tank	20,79,5	1,548
3	Mutha Canal including Matoba Tank	70,19,2	3,252
4	Pravara River Works	1,52,60,5	11,389
5	Ashti Tank	8,41,7	1,064
6	Mhaswad Tank	20,96,0	1,538
7	Kadwa River Works	10,35,9	606
8	Nira L. B. C. & R. B. C.	5,72,06,7	4,791
9	Godavari Canals	1,06,86,4	7,763
	Total (A)	9,75,66,3	54,300
(B) Small storage schemes			
1	Mhaswa Tank	1,39,0	153
2	Mayani Tank	6,80,9	81
3	Bhatodi Tank	3,79,2	37
4	Sirsuphal Tank	2,24,6	330
5	Parsul Tank	4,82,9	98
6	Pathri Tank	6,42,8	407
7	Bhadalwadi Tank	5,91,5	202
	Total (B)	31,40,9	1,308
(C) Weir schemes			
1	Shahada Channel	1,07,5	—
2	Chikhali Canal	57,4	—
3	Upper Man River Project	4,39,3	—
4	Rewadi Canal	59,8	—
5	Lower Panzara River Works	4,68,6	—
6	Yerala River Irrigation Works	7,81,5	—
7	Jamda Canal	10,51,4	—
8	Krishna Canal	9,49,8	—
	Total (C)	39,15,3	—

Notes.—(i) Figures in columns (5) to (9) are averages

(ii) Large storage schemes are those with a

(iii) Small storage schemes are those with a

(iv) Capital outlay for Godavari Canals is up

(v) Other expenditure excludes expenditure

(vi) Dash denotes negligible expenditure.

Source.—(i) Annual Finance Schedules, Maharashtra

(ii) Irrigation Administration Reports,

No. 32—*concld.*

IN THE FIRST AND THE SECOND FIVE YEAR PLANS—*concld.*

Irrigable command (Acres) (6)	Cost per MCft. of live storage (5) divided by (3) (Rs.) (7)	Cost per MCft. of gross annual utilisation (5) divided by (4) (Rs.) (8)	Irrigable command per MCft. of gross annual utilisation (6) divided by (4) (Acres) (9)
1,887	9,913	10,550	17·3
1,600	11,690	14,890	20·0
1,800	10,040	13,050	20·0
1,800	14,910	18,040	22·2
3,000	12,490	8,630	18·2
2,400	18,180	9,943	11·6
1,980	8,358	8,358	15·8
1,704	10,640	6,876	15·1
800	14,610	13,510	15.0
700	21,283	18,110	15·0
17,671	12,480	11,040	16·5

revision. The object of this table is to give an idea of the average cost rather than the exact the averages materially.

Irrigation and Power Department.

extracted from the material supplied by Government to the Estimate Committee of by the Executive Engineers concerned.

No. 33
IRRIGATION SCHEMES IN WESTERN MAHARASHTRA

Receipts (in hundred Rs.)	Recurring expenditure (in hundred Rs.)			
	Maintenance and repairs	Establishment charges	Other expenditure	Total
(5)	(6)	(7)	(8)	(9)
3,40,0	37,8	23,5	5	61,8
6,02,0	33,7	16,5	6	50,8
5,89,7	88,9	74,6	1,6	1,65,1
25,87,6	2,03,6	3,75,9	3,4	5,82,9
31,2	6,7	11,7	2	18,6
62,9	15,5	24,7	3	40,5
1,48,7	14,4	57,6	7,6	79,6
46,35,7	3,51,3	8,51,2	11,5	12,14,0
20,67,9	1,88,7	4,04,2	2,5	5,95,4
1,10,65,7	9,40,6	18,39,9	28,2	28,08,7
3,9	2,2	2,6	—	4,8
17,3	5,2	8,0	1	13,3
5,2	1,8	5,8	1	7,7
5,6	3,9	3,2	—	7,1
10,9	5.8	14,6	1	20,5
27,3	3,9	4,4	—	8,3
13,2	3,6	6,6	1	10,3
83,4	26,4	45,2	4	72,0
56,4	11,6	15,2	2	27,0
4,6	1,6	9	—	2,5
9,5	7,2	11,1	1	18,4
5,0	3,2	4,6	—	7,8
35,0	13,0	19,7	2	32,9
30,7	14,6	20,8	4	35,8
96,6	21,2	31,0	4	52,6
77,2	20,7	41,8	4	62,9
3,15,0	93,1	1,45,1	1,7	2,39,9

for the years 1957-58 to 1959-60.
live storage of more than 500 MCft.
live storage of less than 500 MCft.
to 1946-47 only.
on extensions and improvements.

State.
Government of Maharashtra.

TABLE No. 34

SUMMARY OF THE FINANCIAL POSITION OF COMMERCIAL IRRIGATION SCHEMES IN WESTERN MAHARASHTRA

(Based on Table No. 33)

Serial No.	Item	Large storage schemes		Small storage schemes		Weir schemes
		Total (Lakh Rs.)	Per MCft. (Rs.)	Total (Lakh Rs.)	Per MCft. (Rs.)	Total (Lakh Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Capital outlay up to the end of 1950-51. *	975.66	1,797	31.41	2,401	39·15
2	Receipts	110.66	204	0.83	63	3·15
3	Expenditure—					
	(a) Maintenance and repairs.	9.41	17	0.26	20	0·93
	(b) Establishment ..	18.40	33	0.45	35	1·45
	(c) Other expenditure ..	0.28	0·51	—	—	0·02
	(d) Interest at 4·75 per cent. per annum.	46.34	85.34	1.49	114	1·86
	Total expenditure— (Annual cost) ..	74.43	135.85	2.20	169	4·26
4	Profit (+) or loss (−) ..	+36.23	+68.15	−1.37	−106	−1·11

*For Godavari Canals, capital cost is given up to 1946-47 only so as to exclude the cost of the new Gangapur Project.

Note.—The figures against item 4 are based on the capital outlay against item 1. The capital cost of large storage schemes was Rs. 1,797 per MCft. as stated in column (4) above whereas at the present rates of construction the capital cost would be about Rs. 6,000 per MCft. The apparent profit under large storage schemes obtains only because of the low capital cost incurred on these schemes.

TABLE No. 35

CALCULATION OF THE SUM-AT-CHARGE ON THE CAPITAL COST PER MCFT. OF STORAGE

Year since commencement of construction	Capital cost (In Rs.)	Percentage potential created	Percentage utilisation of the total potential	Annual receipts (In Rs.)	Recurring expenditure (In Rs.)	Interest charges (In Rs.)	Annual cost [col. (6) *plus* col. (7)] (In Rs.)	Annual loss [col. (8) *minus* col. (5)] (In Rs.)	Sum-at-charge at the end of the year
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1st ..	1,100	..	..	..	..	26	26	26	1,126
2nd ..	1,300	..	..	..	..	84	84	84	2,510
3rd ..	1,300	..	..	..	..	150	150	150	3,960
4th ..	1,300	25	10	..	13	219	232	232	5,492
5th ..	500	25	35	14	26	273	299	285	6,277
6th ..	500	25	60	62	39	310	349	287	7,064
7th ..	..	25	85	144	52	336	388	244	7,308
8th ..	..	..	100	246	52	347	399	153	7,461
9th ..	..	..	100	336	52	354	406	70	7,531
10th ..	..	..	100	390	52	358	410	20	7,551
Total ..	6,000	100	100	..	..	..	..	1,551 say (1,550)	..

Therefore, the sum-at-charge is Rs. 6,000 + 1,550 = Rs. 7,550

TABLE

WATER REQUIREMENTS OF CROPS AND THE

Serial No.	Name of crop	Earliest date of watering	Latest date of watering	Normal period of growth (days)	Interval in days between two waterings	Acre-inch depth per watering at canal head
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Rice (early)	15th May ..	14th Oct. ..	110	10	5·2
2	Rice (late)	15th May ..	14th Nov. ..	150	10	5·2
3	*Kharif* jowar	1st July ..	31st Oct. ..	110	30	3·9
4	*Rabi* jowar	1st Sept. ..	28th Feb. ..	130	30	3·9
5	Bajri	1st July ..	31st Oct. ..	100	30	3·9
6	Wheat	1st Nov. ..	28th Feb. ..	130	20	3·9
7	Gram	1st Nov. ..	28th Feb. ..	100	30	3·9
8	Tur	1st July ..	31st Dec. ..	180	30	3·9
9	*Kharif* groundnut ..	1st July ..	31st Oct. ..	120	30	3·9
10	Summer groundnut ..	1st Mar. ..	30th June ..	110	20	3·9
11	Ordy. cotton	1st July ..	30th Nov. ..	150	30	3·9
12	Long staple cotton ..	1st April ..	30th Nov. ..	220	S. 10 O.S. 30	3·9
13	Sugarcane	Throughout the year	..	*	10	5·2
14	Other perennials ..	Throughout the year	..	*	10	5·2
15	Other crops	1st July ..	28th Feb. ..	100	30	3·9

Notes.—(i) Number of waterings during the *kharif* season are worked out after taking into

(ii) Figures in column (16) are worked out on the basis explained in the attached

(iii) S. = Summer.

(iv) O. S. = Other seasons.

(v) Dash denotes 'nil'.

(vi) *Not worked out due to varying periods and seasons.

No. 36

COSTS OF WATER REQUIRED

Annual water requirements in acre-inches at canal head								
Kharif		*Rabi*		Summer		Total		Cost of water required (in Rs.)
1st July to 30th Sept.		1st Oct. to 28th Feb.		1st March to 30th June				
Number of waterings	Quantity (acre-inches)	Number of waterings	Quantity (acre-inches)	Number of waterings	Quantity (acre-inches)	Number of waterings	Quantity (acre-inches)	
(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
5	26·0	—	—	3	15·6	8	41·6	44·20
5	26·0	3	15·6	4	20·8	12	62·4	69·37
1	3·9	1	3·9	—	—	2	7·8	8·19
—	—	4	15·6	—	—	4	15·6	18·41
2	7·8	—	—	—	—	2	7·8	7·18
—	—	6	23·4	—	—	6	23·4	27·61
—	—	3	11 7	—	—	3	11·7	13·81
1	3·9	3	11·7	—	—	4	15·6	17·40
2	7·8	1	3·9	—	—	3	11·7	11·78
—	—	—	—	6	23·4	6	23·4	30·42
2	7·8	2	7·8	—	—	4	15·6	16·38
2	7·8	2	7·8	7	27·3	11	42·9	51·87
7	36·4	15	78·0	12	62·4	34	176·8	206·65
7	36·4	15	78·0	12	62·4	34	176·8	206·65
2	7·8	4	15·6	—	—	*	*	*

consideration a normal effective rainfall of about 10 inches.
notes.

Notes to Table No. 36

Method of calculation of cost of water.

(1) In calculating water requirements at the canal head, losses are assumed to be 30 per cent. of the requirement at the distributary head.

(2) Annual utilization is 128·5 per cent. of stored quantity.

(3) Annual recurring cost is Rs. 410 per MCft. of storage or Rs. 320 per MCft. of water utilised.

(4) Percentage of storage capacity used in the different seasons :—

			Per cent.
Kharif	..	..	28·5
Rabi	..	..	63·9
Summer	..	..	36·1
Total		..	128·5

(5) 1·1 MCft. of water on 1st October is equivalent to 1 MCft. in the summer, the difference being the loss due to evaporation.

(6) If 'W' is the cost of water in the *rabi* season, it is 1·1 'W' in the summer and 100 'W' in the *kharif* season.

128·5

(7) To recover Rs. 410 per MCft., we have

$$\frac{(100\,W \times 28{\cdot}5) + (W \times 63{\cdot}9) + (1{\cdot}1\,W \times 36{\cdot}1)}{128{\cdot}5}$$

= Rs. 41,000

i.e. 125·8 W = 41,000

or W = 325·9 or Rs. 326 approximately.

(8) Hence the cost of water utilised is as below :—

			Per MCft.	Per acre-inch
			Rs.	Rs.
Kharif	..	..	254	0·92
Rabi ..	..	..	326	1·18
Summer	..	..	359	1·30
Average	..	..	320	1·16

TABLE No. 37

WATER UTILISED BY AREAS UNDER DIFFERENT CROPS IRRIGATED BY STORAGE SCHEMES IN WESTERN MAHARASHTRA

Serial No.	Name of crop	Crop pattern (percentage)	Water requirements for areas in column (3) (in acre-inches at canal head)			
			Kharif	*Rabi*	Summer	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Rice (early)	1	26·0	—	15·6	41·6
2	Rice (late)	2	52·0	31·2	41·6	124·8
3	*Kharif* jowar	12	46·8	46·8	—	93·6
4	*Rabi* jowar	20	—	312·0	—	312·0
5	Bajri	9	70·2	—	—	70·2
6	Wheat	7	—	163·8	—	163·8
7	Gram	6	—	70·2	—	70·2
8	Tur	2	7·8	23·4	—	31·2
9	*Kharif* groundnut ..	6	46·8	23·4	—	70·2
10	Summer groundnut ..	—	—	—	—	—
11	Ordinary cotton	5	39·0	39·0	—	78·0
12	L. S. cotton	—	—	—	—	—
13	Sugarcane	22	709·8	1,521·0	1,216·8	3,447·6
14	Other perennials	1	36·4	78·0	62·4	176·8
15	Others	7	23·4	62·4	—	85·8
	Total ..	100	1,058·2	2,371·2	1,336·4	4,765·8

Notes.—(i) Dash denotes nil or negligible.

(ii) Figures in column (3) are percentage shares of different crops irrigated by storage schemes in Western Maharashtra.

(iii) Water utilisation pattern : Percentage of utilisation : Percentage of storage.

	Percentage of utilisation	Percentage of storage
Total	100·0 ..	128·5
Kharif ..	22·2 ..	28·5
Rabi	49·8 ..	63·9
Summer ..	28·0 ..	36·1

(iv) Irrigable area per MCft. at canal head according to above water requirements—

	Acres
(*a*) Per MCft. of utilisation	5·8
(*b*) Per MCft. of storage (allowing 10 per cent of summer utilisation as evaporation losses).	7·2

(v) Acreage actually irrigated by storage schemes in Western Maharashtra, in one MCft. at canal head —

	Acres
(*a*) Per MCft. of utilisation	4·3
(*b*) Per MCft. of storage	5·5

(vi) Figures in columns (4) to (7) are the products of the figures in column (3) multiplied by those in columns (9), (11), (13) and (15), respectively, in Table No. 36, except in respect of items 13 and 15. In respect of '13 Sugarcane', the requirements are worked out for 19·6 acres which would be the equivalent standing cane area for 22 acres. For item '15 Others' out of 7 acres, 3 are assumed as *kharif* and 4 *rabi*.

TABLE No. 38

ESTIMATES OF GROSS INCOMES OF DIFFERENT CROPS IRRIGATED BY GOVERNMENT IRRIGATION WORKS IN WESTERN MAHARASHTRA

Serial No.	Name of crop	Yield per irrigated acre (B. Md.)	Average harvest price (Rs. per B.Md.)	Gross income (Rs. per acre) [col. (3) × col.(4)]	Percentage of area to total area irrigated	Col. (5) × col.(6) (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Paddy	20	14	280	3	840
2	*Kharif* jowar	15	12	180	31	5,580
3	*Rabi* jowar	15	12	180		
4	Bajri	12	14	168	9	1,512
5	Wheat	15	19	285	8	2,280
6	Gram	12	15	180	6	1,080
7	Tur	10	22	220	1	220
8	Groundnut (pods) ..	25	16	400	6	2,400
9	Ordinary cotton (kapas) ..	10	33	330	5	1,650
10	L. S. cotton (kapas) ..	20	33	660		
11	Sugarcane (annual yield) ..	35 (tons)	55 (per ton)	1,925	21	40,425
12	Others	..	..	150	10	1,500
	Total ..	..	..	..	100	57,487

TABLE No. 39

COMPARISON OF COSTS OF WATER REQUIRED BY DIFFERENT CROPS WITH THEIR ESTIMATED GROSS INCOMES

[Figures in Rs. per acre]

Serial No.	Name of crop	Cost of water	Gross income	6 per cent. of column (4)	12 per cent. of column (4)
(1)	(2)	(3)	(4)	(5)	(6)
1	Early rice	44·20	280	16·8	33·6
2	*Kharif* jowar	8·19	180	10·8	21·6
3	*Rabi* jowar	18·41	180	10·8	21·6
4	Bajri	7·18	168	10·1	20·2
5	Wheat	27·61	285	17·1	34·2
6	Gram	13·81	180	10·8	21·6
7	Tur	17·40	220	13·2	26·4
8	Groundnut (pods)	11·78	400	24·0	48·0
9	Ordinary cotton (kapas)	16·38	330	19·8	39·6
10	L. S. cotton (kapas)	51·87	660	39·6	79·2
11	Sugarcane	206·65	1,925	115·5	231·0
12	Others	..	150	9·0	18·0
	Average per acre (weighted) ..	..	575	34·5	69·0

Notes.—(i) Figures in column (3) are those in column (16) of Table No. 36.

(ii) The average per acre is worked out on the basis of the crop pattern shown in column (12) of Table No. 31.

(iii) Figures in column (4) are those in column (5) of Table No. 38.

TABLE

CHARGES FOR IRRIGATION WATER AT PRESENT LEVIED FOR

Serial No.	Category	Sugarcane	Banana	Early rice	Late rice
(1)	(2)	(3)	(4)	(5)	(6)
	(A) Western Maharashtra.				
*1	Major canals—				
	(i) Flow from canals—				
	(*a*) Water rate	160·00	160·00	6·00	15·00
	(*b*) Irrigation cess	30·00	30·00	3·00	3·00
	(*c*) Local fund cess	30·00	30·00	1·12	1·81
	(*d*) Total of (a), (b) and (c) ..	220·00	220·00	10·12	19·81
	(ii) Lift from canals—				
	(*a*) Water rate	160·00	160·00	6·00	15·00
	(*b*) Irrigation cess	—	—	—	—
	(*c*) Local fund cess	30·00	30·00	1·12	1·81
	(*d*) Total of (a), (b) and (c) ..	190·00	190·00	7·12	16·81
	(iii) Pazar flow—				
	(*a*) Water rate	160·00	160·00	Free	Free
	(*b*) Irrigation cess	—	—	—	—
	(*c*) Local fund cess	30·00	30·00	—	—
	(*d*) Total of (a), (b) and (c) ..	190·00	190·00	Free	Free
	(iv) Pazar lift up to 45 ft.—				
	(*a*) Water rate	60·00	60·00	Free	Free
	(*b*) Irrigation cess	—	—	—	—
	(*c*) Local fund cess	11·25	11·25	—	—
	(*d*) Total of (a), (b) and (c) ..	71·25	71·25	Free	Free
2	Minor tanks—				
	**(i) In Nasik and Central Circles—				
	(*a*) Water rate	80·00	80·00	6·00	14·00
	(*b*) Irrigation cess	30·00	30·00	3·00	3·00
	(*c*) Local fund cess	15·00	15·00	1·12	2·62
	(*d*) Total of (a), (b) and (c) ..	125·00	125·00	10·12	19·62
	***(ii) In the Deccan Irrigation Circle—				
	(*a*) Water rate	80·00	N.P.	6·00	14·00
	(*b*) Irrigation cess	30·00	N.P.	3·00	3·00
	(*c*) Local fund cess	15·00	—	1·12	2·62
	(*d*) Total of (a), (b) and (c) ..	125·00	N.P.	10·12	19·62

No. 40

DIFFERENT CROPS IN MAHARASHTRA, BY REGIONS

[In Rs. per acre]

Wheat	*Rabi* jowar	Bajri	Cotton	Groundnut	Fruit trees
(7)	(8)	(9)	(10)	(11)	(12)
9·00	9·00	6·00	15·00	6·00	100·00
3·00	3·00	3·00	3·00	3·00	15·00
1·69	1·69	1·12	1·81	1·12	18·75
13·69	13·69	10·12	19·81	10·12	133·75
9·00	9·00	6·00	15·00	6·00	100·00
—	—	—	—	—	—
1·69	1·69	1·12	1·81	1·12	18·75
10·69	10·69	7·12	16·81	7·12	118·75
Free	Free	Free	15·00	6··00	100·00
—	—	—	—	—	—
—	—	—	1·81	1.12	18·75
Free	Free	Free	16.81	7.12	118·75
Free	Free	Free	6·00	N.P.	30·00
—	—	—	—	—	—
—	—	—	1·12	—	5·62
Free	Free	Free	7·12	N.P.	35·62
8·00	8·00	6·00	14·00	6·00	40·00
3·00	3·00	3·00	3·00	3·00	15·00
1·50	1·50	1·12	2·62	1·12	7·50
12·50	12·50	10·12	19·62	10·12	62·50
8·00	8·00	6·00	14·00	6·00	40·00
3·00	3·00	3·00	3·00	3·00	15·00
1·50	1·50	1·12	2·62	1·12	7·50
12·50	12·50	10·12	19·62	10·12	62·50

TABLE

Serial No. (1)	Category (2)	Sugarcane (3)	Banana (4)	Early rice (5)	Late rice (6)
3	River lift on the Radhanagari Project.—				
	(i) Private lift—				
	(*a*) Water rate	20·00	N.P.	5·00	N.P.
	(*b*) Irrigation cess	—	—	—	—
	(*c*) Local fund cess	3·75	—	0·94	—
	(*d*) Total of (a), (b) and (c) ..	23·75	N.P.	5·94	N.P.
	(ii) Gat. lift (50 feet)—				
	(*a*) Water rate	200·00	N.P.	15·00	N.P.
	(*b*) Irrigation cess	—	—	—	—
	(*c*) Local fund cess	37·50	—	2·81	—
	(*d*) Total of (a), (b) and (c) ..	237·50	N.P.	17·81	N.P.
	(B) Vidarbha.				
	(i) Agreement system—				
1	All tanks in Chanda, Bhandara and Nagpur districts except Sadepur and Kuinbali tanks—				
	(*a*) Water rate	N.P.	N.P.	N.P.	4·00
	(*c*) Local fund cess	—	—	—	0·62
	(*d*) Total of (a) and (c)	N.P.	N.P.	N.P.	4·62
2	Sadepur and Kumbali tanks in Bhandara district—				
	(*a*) Water rate	N.P.	N.P.	N.P.	2·00
	(*c*) Local fund cess	—	—	—	0·31
	(*d*) Total of (a) and (c)	N.P.	N.P.	N.P.	2·31
	(ii) Demand system—				
	All tanks in Chanda, Bhandara and Nagpur districts—				
	(*a*) Water rate	25·00	N.P.	N.P.	12·00
	(*c*) Local fund cess	3·90	—	—	1·87
	(*d*) Total of (a) and (c)	28·90	N.P.	N.P.	13·87
	(C) Marathwada.				
	Rs. 4 to 6 per acre for all crops recovered as consolidated land revenue.				

Notes.—(i) N. P. means rates
*See list
**See list
***See list

(ii) Irrigation cess is levied in

Source.—Relevant Government

No. 40—*cont.*

Wheat	*Rabi* jowar	Bajri	Cotton	Groundnut	Fruit trees
(7)	(8)	(9)	(10)	(11)	(12)
5·00	5·00	5·00	10·00	5·00	N.P.
0·94	0·94	0·94	1·87	0·94	—
5·94	5·94	5·94	11·87	5·94	N.P.
30·00	10·00	15·00	25·00	15·00	N.P.
5·62	1·87	2·81	4·69	2·81	—
35·62	11·87	17·81	29·69	17·81	N.P.
N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
N.P.	N.P.	N.P.	N.P.	N.P.	N.P.
1·50	N.P.	N.P.	4·00	4·00	15·00
0·23	—	N.P.	0·62	0·62	2·34
1·73	N.P.	N.P.	4·62	4·62	17·34

not prescribed.
X below.
Y below.
Z below.
Western Maharashtra only.
Orders on the subject.

TABLE No. 40—*concld.*

LIST X.

(1) Nira Canals.
(2) Pravara Canals.
(3) Godawari Canals.
(4) Mutha Canals.
(5) Gangapur Canals.
(6) Girna Canals.
(7) Ghod Canals.
(8) Shetphal Tank.
(9) Matoba Tank.
(10) Visapur Tank.
(11) Kadwa River Works.

LIST Y.

(1) Ekruk Tank.
(2) Shahada Channel.
(3) Lower Panzra River Works.
(4) Mhaswa Tank.
(5) Jamda Canals.
(6) Ashti Tank.
(7) Pathri Tank.
(8) Krishna Canal.
(9) Mhaswad Tank.
(10) Rewari Canal.
(11) Upper Man River Works.
(12) Yerala River Works.
(13) Mayni Tank.
(14) Shirsuphal Tank.
(15) Bhadalwadi Tank.
(16) Madanwadi Tank.
(17) Parewadi Tank.
(18) Talsangi Tank.
(19) Wahi Bandhara.
(20) Warshinde.
(21) Gherdi Tank.
(22) Hotgi Tank.
(23) Sangvi Tank.
(24) Koregaon Tank.
(25) Wakeswar Bandhara.

LIST Z.

(1) Bhatodi Tank.
(2) Parsul Tank.
(3) Khirdi Sathe Tank.
(4) Khamgaon Tank.
(5) Rakh Tank.
(6) Kasurdi Tank.
(7) Mandvgan Tank.
(8) Limji wadi Tank.
(9) Bahirobawadi Tank.
(10) Durgaon Tank.
(11) Gunjala Tank.
(12) Kolgaon Tank.
(13) Gunodi Tank.
(14) Kanadgaon Tank.
(15) Ladi Tank and Nimgaon Pick-up-weir.
(16) Banganga Tank.

TABLE No. 41

PERCENTAGE DISTRIBUTION OF IRRIGATION WATER BY SEASONS AND CROPS, WORKED OUT ON THE BASIS OF AN ILLUSTRATIVE CROP PATTERN ON THE MAJOR STORAGE SCHEMES IN WESTERN MAHARASHTRA

Serial No.	Name of crop	Percentage of area irrigated	Percentage of water required
(1)	(2)	(3)	(4)
	(A) *Kharif*		
1	Basic cane	12	10·4
2	Overlap cane	6	
3	Other perennials	5	3·3
4	*Kharif* seasonals	12	1·7
5	Cotton in *kharif*	25	3·6
			19·0
	(B) *Rabi*		
1	Basic cane	12	24·7
2	Overlap cane	6	
3	Other perennials	5	7·7
4	*Rabi* seasonals	40	12·4
5	Cotton in *rabi*	25	3·9
			48·7
	(C) Summer		
1	Basic cane	12	14·5
2	Overlap cane	1·2	
3	Other perennials	5	6·2
4	Preseasonal cotton	25	11·6
			32·3
			100·0

Notes.—(i) In item (c) 2, above average percentage of overlap is taken as 10 per cent.

(ii) Figures in column (3) total up to 187·2 acres instead of 100 because following crops occur in each of the three seasons :—

Basic cane—2 × 12 = 24 .. ..
Overlap cane—6 + 1·2 = 7·2 .. ..
Cotton—25 × 2 = 50 .. ..
Other perennials—3 × 2 = 6 ..

87·2 acres.

TABLE No. 42

GROSS INCOME FROM ONE HUNDRED ACRES WITH THE CROPPING PATTERN SHOWN IN TABLE No. 41

Serial No.	Name of crop	Area (Acres)	Gross income per acre (Rs.)	Gross income for the area (3×4) (Rs.)	Percentage of total gross income
(1)	(2)	(3)	(4)	(5)	(6)
1	Basic cane	12	1,925	34,650	53·0
2	Overlap cane	6			
3	Other perennials	5	1,000	5,000	7·6
4	Cotton	25	660	16,500	25·2
5	*Kharif* seasonals	12	168	2,016	3·1
6	*Rabi* seasonals	40	180	7,200	11·1
				65,366	100·0

Note.—One MCft. of water irrigates 4·98 acres. Therefore, gross income from one MCft. of annual utilisation would be :

Rs. 654×5 = Rs. 3,270.

TABLE No. 43

GROSS INCOMES WITH DECREASING AVAILABILITY OF SUPPLY OF WATER

Availability as percentage of requirements of long term commitments	Percentage of normal gross income*		
	A†	B†	C†
(1)	(2)	(3)	(4)
100	100	100	100
98	96	95	95
96	91	91	91
94	87	86	86
92	83	82	82
90	78	77	77
88	74	73	73
85	67	66	70
80	56	54	62
75	47	47	49
70	42	42	42
60	35	35	35
50	25	25	25

*Normal gross income is Rs. 3,270 as shown in note in Table No. 42.

†Alternative orders of priority in which acreage under crops may be cut in the following crop season, as necessitated by the magnitude of the availability shown in column (1).

Alternative (A)—
(1) All cotton.
(2) *Khodwa* sugarcane.
(3) *Rabi* seasonals.

Alternative (B)—
(1) *Khodwa* sugarcane.
(2) All cotton.
(3) *Rabi* seasonals.

Alternative (C)—
(1) *Khodwa* sugarcane.
(2) *Rabi* seasonals (50 per cent).
(3) All cotton.
(4) *Rabi* seasonals (remaining 50 per cent).

TABLE

PROBABLE GROSS INCOME FOR YIELDS OF WATER IN THE FOUR VALLEYS

No. of years	Nira at Vir				
	Yield during 1938 to 1957	50 per cent. dependable supply (*viz.*, 79,670 MCft.)		85 per cent. of 50 per cent. dependable supply	
		A	B	A	B
(1)	(2)	(3)	(4)	(5)	(6)
1	52,113	65	38	77	54
2	33,722	42	22	50	25
3	51,551	64	37	76	51
4	26,824	34	20	40	20
5	1,21,999	100	100	100	100
6	1,15,354	100	100	100	100
7	1,25,604	100	100	100	100
8	98,510	100	100	100	100
9	1,47,928	100	100	100	100
10	95,386	100	100	100	100
11	70,993	89	75	100	100
12	71,541	90	77	100	100
13	58,293	73	46	84	68
14	56,522	71	43	83	66
15	73,883	93	84	100	100
16	98,608	100	100	100	100
17	1,24,739	100	100	100	100
18	79,670	100	100	100	100
19	1,16,355	100	100	100	100
20	54,693	69	41	81	63
(i) Average		..	74·2	..	82·5
(ii) Gross income for 100 per cent. long term commitment at Rs. 3,270 per MCft. (crore Rs.).		..	26·1	..	22·1
(iii) Average annual gross income for the entire period [(i) × (ii)] (crore Rs.).		..	19·4	..	18·2
(iv) Average annual gross income from additional area irrigated by occassional surplus availability up to 50 per cent. dependable supply. (crore Rs.).		..	Nil	..	1·7
(v) Total average annual gross income. [(iii) + (iv)]. (crore Rs.).		..	19·4	..	19·9

No. 44

WITH THE ILLUSTRATIVE CROP PATTERN GIVEN IN TABLE No. 42

No. of years	Mutha at Khadakwasla: Yield during 1936 to 1955	50 per cent. dependable supply (*viz.*, 48,652 MCft.) A	50 per cent. dependable supply (*viz.*, 48,652 MCft.) B	85 per cent. of 50 per cent. dependable supply A	85 per cent. of 50 per cent. dependable supply B
(1)	(7)	(8)	(9)	(10)	(11)
1	32,770	67	39	79	59
2	49,760	100	100	100	100
3	56,261	100	100	100	100
4	36,426	75	49	88	73
5	48,652	100	100	100	100
6	36,009	74	48	87	72
7	57,530	100	100	100	100
8	49,756	100	100	100	100
9	53,966	100	100	100	100
10	58,156	100	100	100	100
11	72,015	100	100	100	100
12	35,623	73	46	86	71
13	25,279	52	27	63	36
14	26,324	54	29	64	37
15	39,761	82	65	96	91
16	38,622	79	59	94	86
17	46,636	96	91	100	100
18	52,203	100	100	100	100
19	56,124	100	100	100	100
20	46,334	95	88	100	100
(i) Average		..	77·1	..	86·2
(ii) Gross income for 100 per cent. long term commitment at Rs. 3,270 per MCft. (crore Rs.).		..	15·9	..	13·5
(iii) Average annual gross income for the entire period [(i × (ii)] (crore Rs.).		..	12·3	..	11·7
(iv) Average annual gross income from additional area irrigated by occassional surplus availability up to 50 per cent. dependable supply. (crore Rs.).		..	Nil	..	1·5
(v) Total average annual gross income. [(iii) + (iv)]. (crore Rs.)		..	12·3	..	13·2

TABLE

No. of Years	Ghod at Nirgudsa				
	Yield during 1906 to 1925	50 per cent. dependable supply (*viz.*, 29,744 MCft.)		85 per cent. of 50 per cent. dependable supply	
		A	B	A	B
(1)	(12)	(13)	(14)	(15)	(16)
1	19,477	65	38	77	54
2	39,610	100	100	100	100
3	47,852	100	100	100	100
4	42,006	100	100	100	100
5	53,493	100	100	100	100
6	17,948	60	35	71	43
7	57,661	100	100	100	100
8	47,624	100	100	100	100
9	45,700	100	100	100	100
10	29,744	100	100	100	100
11	41,479	100	100	100	100
12	18,125	61	36	72	45
13	7,221	24	20	29	20
14	27,582	93	84	100	100
15	16,804	56	31	67	39
16	22,792	90	77	85	70
17	19,989	67	39	79	59
18	20,553	69	41	78	56
19	34,391	100	100	100	100
20	16,425	55	30	65	38
(i) Average		..	71·5	..	76·2
(ii) Gross income for 100 per cent. long term commitment at Rs. 3,270 per MCft. (crore Rs.).		..	9·7	..	8·3
(iii) Average annual gross income for the entire period. [(i) × (ii)]. (crore Rs.).		..	7·0	..	6·3
(iv) Average annual gross income from additional area irrigated by occassional surplus availability up to 50 per cent. dependable supply. (crore Rs.).		..	Nil	..	0·7
(v) Total average annual gross income. [(iii) + (iv)]. (crore Rs.).		..	7·0	..	7·0

Notes.—(i) A : Actual yield as percentage
(ii) B : Gross income as percentage of
(iii) Cut in area according to

No. 44—*concld.*

No. of years	Bhima at Chaskaman: Yield during 1906 to 1925	50 per cent. dependable supply (*viz.*, 16,718 MCft.) A	50 per cent. dependable supply B	85 per cent. of 50 per cent. dependable supply A	85 per cent. of 50 per cent. dependable supply B
(1)	(17)	(18)	(19)	(20)	(21)
1	9,176	55	30	65	38
2	18,155	100	100	100	100
3	24,064	100	100	100	100
4	13,360	80	62	94	86
5	31,054	100	100	100	100
6	21,263	100	100	100	100
7	37,500	100	100	100	100
8	50,444	100	100	100	100
9	31,006	100	100	100	100
10	16,718	100	100	100	100
11	18,048	100	100	100	100
12	14,341	86	71	100	100
13	5,633	34	20	40	20
14	18,182	100	100	100	100
15	9,275	56	31	65	38
16	12,871	77	54	91	79
17	12,967	78	56	91	79
18	12,598	75	49	89	75
19	15,030	90	77	100	100
20	12,110	72	45	86	71
(i) Average		..	74·7	..	84·3
(ii) Gross income for 100 per cent. long term commitment at Rs. 3,270 per MCft. (crore Rs.).		..	5·5	..	4·7
(iii) Average annual gross income for the entire period. [(i) × (ii)] . (Crore Rs.).		..	4·1	..	3·9
(iv) Average annual gross income from additional area irrigated by occassional surplus availablity up to 50 per cent. dependable supply. (crore Rs.).		..	Nil	..	0·4
(v) Total average annual gross income. [(iii) + (iv)] (crore Rs.).		..	4·1	..	4·3

gross income with 85 per cent. of 50 per cent. dependable supply.
alternative 'C' in Table No. 43.

TABLE No. 45

NUMBER OF YEARS BETWEEN 1941 AND 1960 IN WHICH FIRST REPLENISHMENT WAS RECEIVED IN THE VARIOUS RESERVOIRS BEFORE CERTAIN DATES

Serial No.	Name of reservior	Number of years in which first replenishment was received		
		By 15th June	Between 16th June to 30th June	After 30th June
(1)	(2)	(3)	(4)	(5)
1	Bhatghar	6	11	3
2	Bhandardara	5	11	4
3	Darna	5	12	3
4	Chankapur	7	10	3
5	Khadakwasla	4	14	2
6	Asola Mendha	7	9	4
7	Ghorajheri	6	7	7
8	Naleshwar	6	7	7
9	Garmosi	6	10	4
10	Khairbandha	5	11	4
11	Ramtek	7	8	5
12	Chandpur	6	11	3
	Average ..	5·9	10·1	4·0
	Percentage of the total number of years (cumulative).	29·5	80·0	100·0

TABLE No. 46

UTILISATION OF THE AVAILABLE WATER AT THE VIR PICK-UP-WEIR

Serial No.	Item	1954-55	1955-56	1956-57
(1)	(2)	(3)	(4)	(5)
1	Storage on the first date of withdrawal (capacity of the Bhatghar reservoir).	24,198	24,198	24,198
2	Overflow at Vir	45,050	25,387	48,462
3	Water which could have been carried by canals in the overflow period.	12,210	20,630	21,900
4	Water carried by canals when Vir was not overflowing in monsoon.	4,330	3,394	2,266
5	Total canal supply available in monsson (item 3 + item 4).	16,540	24,024	24,166
6	Quantity utilised in monsoon at canal head ..	10,160	10,380	11,240
7	Non-utilisation in monsoon (Per cent). $\frac{\text{item 5} - \text{item 6}}{\text{item 5}} \times 100$	38·57	60·95	53·48
8	Quantity utilised in the year outside the monsoon	21,285	19,594	18,744
9	Non-utilisation in other seasons (Per cent). $\frac{\text{item 11}}{\text{item 1}} \times 100$	3·68	7·61	9·98
10	Total quantity utilised at canal head in the year (item 6 + item 8).	31,445	29,974	29,984
11	Quantity carried over to next year..	891	1,841	2,416
12	Losses by evaporation, etc. (item 1 — item 8 — item 10).	2,022	2,763	3,038
13	Quantity not utilised—			
	(*a*) out of monsoon supply (item 5 — item 6) ..	6,380	13,644	12,926
	(*b*) in other seasons (item 11)	891	1,841	2,416
	(*c*) Total (*a*) + (*b*)	7,271	15,485	15,342
14	Non-utilisation of total supply (Per cent)—			
	(*a*) monsoon $\frac{\text{item 13 } (a)}{\text{item 5 + item 1}} \times 100$	15·66	28·29	26·72
	(*b*) other seasons $\frac{\text{item 13 } (b)}{\text{item 5 + item 1}} \times 100.$	2·18	3·81	4·99
	(*c*) Total (*a*) + (*b*) $\frac{\text{item 13 } (c)}{\text{item 5 + item 1}} \times 100.$	17·85	32·11	31·72
15	No. of days from first replenishment to first withdrawal (days).	117	135	156

Note.—All figures in MCft. except where indicated otherwise.

Source.—Superintending Engineer, Deccan Irrigation Circle (I), Maharashtra State,

TABLE No. 47

COMPARISON OF IRRIGABLE COMMANDS AS PER PROJECT REPORT WITH AREAS ACTUALLY IRRIGATED IN RESPECT OF THREE MAJOR STORAGE SCHEMES IN MAHARASHTRA

[Figures in acres]

Year	Nira Canals				Pravara Canals				Girna Canals			
	Sugarcane	Other crops	Total	Total 'standard crop acres'.	Sugarcane	Other crops	Total	Total 'standard crop acres'.	Sugarcane	Other crops	Total	Total 'standard crop acres'
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
According to the project report.	21,750	1,63,875	1,85,625	3,63,975	10,000	52,000	62,000	1,44,000	1,800	8,500	10,300	25,060
Actual irrigation.												
1948-49 ..	23,041	1,35,219	1,58,260	3,47,196	16,633	43,518	60,151	1,96,542	3,584	15,020	18,604	47,998
1949-50 ..	23,275	1,43,270	1,66,545	3,57,400	16,216	55,674	71,890	2,04,861	3,650	15,350	19,000	48,930
1950-51 ..	26,511	1,32,327	1,58,838	3,76,223	16,582	52,356	68,938	2,04,910	3,455	15,661	19,116	47,447
1951-52 ..	20,290	1,29,126	1 49,416	3,15,794	16,457	45,350	61,807	1,96,754	3,944	16,377	20,321	52,662
1952-53 ..	20,584	1,24,954	1,45,538	3,14,327	16,232	44,545	60,777	1,93,879	3,244	14,089	17,333	43,934

1953-54 ..	17,741	1,53,445	1,71,186	3,16,662	8,272	54,615	62,887	1,30,717	4,226	13,466	17,692	52,345
1954-55 ..	26,360	77,475	1,03,835	3,19,987	16,456	50,054	66,510	2,01,449	4,951	7,260	12,211	52,809
1955-56 ..	22,799	1,22,049	1,44,848	3,31,800	16,585	29,209	45,794	1,81,791	5,799	9,022	14,821	62,373
1956-57 ..	27,492	1,24,455	1,51,947	3,77,381	20,588	23,198	43,786	2,12,608	6,628	11,353	17,981	72,331
1957-58 ..	29,759	1,25,645	1,55,404	3,99,428	17,863	31,357	49,220	1,95,697	3,441	6,616	10,057	38,273
Average ..	23,785	1,26,797	1,50,582	3,45,620	16,188	42,988	59,176	1,91,921	4,292	12,421	16,713	51,910

Note.—Standard acres are obtained by multiplying the figures in columns (2), (6) and (10) by 9·2 which is the ratio of the water requirements of sugarcane in terms of equivalent standing cane area and the group 'Other crops' and then adding them to the figures in columns (3), (7) and (11), respectively.

Source.—Irrigation Administration Reports, Government of Maharashtra.

TABLE No. 48

UTILISATION OF STORED WATER IN SOME MINOR TANKS IN THE LOW RAINFALL ZONE OF MAHARASHTRA

Serial No.	Name of tank and storage capacity	District	Stored water: Utilised during the year MCft.	Stored water: In balance as on 15th June MCft.	Percentage of col. (5) to col. (4)
(1)	(2)	(3)	(4)	(5)	(6)
1	Shirsuphal 330.06 MCft. excluding silt.	Poona ..	138	55	40
2	Bhadalwadi 202·42 MCft. excluding silt.	Poona ..	126	20	16
3	Mandanwadi 197·93 MCft. excluding silt.	Poona ..	83	68	82
4	Palasdar 61·04 MCft. excluding silt.	Poona ..	49	31	63
5	Banganga 271 MCft.	Satara ..	153	92	60
6	Khamgaon 84 MCft.	Poona ..	22	11	50
7	Parsul 118·70 MCft.	Nasik ..	69	41	59
8	Rooty 232·13 MCft.	Bhir ..	224	149	66
9	Nher 386 MCft. (Live storage) ..	Satara ..	310	94	30
10	Pingli 103·00 MCft. (Live storage)	Satara ..	66	15	23
11	Ranand 225·00 MCft. (Live storage).	Satara ..	150	68	45
12	Mayani 70·44 MCft. (Live storage)	Satara ..	81	46	57

Note.—Figures in columns (4) and (5) are averages for the years 1956-57 to 1960-61.

SUBJECT INDEX

SUBJECT	PAGE

SUBJECT	PAGE

GPN—J-1099—MSIC—25-7-62—1,500.

A TYPICAL CROSS SECTION OF A VALLEY IN THE DECCAN TRAP AREA

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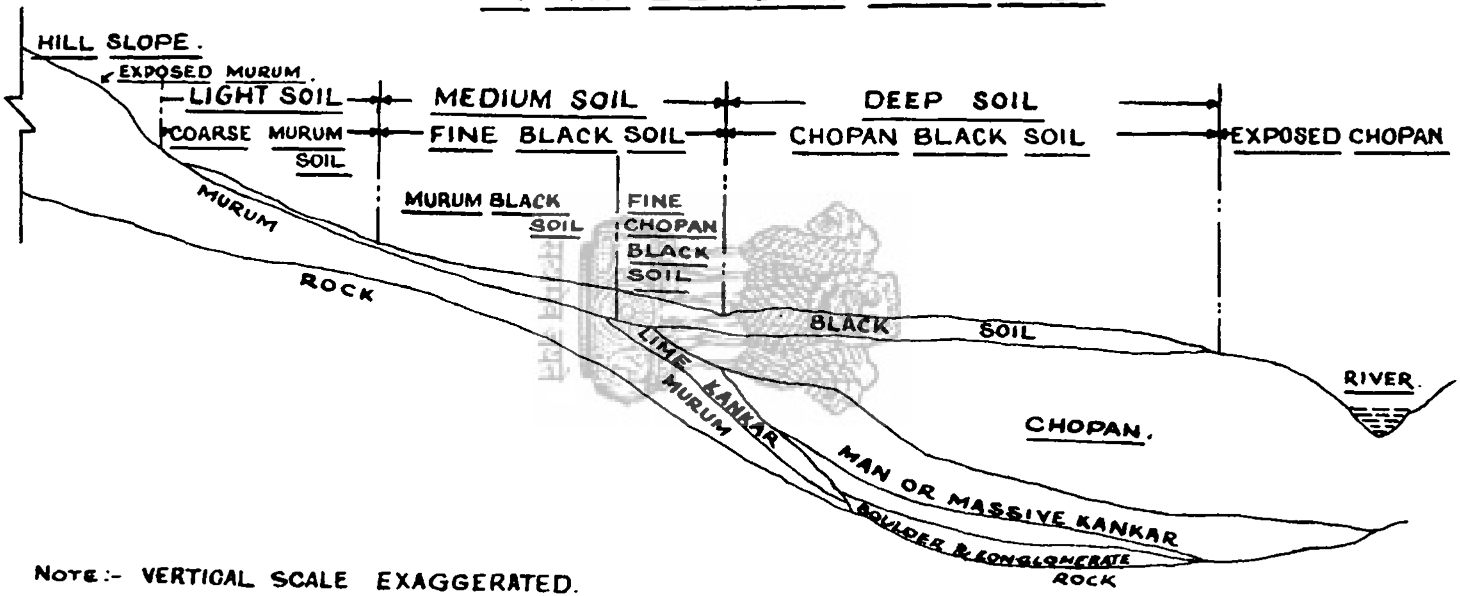
J-1099—4-A

A TYPICAL CROSS SECTION OF A VALLEY IN THE DECCAN TRAP AREA



NOTE :- VERTICAL SCALE EXAGGERATED.

MAHARASHTRA STATE IRRIGATION COMMISSION.

G.P.Z. P. POONA UR\3320-1500