

**STUDY ON THE UTILISATION OF KHARIF IRRIGATION
POTENTIAL IN FIVE AGRO - CLIMATIC ZONES
OF MAHARASHTRA**

ASHOK K. MITRA

**GOKHALE INSTITUTE OF POLITICS AND ECONOMICS
PUNE - 411 004 (INDIA)**

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FOREWORD

Endowed with the largest irrigation system in the world, India has a long history of irrigation development and utilization. Nevertheless in drought prone and water scarce States like Maharashtra, the management of surface irrigation is crucial for economic progress.

Efficient management is the most important factor in obtaining the largest returns from present and future investments in surface irrigation. According to the Maharashtra State Irrigation Commission, which assessed the ultimate irrigation potential of the State, full exploitation of all the available surface water resources would bring under irrigation hardly 26 per cent of the cultivated acreage of the State. In view of this, water resources have become a limiting factor in the development of agriculture and full and proper utilization of the available irrigation potential becomes extremely important.

A number of studies have been carried out at the Institute in recent years on the management and the use of irrigation water in Maharashtra and issues related to this. The present study is in continuation of the previous studies and is especially concerned with the crucial issue of the full utilization of the irrigation potential of the State.

This study was undertaken at the instance of the Government of Maharashtra and was funded by the USAID. The study covers all the five major agro-climatic zones in Maharashtra State and examines the utilization of kharif irrigation potential, in particular.

The extent of utilization of the irrigation potential is generally found to be very low in Maharashtra during the kharif

(ii)

season. This study utilizes both the conventional method of estimating the extent of utilization as well as the subjective evaluation of farmers regarding their demand for irrigation water during kharif season. The various factors accounting for the different levels of utilization in the different agro-climatic zones are identified and their relative importance assessed. These factors could, of course, differ from one agro-climatic zone to another.

The study reveals the conflicting demands that arise in zones with assured rainfall and other zones between the objectives of supply of water for protective irrigation when rainfall is inadequate and for intensive irrigation.

Detailed meso-level studies regarding the irrigation potential, cropping pattern, rotation and intensity, rainfall and the distribution of water for protective and productive irrigation, are essential for efficient management of water resources, especially in a water scarce State like Maharashtra. It is hoped that plans for agricultural development would be based on such studies. The assessment of the rates of returns from investment in irrigation and agriculture can be made only on the basis of such studies. It is hoped that this study is useful to the planners and policy-makers in answering some of the questions relating to efficient water management and for improving the irrigation system in the State of Maharashtra.

Gokhale Institute of
Politics and Economics
Pune-411 004

February 1987

K. Sivaswamy Srikantan
Officiating Director

PREFACE

This study is an enquiry into the utilization of irrigation potential in the State of Maharashtra with special reference to kharif season utilization. It is based on the subjective and objective evaluations of the factors responsible for particularly low utilization of irrigation potential in kharif season in five agro-climatic zones in Maharashtra. The purpose of enlisting irrigation schemes from different agro-climatic zones is to ensure the inclusion of different rainfall patterns of the state which is likely to have an impact on utilization of kharif irrigation potential.

The subjective evaluation of the reasons for low utilization is based on the opinion survey of the irrigators in the command area of different projects, whereas the objective evaluation of the same is carried out through the analysis of time series data on rainfall in the command and catchment areas and on the availability of storage at different dates during the year. The nature and extent of supply and demand constraints for low utilization, particularly in kharif season, are attempted to be ascertained through these evaluations.

The purpose of undertaking both subjective and objective evaluations is to examine the correspondence between the reasons arising out of these evaluations and to ascertain which of the factors responsible for low utilization in kharif arising out of objective evaluation is considered most important by the irrigators.

The study was undertaken at the instance of the USAID through the Government of Maharashtra. We thank the Government of Maharashtra for entrusting this study to us and for rendering financial support to carry out the study.

(iv)

I am grateful to Professor N. Rath for the comments and suggestions I received in preparing the proposal for the study. I am also grateful to several of my colleagues with whom I have had fruitful discussion in course of preparing this study, and specially to Dr. Sulabha Brahme who has helped me in every way in completing this study in time.

My special thanks are due to Shri D.B. Sardesai for his advice and guidance in data processing and to Ms. A.A. Kher and Shri M.M. Marathe for speedily handling the computational work. My sincere thanks are also due to Shri R.D. Khodaskar for supervising and carrying out the field work in time and to Shri S.S. Kulkarni for efficiently handling the tabulation work. I am also grateful to the respondents (irrigators) who have supplied us with required information pertaining to the study.

But for the unstinted cooperation and help received from the concerned officers and staff of the Department of Irrigation it would not have been possible to complete the study in time. I express my sincere thanks to all of them for this.

Lastly I owe a debt of gratitude to the administrative and other staff who have helped with typing the material and in making the study report ready for circulation in time.

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Ashok K. Mitra

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CONTENTS

	<u>Page</u>
FOREWORD	(i)
PREFACE	(iii)
LIST OF TABLES	(viii)

Chapter

I	INTRODUCTION	1
	1. Introduction	1
	2. The Present Study	1
	3. Methodology	3
	4. Data Need for the Study	8
	5. Sampling Framework	10
	6. Chapterwise Scheme	12
II	SALIENT FEATURES OF THE SCHEMES...	14
	1. Introduction	14
	2. Minor Irrigation Scheme (Kalote- Mokashi - Raigad)	14
	3. Medium Irrigation Scheme (Asola-Mendha, Chandrapur)	18
	4. Medium Irrigation Scheme (Nirguna, Akola)	21
	5. Medium Irrigation Scheme (Manyad - Jalgaon)	25
	6. Medium Irrigation Scheme (Nazare - Pune)	28
III	UNDERUTILISATION - THE CONCEPT AND MEASUREMENT	32
	1. Introduction	32
	2. Conceptualisation of Irrigation Potential and Utilisation	32

<u>Chapter</u>	<u>Page</u>
3. Conceptualisation of Underutilization and Its Measures	36
4. Measurement of Underutilisation ...	38
5. Minor Irrigation Scheme (Kalote-Mokashi, Raigad)... ..	38
6. Medium Irrigation Scheme (Asola-Mendha, Chandrapur). ...	43
7. Medium Irrigation Scheme (Nirguna, Akola)	48
8. Medium Irrigation Scheme (Manyad - Jalgaon)	53
9. Medium Irrigation Scheme (Nazare - Pune)	58
 IV	
SUBJECTIVE EVALUATION OF REASONS FOR LOW KHARIF UTILISATION	63
1. Introduction	63
2. Characteristic Features of the Sample Holdings	63
3. Holdings Using/Not Using Canal Water for Kharif Irrigation	73
4. Factors Responsible for Particularly Low Utilization of Kharif Irrigation Potential	76
5. Summing Up	113
 V	
OBJECTIVE EVALUATION OF THE REASONS FOR LOW KHARIF UTILISATION	115
1. Introduction	115
2. Change in Crop-Mix and Underutilisation	115
3. Medium Irrigation Scheme (Nirguna, Akola)	117
4. Medium Irrigation Scheme (Manyad-Jalgaon	119

<u>Chapter</u>	<u>Page</u>
5. Medium Irrigation Scheme (Nazare-Pune)	122
6. Supply and Demand Constraints and Underutilisation	125
7. Minor Irrigation Scheme (Kalote-Mokashi - Raigad)	125
8. Distribution of Rainfall Affecting Demand for and Supply of Water ...	130
9. Medium Irrigation Scheme (Asola-Mendha - Chandrapur)	134
10. Distribution of Rainfall Affecting Demand for and Supply of Water ...	141
11. Medium Irrigation Scheme (Nirguna - Akola)	146
12. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water	154
13. Medium Irrigation Scheme (Manyad - Jalgaon)	158
14. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water	166
15. Medium Irrigation Scheme (Nazare-Pune)	172
16. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water	181
17. Summing Up	186
VI SUMMARY AND CONCLUDING REMARKS	220
APPENDIX TABLES	234
REFERENCES	250
MAPS	251

LIST OF TABLES

<u>Table No.</u>		<u>Page</u>
3.1	Area Proposed to be Irrigated as Per Project Cropping Pattern ...	39
3.2	Yearwise and Seasonwise Area Actually Irrigated (hectares) ...	39
3.3	Water Proposed to be Released for Irrigation as per Project Water Planning (Mm ³) ...	40
3.4	Yearwise Water Actually Released for Irrigation (Mm ³) ...	40
3.5	Area Proposed to be Irrigated as per Project Cropping Pattern ...	44
3.6	Yearwise and Seasonwise Area Actually Irrigated (hectares) ...	45
3.7	Yearwise and Seasonwise Water Actually Released for Irrigation (Mm ³) ...	46
3.8	Yearwise and Seasonwise Potential Created...	48
3.9	Yearwise and Seasonwise Area Irrigated ...	49
3.10	Water Proposed to be Released for Irrigation as per Project Water Planning (Mm ³) ...	51
3.11	Yearwise and Seasonwise Water Released (Mm ³)	52
3.12	Yearwise and Seasonwise Potential Created ..	53
3.13	Yearwise and Seasonwise Area Irrigated ...	54
3.14	Water Proposed to be Released for Irrigation as per Project Water Planning (Mm ³) ...	55
3.15	Yearwise and Seasonwise Water Released for Irrigation (Mm ³) ...	56
3.16	Area Proposed to be Irrigated as per Project Cropping Pattern ...	58
3.17	Yearwise and Seasonwise Area Irrigated ...	59
3.18	Water Proposed to be Released for Irrigation as per Project Water Planning (Mm ³) ...	60
3.19	Yearwise and Seasonwise Water Released for Irrigation (Mm ³) ...	61

(ix)

<u>Table No.</u>		<u>Page</u>
4.1(a)	Distribution of Land by Holding Size Scheme <u>Kalote Mokashi</u> - Raigad ...	65
4.1(b)	Distribution of Land by Holding Size Scheme <u>Asola Mendha</u> - Chandrapur ...	65
4.1(c)	Distribution of Land by Holding Size Scheme <u>Nirguna</u> - Akola ...	66
4.1(d)	Distribution of Land by Holding Size Scheme <u>Manyad</u> - Jalgaon ...	66
4.1(e)	Distribution of Land by Holding Size Scheme <u>Nazare</u> - Pune ...	67
4.2(a)	Distribution of Irrigated Area by Source and Size of Holding Scheme : <u>Kalote Mokashi</u> - Raigad ...	67
4.2(b)	Distribution of Irrigated Area by Source and Size of Holding Scheme : <u>Asola Mendha</u> - Chandrapur ...	69
4.2(c)	Distribution of Irrigated Area by Source and Size of Holding Scheme : <u>Nirguna</u> - Akola ...	69
4.2(d)	Distribution of Irrigated Area by Source and Size of Holding Scheme : <u>Manyad</u> - Jalgaon ..	70
4.2(e)	Distribution of Irrigated Area by Source and Size of Holding Scheme : <u>Nazare</u> - Pune ...	70
4.3	Distribution of Beneficiaries According to the Location of the Farm in Relation to the Canal ...	71
4.4	Main Crops Grown in Kharif ...	71
4.5	Distribution of Beneficiaries on the Basis of Whether Canal Water is Taken for Kharif Irrigation ...	74
4.6	Response to Whether Application is Made Every Year for Kharif Irrigation from Canal ...	74
4.7(a)	Reasons for Non Using Canal Water for Kharif Irrigation ...	77
4.7(b)	Most Important Reason for Not Using Canal Water for Kharif Irrigation ...	78

(x)

<u>Table No.</u>		<u>Page</u>
4.8	Response to Whether Water was Taken in Each Rotation (only for those who take canal water in kharif) ...	89
4.9	Main Reasons for Not Taking Water in Each Rotation for Kharif Crops (only for those who take canal water in kharif) ...	90
4.10	Distribution of the Beneficiaries (Taking Water in Kharif from Canal) on the Basis of Area Sanctioned for Kharif Irrigation as Against Area Demanded to be Irrigated ...	92
4.11	Response to Whether the Demand Application Depends Upon the Rain (only for those who take canal water for kharif irrigation) ...	93
4.12	Response to Whether the Adequate Supply of Water Available, if Applied Late for Canal Water (only for those, who take canal water in kharif irrigation) ...	94
4.13	Response to Whether Yield Gets Adversely Affected because of Delayed Application of Canal Water (only for those who take canal water in kharif). ...	96
4.14	Response to Whether the Land that Can be Irrigated in Kharif is Kept Fallow for Rabi Irrigation ...	98
4.15	Distribution of Beneficiaries by Having and Not Having Wells on Farm ...	100
4.16(a)	Information on Irrigation by Wells Scheme : <u>Nazare</u> - Pune ...	101
4.16(b)	Information on Irrigation by Wells Scheme : <u>Manyad</u> - Jalgaon ...	102
4.16(c)	Information on Irrigation by Wells Scheme : <u>Nirguna</u> - Akola ...	103
4.16(d)	Information on Irrigation by Wells Scheme : <u>Asola-Mandha</u> - Chandrapur ...	104
4.17	Distribution of Well Users by Land Which can be Irrigated Both by Canal and Well ...	106

<u>Table No.</u>		<u>Page</u>
4.18	Distribution of Irrigators (With Land Irrig- able Both by Canal and Well) by Actual Source of Irrigation ...	107
4.19	Response to the Awareness About the High Yielding Varieties, Application of Fertilizer and Improved Practices for Kharif Cultivation	109
4.20	Response About the Availability of Help and Guidance from the Agricultural Department ...	109
4.21	Response to Whether Water Rates are Exhorbi- tant for Kharif Crops ...	111
4.22	Distribution of Beneficiaries Based on the Opinions for Fixing Water Rates for Kharif Crops ...	111
4.23	Reasons for Preparing Water Rates on Number of Watering Basis ...	112
5.1	Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of <u>Nirguna</u> Scheme ...	118
5.2	Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of <u>Manyad</u> Scheme ...	120
5.3	Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of <u>Nazare</u> Scheme	123
5.4	Availability and Utilisation of Irrigation Water in Respect of <u>Kalote-Mokashi</u> Scheme ..	126
5.5	Water Content of the Reservoir at Different Dates During the Years in Respect of <u>Kalote</u> - <u>Mokashi</u> Scheme	129
5.6	Availability and Utilisation of Irrigation Water in Respect of <u>Asola-Mendha</u> Scheme ...	135
5.7	Water content of the Reservoir at Different Dates During the Year in Respect of <u>Asola-</u> <u>Mendha</u> Scheme ...	139

<u>Table No.</u>		<u>Page</u>
5.8	Statement Showing Wells in the Command and Area Irrigated in Respect of <u>Asolamendha</u> Project ...	145
5.9	Availability and Utilization of Irrigation Water in Respect of <u>Nirguna</u> Scheme ...	147
5.10	Water Content of the Reservoir at Different dates During the Year in Respect of <u>Nirguna</u> Scheme ...	151
5.11	Availability and Utilisation of Irrigation Water. in Respect of <u>Manyad</u> Scheme ...	159
5.12	Water Content of the Reservoir at Different Dates During the Year in Respect of <u>Manyad</u> Scheme ...	164
5.13	Demand for Kharif Irrigation by the Irrigators and Sanctioned by the Canal Authorities ...	169
5.14	Availability and Utilisation of Irrigation Water in Respect of <u>Mazare</u> Scheme ...	173
5.15	Water Content of the Reservoir at Different Dates During the Year in Respect of <u>Mazare</u> Scheme ...	177
5.16	Demand for Kharif Irrigation by the Irrigators and Sanctioned by the Canal Authorities ...	184
5.A1	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 1 <u>Kalote Mokashi-Raigad</u> ...	189
5.A2	Weekly Total Rainfall and No.of Rainy Days and Variations For Centre : 1 <u>Kalote Mokashi-Raigad</u> ...	191
5.B1	Weekly Total Rainfall and No.of Rainy Days and Variation For Centre : 9 <u>Asola Mendha</u> Tank-Chandrapur ...	192
5.B2	Weekly Total Rainfall and No.of Rainy Days and Variation For Centre : 9 <u>Asola Mendha</u> Tank - Chandrapur ...	194
5.B3	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 11 <u>Sadli</u> -Chandrapur ...	195

<u>Table No.</u>		<u>Page</u>
5.B4	Weekly Total Rainfall and No.of Rainy Days and Variation For Centre : 11 <u>Saoli-Chandrapur</u>	197
5.C1	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 6, <u>Chondhi-Akola</u> ...	198
5.C2	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 6, <u>Chondhi-Akola</u>	200
5.C3	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 7, <u>Tuljapur-Akola</u> ...	201
5.C4	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 7 <u>Tuljapur-Akola</u> ...	203
5.C5	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 8, <u>Malegaon-Akola</u> ...	204
5.C6	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 8, <u>Malegaon-Akola</u> ...	206
5D1	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre : 4, <u>Talode-Jalgaon</u> ...	207
5.D2	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 4, <u>Talode-Jalgaon</u> ...	209
5.D3	Weekly Total Rainfall and No.of Rainy Days and Variation For Centre: 5, <u>Manyad Dam-Jalgaon</u>	210
5.D4	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 5, <u>Manyad Dam-Jalgaon</u>	212
5.E1	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 2, <u>Nazare-Pune</u> ...	213
5.E2	Weekly Total Rainfall and No.of Rainy Days and Variations, for Centre:2 <u>Nazare-Pune</u> ...	214
5.E3	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 2 <u>Nazare-Pune</u> ...	215
5.E4	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre:2 <u>Nazare-Pune</u> ...	216
5.E5	Weekly Total Rainfall and No.of Rainy Days and Variation For Centre: 3, <u>Saswad-Pune</u> ...	217
5.E6	Weekly Total Rainfall and No.of Rainy Days and Variation for Centre: 3, <u>Saswad-Pune</u> ...	219

CHAPTER I
INTRODUCTION

1. Introduction

1.1 Underutilisation of irrigation potential of most of the major, medium and minor irrigation projects seems to be a perpetual and intricate problem in irrigation water management and distribution in India, and Maharashtra is no exception; if at all, the situation in this regard in Maharashtra is reported to be more serious than in many other states. While overall utilisation percentage in Maharashtra is reported to be low, there seems to be wide variation in the extent of utilisation of the irrigation potential between various seasons. Performance of a number of functioning irrigation projects in Maharashtra showed that actual water utilisation achieved on these projects was not impressive, particularly in kharif season, when water utilisation by farmers fell short of design assumption. It is further stated that major shortfall in utilisation is due to low utilisation in kharif season.

2. The Present Study

2.1 While overall underutilisation of irrigation potential may be attributed to a set of factors some of which would be common to all seasons, there ought to be some specific factors responsible for comparative poor performance in kharif season in particular. The present enquiry relates to a study of utilisation of kharif potential on some of the functioning

irrigation projects in different agro-climatic and rainfall zones in Maharashtra. The purpose of enlisting irrigation schemes from different agro-climatic zones is to ensure the inclusion of different rainfall pattern of the state which is likely to have an impact on utilisation of kharif irrigation potential.

2.2 Many Commissions and Committee appointed from time to time by the Government of Maharashtra and also a number of other studies have gone into the question of overall underutilisation of irrigation potential, but, no indepth investigation into the causes of underutilisation in kharif season in particular is available.¹ The present study is an attempt in that direction.

1 See for example

(a) Government of Maharashtra, Report of the Irrigation Commission, Bombay, 1962.

(b) Robert Wade, 'Performance of Irrigation Projects', Economic and Political Weekly, Vol. XI, No.3, January 17, 1976.

(c) Government of Maharashtra, Report of the High Power Committee, Irrigation Department, 1981.

(d) Dhawan B.D., 'Questionable Conceptions and Simplistic Views about Irrigated Agriculture of India', Indian Journal of Agricultural Economics, January-March, 1985.

(e) Ashok K. Mitra, 'Underutilisation Revisited', Economic and Political Weekly, Vol. XXI, No.17, April 26, 1986.

3. Methodology

3.1 Underutilisation of irrigation water in a particular project can be measured in two ways. In the first place, if the actual area irrigated under different crops during the kharif season turns out to be less than the area visualised, proposed and designed by the project planners to be irrigated during the season, it may be termed underutilisation. Alternatively, if the volume of irrigation water used by farmers during the kharif season turns out to be less than the quantity of water designed to be supplied during that season, then it may be termed underutilisation. It is quite possible that there may be underutilisation in a particular year in the first sense but not in the second, and vice versa. The first task therefore has been to ascertain the extent of such underutilisation in the aforementioned sense and also to ascertain the extent of such underutilisation under different schemes during the last 5 to 10 years depending upon the availability of data.

3.2 Having ascertained the manner in which irrigation utilisation percentage is estimated and also the rationale behind the project authorities' stipulation of the percentage of area to be irrigated in kharif season under different crops we have enquired into the factors responsible for low utilisation of kharif potential.

3.3 Reasons for low utilisation of kharif potential may presumably be classified into reasons arising out of demand

factors as well as of supply factors. In this study we attempt to look into these factors and examine them both from the point of view of objective evaluation as well as of subjective evaluation. The objective evaluation of the reasons for low utilisation of kharif potential arising out of both demand and supply factors involves looking into and examining and analysing the time series data made available from the official records, whereas the subjective evaluation of the same involves the opinion survey of the irrigators in the command area of different projects. The idea behind undertaking both objective and subjective evaluations is to find out the extent to which the findings of these evaluations correspond and/or match with each other.

3.4 The first aspect of the objective evaluation involves looking into and examining the area under crops irrigated during kharif season in different years. In this connection it would be necessary to find out the interval of each watering, total number of watering in the season and the dates of each watering. These data are expected to throw light on the periodicity of each watering during the entire kharif season.

3.5 The second aspect of the objective assessment is the amount of rainfall in the catchment and command areas and its distribution. Analysis of the time series data regarding this will enable us to explain both the demand and supply factors relating to utilisation of kharif potential. If the rainfall is adequate

and well distributed in the catchment area and in the command area for the crops to be grown, the demand for water may be low. The two aspects mentioned above will have to be compared in order to see if the date of irrigation for each watering corroborates with the distribution of rainy days; juxtaposing one against the other would reveal the reasons for the irrigators' demand for water in particular period. An analysis of the rainfall data for the last 10-15 years (depending upon the availability) would reveal the statistical probability of the periodicity of long and short break in monsoon. Further, the long break in monsoon and its periodicity would also affect the availability of water in the reservoir and even if there is demand for water, the supply would not be able to cope with the demand. All these would affect the utilisation percentage in kharif.

3.6 The third aspect of objective assessment is the cropping pattern in the command area under different crops grown under rainfed condition and under canal irrigated condition. A comparison of the area irrigated under different crops in kharif with the project cropping pattern would indicate the change in demand for water from what was contemplated in the project report due to the adoption of more water intensive crops by the irrigators in some regions.

3.7 The fourth aspect of the objective evaluation is to examine the need for and so also the existing practice of earmarking the quantity of water that is required to be stored every year for

rabi and hot weather seasons, because this would significantly affect the supply of water during the kharif season.

3.8 As mentioned earlier the subjective evaluation of the reasons for particularly low utilisation in kharif involves the opinion survey of the irrigators. Accordingly, as proposed, relevant information are collected from the sample beneficiaries under the five schemes, through field investigation. It would be necessary to look into the cropping pattern and the nature of the crops grown during kharif season, the reason for choosing particular crop combination, the pattern and extent of demand for irrigation water and reasons thereof. The conventional crops might need comparatively less financial resources in the form of costly seeds, fertilizer and pesticides. Resources at the command of the farmers may put a restriction on use of such costly inputs for kharif cultivation, particularly so, if the limited financial resources are to be allocated for other crops grown in subsequent seasons. This aspect needs to be examined.

3.9 The question of yield differences between growing these crops under rainfed conditions in normal year and growing these crops under irrigated condition would also arise. If the yield differences are marginal the farmers may not demand water even during the period of small break in monsoon. But it is difficult to estimate such yield differences. One would like to compare the yield of those farmers in the command area who did not demand any water with that of those who did during normal years of monsoon, but such data would be difficult to get. Some

approximation of such yield differences, if any, has to be arrived at by comparing the average yield of crops grown under irrigated and rainfed conditions in the catchment/command area of the project.

3.10 The other aspect of the subjective evaluation is the extent of well irrigation by the irrigators in the canal command. Availability of water in the well and the land under well command would adversely affect the demand for irrigation water from the state sources.

3.11 To examine all the aspects raised above in relation to the subjective evaluation of the reasons for particularly low utilisation of kharif potential, relevant information need to be collected from the irrigators through structured questionnaire.

3.12 The subjective evaluation through opinion survey of the farmers would throw light on farmers' perception of the question of kharif underutilisation. Carrying out an objective evaluation also along with the subjective evaluation should help us to bring about a correspondence between the reasons arising out of each evaluation and also to identify the reasons arising out of objective evaluation, considered to be most important from irrigators' point of view. We may also be able to find out how strong is the relation between water use and agro-climatic conditions, and if it is consistent with farmers' views. Finally, based on farmers' opinion survey (subjective evaluation) it may be possible to attach some kind of weights to the factors for low kharif utilisation arrived at by objective evaluation.

Obviously the agro-climatic conditions are different under different project areas and to that extent the importance of the factors for low utilisation will vary from zone to zone, however, the data to be examined would be common for all the projects.

4. Data Need for the Study

4.1 For the purpose of ascertaining the nature and extent of underutilisation the following data from the project authorities are used.

(i) The area under different crops, proposed to be irrigated in kharif season, as per the project scheme.

(ii) The total volume of irrigation water expected to be made available and utilised in the kharif season, as per the project scheme.

(iii) The areas under different crops actually irrigated in kharif season every year for the past 5 to 10 years.

(iv) The total quantity of irrigation water actually used (released) during the kharif season every year for the last 5 to 10 years.

(v) The number of irrigation (rotation) expected for individual irrigated crops in kharif season in the project scheme.

4.2 For the above purposes copies of the project proposal in respect of each scheme, on the basis of which the projects were constructed and are supposed to be operated, are used along with the existing information on irrigation.

4.3 To examine all the issues raised in relation to the objective evaluation of the reasons for low utilisation of

kharif potential the following data are used.

(i) Weekly rainfall data in the catchment area and command area of each of the five projects for the last 10 years or so (depending upon the availability of data), with number of rainy days and amount of precipitation for each observation.

(ii) Cropping pattern in the command area of the projects for the last 5 years.

(iii) Water content in the reservoir each day (at least each week) yearly for the last 5 to 10 years in respect of each project.

(iv) Live storage available at the beginning i.e. on 1st June every year for the last 5 to 10 years in respect of each project.

(v) Canal flow in each rotation in kharif and distributory flow in each rotation in kharif for last 5 years (depending upon the availability of data) for all the five projects.

(vi) Area irrigated in each rotation in kharif under each project for the last 5 years or so (depending upon the availability of data).

(vii) Villagewise water application (demand) in kharif for last 5 years (depending upon the availability of data) in respect of each of the five schemes.

(viii) Information regarding wells in the command area under each scheme and the development of well irrigation over the years.

4.4 The aforementioned information and data are obtained

from the irrigation department and the relevant project authorities.

5. Sampling Framework

5.1 As mentioned earlier, to carry out the subjective evaluation through opinion survey of the farmers a sample of beneficiaries under each scheme is drawn for detailed investigation. In consultation with the Department of Irrigation, Government of Maharashtra, this study is taken up in respect of four existing medium irrigation schemes and one minor irrigation scheme is follows :

Agro-climatic zone	Name of the project (scheme) and site	No.of vill-ages under command	No.of bene-ficiaries under command
1. Very high rainfall zone	Minor Irrigation Scheme, <u>Kalote Mokashi</u> (Raigad)	4	116
2. High rainfall zone	Medium Irrigation Scheme, <u>Asola-Mendha</u> (Chandrapur)	65	7609
3. Assured rainfall zone	Medium Irrigation Scheme, <u>Nirguna</u> (Akola)	22	1972
4. Transition zone	Medium Irrigation Scheme, <u>Manyad</u> (Jalgaon)	15	3486
5. Scarcity	Medium Irrigation Scheme, <u>Nazare</u> (Pune)	5	2155

5.2 In order to select the beneficiaries of a scheme a multi-

stage stratified random sampling procedure is followed with the village as the primary unit and the beneficiaries in a village as the ultimate unit of sampling. Out of the 4 medium irrigation schemes selected for study a sample of 20 per cent of villages are selected from each of the three schemes, viz., Asola Mendha, Nirguna and Manyad; where as for Nazare scheme in Pune district 3 villages are selected as the total number of villages benefiting by the scheme is only five. From the minor irrigation scheme in Raigad district two villages are selected out of four benefiting from the scheme. So, in all around 26 ✓ villages are covered out of a total number of 111 villages benefiting from the five schemes selected for study. In order to get representation from the head reach, middle reach and tail reach of the distribution system, villages under each scheme are classified according to their location along the distribution system. As far as possible an equal number of villages are then selected from each of the three reaches of the distribution system so as to make a sample of around 20 per cent of the total number of village under each of the three medium irrigation schemes mentioned earlier. In the case of the fourth medium irrigation scheme (Nazare Pune) one village each from head reach, middle reach and tail reach are selected and in the case of the minor irrigation scheme out of the two villages selected one is from the head reach and the other is from the tail reach.

5.3 In the second stage of sampling the beneficiaries of the schemes are selected. The beneficiaries in each of the selected

villages are listed in descending order of magnitude as per the land holding and then a total of twenty beneficiaries are selected randomly from the list from each village selected under the four medium irrigation schemes and, further, a total of another twenty beneficiaries are selected randomly from the list of the beneficiaries of the two selected villages under the minor irrigation scheme. The total number of beneficiaries so selected are around five hundred and thirty from the five schemes selected for study.

5.4 In addition to specific information collected from the records of the irrigation department and from the project authorities of each scheme and also from the irrigators through structured questionnaire some relevant and useful information are also gathered from the discussion with the officials of the Agricultural Department and of the Agricultural Universities.

6. Chapterwise Scheme

6.1 The second chapter is about the salient features of the schemes selected for the study. This gives among other aspects of the scheme the details of the system design, cropping pattern, proposed water allocation in each season etc. with a view to highlight the provision made for the kharif irrigation under each scheme and the reasons thereof.

6.2 The third chapter deals with the concept and the measurement of underutilisation with a view to highlight the manner in which underutilisation in irrigation system needs be considered and also to ascertain the extent of underutilisation yearwise

under different schemes.

6.3 The fourth chapter presents the subjective evaluation of the factors responsible for low kharif utilisation. It is attempted through the opinion survey of the irrigators in the command area of the projects under study with a view to know how the farmers - the ultimate users and beneficiaries of the irrigation systems view the question of kharif underutilisation.

6.4 The fifth chapter discusses the objective evaluation of the factors responsible for low utilisation of kharif potential. The objective evaluation purports to identify the major factors responsible for low utilisation on the basis of the analysis of the time series data on a number of important variables affecting the demand for and supply of irrigation water.

6.5 The sixth and the last chapter is the concluding part of the study. In this chapter we attempt to bring about a correspondence between the reasons arising out of each evaluation. The purpose is to ascertain which of the factors responsible for low utilisation in kharif arising out of objective evaluation is considered most important by the irrigators and also to examine if, based on the irrigators' opinion survey, it may be possible to attach some kind of weights to the factors for low kharif utilisation arrived at by objective evaluation.

SUBJECT MATTER TO THE SCHEMES

1. Introduction

1.1 As mentioned in the earlier chapter, five irrigation schemes are selected in consultation with the Department of Irrigation, Government of Maharashtra for the study of utilization of loaned irrigation potential. The assumption behind selecting these five schemes (four medium and one minor) is that each one of these schemes is representative of the schemes in a given agro-climatic zone. Hence the five schemes are five representative zones representing five different patterns of the water with its likely to have impact on irrigation utilization in future. In what follows we give an account of the salient features of each scheme with a view to highlight the provision made for loaned irrigation under each scheme. We shall begin with the scheme in agro-climatic zone where stressed by heavy rain and when provided one by one with the schemes in zones where stressed by less and less assured rainfall, finally starting with the scheme in the zone where stressed by scarcity condition.

2. THE FOUR IRRIGATION SCHEMES
(AGRO-CLIMATIC ZONE - B)

2.1 It is a minor irrigation scheme with a storage dam across the left upstream of village INDRAPUR with a storage left bank dam (distrib.) with its surplus to irrigate 235 hectares (550 acres) of irrigated lands four villages. The

Vala across which the dam is constructed rises on the North-Eastern side of the hill of Kalote-Mokashi village and has a catchment area of 5.62 sq.km. at the dam site. The source of supply to the dam is rain water. The average annual rainfall is around 3100 mm. The yield calculated is around 8.49 Mm³; the 75 per cent dependable yield available at the dam site is around 5.34 Mm³. The justifications given for the project are:

- (i) providing irrigation in rabi and hot weather,
- (ii) improving the irrigation conditions for kharif crops,
- (iii) providing irrigation water for raising seedlings for growing high yielding varieties of paddy,
- (iv) providing seepage water to lands and wells below the dam site,
- (v) providing drinking water in fair weather seasons to the villages in the vicinity,
- (vi) restricting the flood problem to down stream villages.

2.2 The construction work of the dam and the distribution system started in October 1973 and the project was commissioned for use in June 1976. Although the projected ICA was 235 hectares, actual revised estimate of ICA is 125 hectares.

Salient Features of the Scheme (as per project report)

1.	Average annual rainfall	3100 mm.
2.	Gross storage	4.34 Mm ³
3.	Live storage	4.19 Mm ³
4.	Evaporation losses	0.83 Mm ³

5.	Length of canal	7.60 km.
6.	Gross command area (GCA)	365 hectares
7.	Culturable command area (CCA)	235 hectares
8.	Irrigable command area (ICA)	235 hectares (projected)

Approved Crop Pattern (as per project report)

	<u>Crop</u>	<u>Percentage of ICA</u>
1.	Perennials	10
2.	Paddy (short term + long term)	90

Follow-on Crops

1.	Rabi Rice on short term Paddy	45
2.	Vegetable on long term paddy	13
3.	Fodder on long term paddy	5
4.	Unirrigated pulses on long term paddy	10
5.	Hot weather groundnut	10
6.	Hot weather fodder crops	2

Water required seasonwise (as per project report)

1.	Kharif	=	0.33 Mm ³
2.	Rabi	=	1.95 Mm ³
3.	Hot weather	=	1.64 Mm ³

			3.92 Mm ³

The Live Storage requirement in the reservoir
(as per project report)

1)	Rabi requirements	=	1.95 Mm ³
2)	Hot weather requirement	=	1.64 Mm ³
3)	Carry over for 22 days	=	0.06 Mm ³
4)	Seedling requirement	=	0.01 Mm ³
5)	Fair Weather Lake Losses	=	0.63 Mm ³

			4.29 Mm ³

2.3 It may be noted from the above statements that although the water requirement statement gives an estimate of around 0.33 Mm³ water required for kharif season based on the projected cropping pattern, the live storage statement does not show any provision for kharif irrigation. Provisions in live storage are however made for carry over which means reserving water for irrigation in case the monsoon is late and also for raising paddy seedlings. It may be surmised from the above observation that as per the project proposal kharif crops (mainly paddy) are to be grown mainly on rain water with utilisation of overflow water as and when it occurs. The underlying reasoning behind such provisions for storage is that kharif paddy can be grown with monsoon rain which is heavy and fairly well distributed. This aspect, however, needs to be checked with the rainfall data.

2.4 Actual irrigation over the years is in tune with what was proposed in so far its approach and direction are concerned but, not so much in the extent of irrigation. The irrigation authorities as well as the farmers are mainly concerned with

irrigation during what is called the 'Konkan Hangam', i.e., between December and April for the second crop of rice. The cropping pattern proposed, mainly paddy after paddy, also seems to be conservative in nature. The water distribution system followed is field to field irrigation.

3. Medium Irrigation Scheme (Asola-Mendha, Chandrapur)

3.1 This medium irrigation scheme is one of the oldest pre-plan irrigation systems in Maharashtra. The scheme was commissioned in the year 1915. The project is in Sindowahi taluka and its command area extends to Sindowahi, Mul and Gondpipari talukas. The project consists of an earthen dam across a local river with a main canal (LBC) of 43.4 kms. long and with minors and distributories extending upto 219.4 kms. The Irrigable Command Area of the project (ICA) is 9919 hectares. The average annual rainfall in this area is around 1146.56 mm and the estimated normal yield is around 115.70 Mm³. As per the project report, the gross and the live capacities of the storage are 92.96 Mm³ and 74.62 Mm³ respectively. However, according to 1977 estimate the gross and live storages are 67.02 Mm³ and 56.38 Mm³.

3.2 The main objective of starting the scheme was to provide protective irrigation to kharif paddy. The whole development of the irrigation system has been towards providing protective irrigation to paddy only, as a result of this the land development for irrigation has also been towards providing irriga-

tion to paddy only. Generally the monsoon sets in this region during the 2nd and 3rd week of June. The irrigation under this scheme is carried out under a system of agreement. The irrigators enter into contract with the irrigation department for a period of 3 years and the irrigation department is bound to provide water to the farmers as per the agreement. There is no commitment or provision for hot weather crops. If there is any balance of water available in the storage then irrigation is made available to the rabi and hot weather crops. In fact a provision has been made to carry over 15 to 20 per cent of water for irrigation in early kharif, if the monsoon is delayed and/or uneven in the initial period.

3.3 The construction of the project started in 1903 and the project was completed in all respect by 1918 and was commissioned for use. Although the storage capacity, as mentioned earlier, as per original project proposal, was 74.16 Mm³ (live), the live storage as estimated in 1977 turns out to be 56.38 Mm³.

Salient Features of the Scheme (as per project report)

1.	Average annual rainfall	1146.56 mm
2.	Gross storage	93.02 Mm ³ (projected)
3.	Live storage	74.16 Mm ³ (projected)
4.	Evaporation losses	N.A.
5.	Length of canal + distributories	220 km (approx.)
6.	Gross command area	50859 hectares
7.	Culturable command area	37045 hectares
8.	Irrigable command area	9919 hectares

Approved Crop Pattern (as per Ex-M.P. Government)

<u>Crop</u>	<u>Percentage of ICA</u>
1. Perennials	2
2. Kharif paddy	98

3.4 Since this project is a pre-plan project (1918) no records for water planning and approved crop pattern are available. The crop pattern has been suggested by the Ex-M.P. Government on the basis of the practice in the irrigated area in command.

3.5 Farmers grow only paddy, even the 2nd crop is paddy, no other crop is preferred by them. Over the last 70 years the irrigation development has taken place in such a way that only paddy is suitable in this region, soil is not considered to be suitable for growing any other crop. Even if it is possible to grow other crops in rabi and hot weather, there is no assurance of availability of water from the reservoir. Irrigation of kharif paddy is by field to field method and not through field channels. This seems to be the most suitable method for paddy irrigation by the irrigators. This system has so developed over the last 60 to 70 years that it is not easy to change over to any other form of water distribution. However, there is heavy seepage loss due to this practice of water distribution. Kharif irrigation generally begins by the end of August or the beginning of September and continues up to the middle of November.

3.6 Actual irrigation over the years seems to be in tune with what was originally proposed both in its approach and in extent of irrigation. The irrigation authorities and the farmers are mainly concerned with the irrigation of kharif paddy and that too of protective nature. It is in keeping with this practice that the irrigation for kharif (paddy) begins normally in the first week of September and continues up until the end of November. During this period 4 to 5 waterings for kharif paddy are provided; the rotation period of each watering is normally 15 days. This practice is followed considering the distribution of rainfall which normally sets in June 1st or 2nd week and continues upto August and thereafter there is a break when the irrigators require canal water for the standing crop of paddy. However, in years when the onset of monsoon is very much delayed, the project authorities provide water even for raising seedlings and thereafter for transplantation if there is available water in the storage. All these, however, have to be corroborated with the factual information in terms of yearly rainfall data.

4. Medium Irrigation Scheme (Nirguna, Akola)

4.1 It is a medium irrigation scheme on the stream of confluence of two rivers Godavari and Nirguna. River Nirguna is a tributary of river Punra which ultimately drains into the Tapy valley. This river had remained untapped for irrigation till then. The scheme consists of an earthen dam on river

Nirguna near village Chondi in Patur taluka of Akola district. The construction work on the dam began in late 60's and after completion the scheme was commissioned for irrigation in mid 70's. The catchment area upto dam site is around 195.55 sq.kms. and with an annual average rainfall of about 802.64 mm the 60 per cent dependable yield with post-monsoon flow is around 38.81 Mm³. The net capacity (live-storage) of the reservoir is estimated to be 28.84 Mm³. The distribution system comprises a contour canal and a large number of distributories and minors with an irrigable command area of 4229 hectares and area to be irrigated (including follow-on crop) of 6470 hectares.

4.2 The main objective of the scheme is to provide for full irrigation requirement of 43 per cent of ICA in rabi and 10 per cent of ICA in hot weather and to provide only for 20 per cent of the full water requirement of the 85 per cent of ICA in kharif. The underlying reasoning behind such an approach may perhaps be explained in terms of expectation of assured and well distributed rainfall to take care of kharif cultivation. The provision for kharif irrigation is made in case there is long break in monsoon. In other words, the objective of the irrigation scheme seems to be to provide both protective and productive irrigation. The other objective of the scheme is also to control flood. As mentioned earlier, the average annual rainfall is around 800 mm and normally the monsoon sets in the 2nd week of June and is expected to be assured and well distributed.

Salient Features of the Scheme (as per project report)

1.	Average annual rainfall	802.64 mm
2.	Gross storage	32.29 Mm ³
3.	Live storage	28.84 Mm ³
4.	Evaporation losses	4.89 Mm ³
5.	Length of canal	30 kms.
6.	Gross command area	8219 hectares
7.	Culturable command area	6041 hectares
8.	Irrigable command area	4229 hectares
9.	Gross cropped area irrigable (including 15 per cent of unirrigated pulses in kharif)	6470 hectares (153 per cent of ICA)

Approved Crop Pattern (as per project report)

	<u>Crop</u>	<u>Percentage of ICA</u>
1)	Light perennial	1
2)	L.S. Cotton	40
3)	Chilly	6
4)	Paddy	5
5)	Jowar (Kharif hybrid)	25
6)	Unirrigated pulses	15
7)	Green manure	8
	<u>Follow-up Crops</u>	
8)	Wheat on pulses	23
9)	Gram on paddy	5
10)	Jowar and Maize (Rabi)	15
11)	Groundnut (hot weather)	10

Water required seasonwise (as per project report)

1)	Kharif	11.500 Mm ³
2)	Rabi	10.560 Mm ³
3)	Hot weather	12.402 Mm ³

Storage requirement of reservoir (as per project report)

1)	Kharif requirement	2.306 Mm ³
2)	Rabi requirement	10.566 Mm ³
3)	Hot weather requirement	12.410 Mm ³
4)	Lake losses	5.449 Mm ³
5)	Dead storage	3.446 Mm ³

34.177 Mm³

Deduct for post monsoon flow 1.846 Mm³

Net storage 32.331 Mm³

4.3 The main crops grown in this region in kharif is cotton (L.S. and ordinary), jowar and to some extent pulses; in rabi the main crops are wheat and gram and in hot weather main crop grown is groundnut. In point of fact, over the years hot weather groundnut has turned out to be a very popular crop in the irrigated tract. Irrigators prefer to rotate hot weather groundnut (January to May) with ordinary cotton (monsoon crop).

4.4 Actual irrigation over the years does not seem to be in tune with what was proposed both in terms of its extent and its approach. As mentioned earlier, the objective of the scheme was to provide both protective and productive irrigation. The protective part of the irrigation does not seem

to be taken as seriously as it merits, although the system is designed accordingly. The underlying reasoning behind such a state of affair is the seeming possibility of growing kharif crop entirely on rain water. The rainfall is reported to be assured in this region for such a practice. All these issues need closer examination.

5. Medium Irrigation Scheme (Manyad - Jalgaon)

5.1 This is a medium irrigation project with storage on the river Manyad near village Nandre with Right Bank Canal (RBC) 20 kms. in length having an irrigable command area of 4864 hectares. The source is the Manyad river, tributary of Girna river in Tapi basin in Chalisgaon taluka of Jalgaon district in the western north Maharashtra. The scheme comprises an earthen dam and a right bank canal. The command area is situated on the right bank and is catered by a net work of 12 distributories. The annual average rainfall is estimated to be 600 mm. The catchment area at the dam site is 913 sq.kms. with a 75 per cent dependable yield of around 56.64 Mm³. The capacity of the live storage is 40.27 Mm³.

5.2 The main objective of the scheme is reported to be providing protective irrigation to kharif crops and also to provide productive irrigation to rabi crops. Since the area under this scheme fall in the transition zone of rainfall it is expected that the rainfall during monsoon would be more or less assured and would be generally well distributed. The provision for kharif irrigation is made in case there is long

delay in monsoon and also if there is a long break in monsoon. Traditionally main crops grown during monsoon in this region are jowar and cotton. In keeping with the objective of the scheme the proposal was to make provision for only 20 per cent of the total water requirements of the 89 per cent of ICA in kharif, whereas for rabi crops, full water requirement was to be provided for 51 per cent of ICA. No provision was made for hot weather crops.

Salient Feature of the Scheme (as per project report)

1)	Average rainfall	700 mm
2)	Gross storage	53.95 Mm ³
3)	Live storage	40.27 Mm ³
4)	Evaporation losses	10.81 Mm ³
5)	Length of the canal	20 Kms.
6)	Gross command area	8135 hectares
7)	Cultural command area	6508 hectares
8)	Irrigable command area	4864 hectares
9)	Total cropped area irrigable (including unirrigated pulses of 20 per cent of ICA)	6809 hectares (140 per cent of ICA)

Approved Crop Pattern (as per project report)

	<u>Crop</u>	<u>Percentage of ICA</u>
1)	Kharif jowar - Maize	11
2)	Kharif pulses (unirrigated)	20
3)	Groundnut	25
4)	Cotton (L.S.)	25
5)	Chillies and vegetable	8

<u>Follow-up crops</u>	<u>Percentage of ICA</u>
6) Jowar-Maize	11
7) Rabi pulses	20
8) Wheat	10
9) Onion	10
<u>Water required seasonwise (as per project report)</u>	
1) Kharif	16.17 Mm ³
2) Rabi	15.57 Mm ³
3) Hot weather	13.02 Mm ³
<u>Storage requirement of the reservoir (as per project report)</u>	
1) Kharif requirement	3.31 Mm ³
2) Rabi requirement	15.57 Mm ³
3) Hot weather requirement	13.02 Mm ³
4) Carry over storage	2.15 Mm ³
5) Evaporation (Lake) losses	9.03 Mm ³
6) Dead storage	13.67 Mm ³

	56.75 Mm ³
Deduct post-monsoon flow	2.83 Mm ³

Net storage	53.92 Mm ³

5.3 Although there is no provision for hot weather crops in the proposed cropping pattern, in the proposed water storage plan there is provision for hot weather, mainly for two seasonals like cotton and chillies and also to an extent for other crops like onion, etc. The provision for carry over storage is made for the eventualities of delayed monsoon.

From the storage plan also it appears that the scheme is meant to provide protective irrigation to kharif crops and productive irrigation mainly to rabi crops. However, over the years the irrigators have been showing increasing preference for hot weather groundnut.

5.4 Actual irrigation does not seem to be in tune with what was proposed originally both in its extent and its approach. As mentioned earlier, the objective of the scheme is to provide both protective and productive irrigation but in practice the protective part of the irrigation does not seem to be given due consideration both by the scheme authorities as well as by the users. This aspect has to be examined in detail along with the time series data on rainfall before arriving at any conclusion.

6. Medium Irrigation Scheme (Nazare - Pune)

6.1 This is a medium irrigation scheme in the scarcity zone in Western Maharashtra. The scheme comprises a storage on Karha river near village Nazare in Purandhar taluka of Pune district with a right bank canal of 5.63 kms. long having an ICA of 2458 hectares in Purandhar and Baramati talukas. The dam is an earthen dam with a catchment area above the dam site of 397.82 sq.kms. The work on the project begun in 1969 and it is reported to be completed in all respect in 1975.

6.2 Karha river is a tributary of Bhima. The river originates about 16.09 km. west of Saswad in Poona district. The total length of the river upto the dam site is about 40 km. and

it passes entirely through Poona district. The entire catchment falls under low rainfall belt and receives an annual rainfall of about 540 mm.

6.3 Justification for the project is given as follows.

The portion of Karha valley downstream of Jejuri often suffers due to scarcity and people have to migrate for livelihood. This itself justifies the need for a storage in this region. The river has no perennial flow. There are no water pools having adequate volume of water during the hot weather season. Rains are restricted to monsoon only and all the flashy floods go waste. Hence there is a long standing demand for irrigation facilities for the tract. Storage near Nazare has been therefore in view since 1953. In the present scheme a direct canal originates from the reservoir as the canal gains good command right from the dam. As the area served by the scheme lies in the scarcity zone, any scheme giving assured water supply to the crops is welcome by the people of the region. The project is supposed to mitigate the hardships of the farmers in area often affected by famine.

Salient features of the scheme (as per project report)

1)	Annual average rainfall	540 mm
2)	Gross storage	16.17 Mm ³
3)	Live storage	10.51 Mm ³
4)	Evaporation losses	2.92 Mm ³
5)	Length of canal	5.63 Kms.
6)	Gross command area	3990 hectares
7)	Culturable command area	3071 hectares
8)	Irrigable command area	2458 hectares
9)	Gross cropped area irrigable (including 24 per cent of unirrigated pulses)	3785 hectares (154 per cent of ICA)

Approved crop pattern (as per project report)

	<u>Crop</u>	<u>Per cent of ICA</u>
1)	Kharif groundnut	21
2)	Kharif hybrid bajra	10
3)	Kharif hybrid maize	13
4)	Kharif vegetables	8
5)	Two seasonal chillies	20
6)	Kharif unirrigated pulses	24
	<u>Follow-up crops</u>	
7)	Rabi jowar after pulses	18
8)	Rabi vegetables after pulses	10
9)	Wheat after groundnut	10
10)	Gram after hybrid bajra and maize	20

Water required for the irrigable command
area of 2458 hectares (as per project report)

1)	Kharif	7.30 Mm ³
2)	Rabi	7.71 Mm ³
3)	Hot weather	-

Storage requirement of the reservoir (as per project report)

1)	Kharif requirement	1.46 Mm ³
2)	Rabi requirement	7.71 Mm ³
3)	Hot weather requirement	-
4)	Evaporation losses	2.19 Mm ³
5)	Dead storage	5.66 Mm ³
	Deduct post-monsoon flow 5%	0.95 Mm ³
	Net storage	16.08 Mm ³

6.4 There does not seem to be any provision for hot weather crops and it is in keeping with the objective of the scheme in the scarcity zone. Although the main objective of the scheme is only to provide protective irrigation, the provision made for in storage for kharif irrigation is only 20 per cent of the water requirement of 96 per cent of ICA. This supposes that the remaining 80 per cent of water required would be met by rain. How far does this supposition hold good in fact has to be analysed by the rainfall data. In the case of rabi crops full 100 per cent of the water requirement of 58 per cent of ICA is provided for in the storage.

6.5 Actual irrigation does not seem to be in tune with what was proposed originally both in its extent and in its approach. As mentioned earlier, the main objective of the scheme is to provide protective irrigation to crops, but, it seems 'protective' concept of the irrigation does not get due consideration either of the irrigators or of the scheme authorities. This aspect has to be examined in detail with reasons thereof.

CHAPTER III

UNDERUTILISATION - THE CONCEPT AND MEASUREMENT

1. Introduction

1.1 In this study we are concerned with the utilisation of kharif irrigation potential so as to ascertain whether the extent of utilisation in kharif season is particularly low and then to find out the reasons there-of. Naturally the extent of utilisation and the reasons there-of would be different in different agro-climatic zones. However, to ascertain whether the extent of utilisation in kharif season is particularly low one would have to examine the extent of utilisation of irrigation potential in rabi and hot weather seasons also. In this chapter, therefore, we begin with the conceptualisation of the oft repeated terms like 'irrigation potential', 'underutilisation etc.', and then examine the extent of underutilisation in different crop seasons during the year based on the measures devised for estimating underutilisation.

2. Conceptualisation of Irrigation Potential and Utilisation

2.1 Let us begin with the definition of irrigation potential as defined by the Planning Commission and accepted widely including the irrigation systems under study. According to the Planning Commission, "Irrigation Potential is the gross area that can be irrigated from a project in a design year (July 1 to June 30 of the succeeding year) for the projected cropping pattern and assumed water allowance on its full development. The gross irrigated area will be the aggregate of the areas

irrigated in different cropping seasons, the areas under two seasonals and perennial crops being counted only once in a year". It has further been explained that before an area is included and reported under 'potential created', it has to be ensured that the water for the area to be reported upon is available and the conveyance system upto and including the irrigation outlet to serve an area upto 40 hectares is completed.¹

2.2 From this definition it is clear that there are three important requirements in the creation of irrigation potential and these are (i) availability of water for the area proposed to be irrigated in each season during the irrigation year, (ii) availability of conveyance system to carry water upto the outlet head and (iii) adherence to the projected cropping pattern.² It would be instructive to examine the conditions mentioned above under which the 'potential created' is declared for any irrigation system.

2.3 The first condition is the availability of water for the area proposed to be irrigated in each season during the year. It is reasonable to assume that the availability of water for area proposed to be irrigated in each season during the year would vary from year to year, particularly in this region where the sources of water are not necessarily perennial in nature and, further, lower is the 'dependability ratio' higher would be such variation. It follows from this that the definition of 'potential created' loses much of its meaning viewed thus,

1. Government of Maharashtra, 1981, op.cit. pp.5.

2. Ashok K. Mitra, 1986, op.cit. pp.752.

because then the potential area for each season during the year might vary from year to year depending upon the available water and there can not be a given area of potential created which is fixed for different seasons during the year for all times to come.

2.4 The second condition is the availability of conveyance system to carry water upto the outlet head. From the experience of the functioning of various irrigation systems it is known that creation (construction) of distribution net work is done in phases over a number of years. In fact the construction of considerable part of distribution system lags much behind the construction of the reservoir and the upper reaches of the main canal. Consequently, the potential is also created in phases and it is only after the full development of the irrigation system including distribution system upto the outlet to serve an area upto 40 hectares that the full potential can be said to have been created. Since the full development in the sense defined above generally takes a very long time (in some cases more than 10 years after the project is commissioned for use), the full potential is assumed to have been created within a period of 4 years from the date of commissioning irrespective of whether it has actually been created or not. In point of fact, in some cases in the absence of the information about the actual potential created, the project authorities consider either the ICA or the entire cropped area irrigable (which is ICAX intensity of cropping) as the potential created. It is obvious that the potential created declared in this manner loses much of its meaning because the conveyance system to

carry water may not be existing for a considerable part of the potential created so declared.

2.5 There is another aspect in this regard which merits attention. The aspect is that of the term 'full development' of the irrigation system for declaring irrigation potential created. Now, as per the Planning Commission's definition full development presumably means (i) development of the full storage capacity and (ii) development of the water distribution net work such that water can be transmitted upto the outlet serving an area upto 40 hectares. Does this really mean full development of the conveyance system? What about the land development and field channels below the outlet? If the distribution network below the outlet is not fully developed, potential created in the aforementioned sense again loses much of its meaning because the entire irrigation potential so declared cannot be brought under irrigation because of the inadequate conveyance net work below the outlet.

2.6 The third condition is adherence to the project cropping pattern. It is the general experience that in respect of many projects (particularly those in sugarcane belt of Western Maharashtra) actual cropping pattern that emerges in the benefited areas is significantly different from what was projected. Under such a situation potential created needs to be modified in terms of the newly developed cropping pattern.

2.7 In so far as utilisation is concerned it is based on the data on the area actually irrigated in each season during the year. Here again no allowance is made for the nature of crops grown. It may so happen that in the cropping pattern

that develops in the benefited area in the post project period, the proportion of heavy water using crop turns out to be larger than what was proposed. In such a case the area actually irrigated is bound to be less than what was projected.

3. Conceptualisation of Underutilisation and its Measures

3.1 Traditionally underutilisation is measured in terms of the proportion of potential area (created) not irrigated. In other words, if the area actually irrigated in a season or during the irrigation year is smaller than the area contemplated to be irrigated (potential created) then there is underutilisation. However, this way of expressing underutilisation (in terms of area) will be meaningful only if (i) water is available for the area proposed to be irrigated in each season during the irrigation year, (ii) conveyance system is fully developed to carry the water upto the outlet head at least and (iii) the projected cropping pattern is followed. In other words, potential created itself should be properly assessed for a meaningful assessment of the extent of underutilisation in terms of area.

3.2 Given these considerations it logically follows that whenever underutilisation is reported during an irrigation year it means that a part of the water in storage for irrigation has remained unused. As mentioned earlier, traditionally irrigation utilisation is expressed as a percentage of actual area irrigated to the potential created. It presumably means that given the same cropping pattern, whatever is the percentage of area actually irrigated is also the percentage of water actually used from the storage for irrigation during the year. In other words,

for instance, if only 50 per cent of the potential area is actually irrigated it follows that only 50 per cent of the water has been utilised. However, in reality these ideal conditions are hardly fulfilled, yet the magnitude of under-utilisation is estimated as mentioned above which consequently gives a distorted picture of the extent of utilisation.

3.3 To get a clearer and truer picture of the extent of underutilisation, it would be necessary to take into account the amount of water used in various seasons from the quantity of water available in storage for irrigation in each season during the year, in addition to the area actually irrigated.

3.4 It is against this background that in this study we measure underutilisation in two ways. In the first place, if the actual area irrigated under different crops during different seasons of the irrigation year turns out to be less than the areas proposed to be irrigated in respective seasons it may be termed underutilisation. Alternatively, if the volume of irrigation water used by farmers during each season turns out to be less than the quantity of water designed to be supplied in each season during the year, then it may be termed underutilisation. It is quite possible that there may be underutilisation in a particular year in the first sense but not in the second and vice-versa, or, it is also possible that the extent of underutilisation varies if measured in two different ways.

3.5 In what follows we attempt to ascertain the extent of

such underutilisation in the aforementioned sense for the different schemes under study for the last 5 to 10 years depending upon the availability of data. In order to determine if the utilisation is particularly low in kharif we estimate the extent of utilisation in rabi and hot-weather seasons also in addition to attempting such estimates for the kharif season.

4. Measurement of Underutilisation

4.1 An attempt is being made in this section to measure the extent of underutilisation in both the senses mentioned earlier. As there are five schemes to be studied from five different agro-climatic zones in the state what we propose to do is to consider first the scheme in the agro-climatic zone characterised by heavy rain and then proceed one by one with the schemes in other zones characterised by less and less assured rainfall, finally ending with the scheme in the zone characterised by scarcity conditions.

5. Minor-Irrigation Scheme (Kalote-Mokashi, Raigad)

5.1 We first consider the 'area approach' of underutilisation in which, as defined earlier, if the area actually irrigated is smaller than the area proposed to be irrigated (potential created) then there is underutilisation. There is no separate information available about the potential created. But, since this is a minor irrigation project and since the project was commissioned for use in 1976 and we are considering the last five years data it is reasonable to assume that the cropped area proposed to be irrigated in each season is synonymous with the potential created.

5.2 Area proposed to be irrigated has in its fold perennial crops also in addition to kharif, rabi and hot weather crops as follows. The total cropped area excludes 10 percent of unirrigated pulse in rabi.

Table 3.1 : Area Proposed to be Irrigated as Per Project Cropping Pattern

	Kharif	Rabi	Hot Weather	Two Season- nals	Pere- nnials	Total
1 Area (hectares)	112.50	72.50	21.25	-	12.50	218.75
2 Percent of ICA	(90.00)	(58.00)	(17.00)	-	(10.00)	(175.00)

As against the area proposed to be irrigated in each season the actual area irrigated for the last six years is as follows.

Table 3.2: Yearwise and Seasonwise Area Actually Irrigated (hectares)

Year	Kharif		Rabi	Hot-weather	Total	
	Area	% of Pro- posed area	Area	% of propos- ed area	Area	% of pro- posed area
1979-80	Nil	Nil	75.99	81.06	75.99	37.06
1980-81	Nil	Nil	79.15	84.43	79.15	38.60
1981-82	Nil	Nil	86.29	92.04	86.29	42.98
1982-83	Nil	Nil	78.11	83.32	78.11	38.09
1983-84	Nil	Nil	86.40	92.16	86.40	42.13
1984-85	Nil	Nil	81.51	86.94	81.51	39.74
Average	Nil	Nil	81.24	86.66	81.24	39.76

5.3 From tables 3.1 and 3.2 it is clear that the utilisation percentage of irrigation potential in kharif is nil, whereas for rabi and hot weather seasons together the same is very high, ranging from 81 to 92 percent during different years. Because the kharif utilisation is nil the over all utilisation turns out to be around 40 percent even though the combined utilisation of rabi and hot-weather is around 87 percent on an average. Before making any comments on the performance of utilisation of irrigation potential particularly in kharif season let us estimate the extent of utilisation by the other measure.

Table 3.3 : Water Proposed to be Released for Irrigation as per Project Water Planning (Mm³)

Kharif	Rabi	Hot Weather	Total
0.33	1.95	1.64	3.92
(8.42%)	(91.58%)		(100.00%)

Table 3.4 : Yearwise Water Actually Released for Irrigation (Mm³)

Year	Kharif		Rabi		Hot Weather		Total	
	Q	%	Q	%	Q	%	Q	%
1976-77	Nil	Nil	2.24	62.40	2.24	57.14		
1977-78	Nil	Nil	2.56	71.31	2.56	65.31		
1978-79	Nil	Nil	2.89	80.50	2.89	73.72		
1979-80	Nil	Nil	3.53	98.33	3.53	90.05		
1980-81	Nil	Nil	3.23	89.97	3.23	82.40		
1981-82	Nil	Nil	3.14	87.47	3.14	80.10		
1982-83	Nil	Nil	3.10	86.35	3.10	79.08		
1983-84	Nil	Nil	3.39	94.44	3.39	86.48		
1984-85	Nil	Nil	3.70	103.06	3.70	94.39		
Average	Nil	Nil	3.09	86.07	3.09	78.83		

Q = Quantity of water in Mm³

% = percent of water planned to be released

5.4 Table 3.4 shows that no water was released from the storage for irrigation in kharif season and this is in keeping with the fact presented in table 3.2 that the area irrigated in kharif season is nil. In terms of water actually released as against proposed released (Table 3.4) the extent of utilisation in rabi and hot-weather seasons together is found to be as high as 86 percent on an average and the same varies between 71 and 98 percent in different years. The overall utilisation percentage is found to be around 79 on an average.

5.5 A comparison of the extent of utilisation by two measures in tables 3.2 and 3.4 shows that the estimated utilisation percentage is higher when measured in terms of water released than when measured in terms of area irrigated. A small part of this difference is presumably due to differences in actual crop mix and the proposed one and low water allowances assumed in water planning compared to the actuals. However, the main reason for such a difference in their case is due to the fact that while water proposed to be utilised in kharif season is only around 8.46 percent of the total water proposed to be released during the year, the proposed area to be irrigated in kharif season is as high as 90 percent of the total area proposed to be irrigated during the year. In this connection it would be interesting to note that although water proposed to be released in kharif season is reported to be 0.33 Mm^3 , the storage requirement planned for kharif season is reported to be nil. Presumably the kharif crops do not need any irrigation because of adequate rainfall during the monsoon in this region.

5.6 From the aforementioned observations it is clear that in the execution of the scheme no provision was made for kharif irrigation and the system of distribution is also designed accordingly, hence raising the question of particularly low utilisation of kharif potential is not very meaningful in this context.

5.7 It may be recalled that unlike in other agro-climatic zones in Maharashtra where there are generally three irrigation seasons viz.; kharif, rabi and hotweather, in heavy rainfall areas of Konkan there is only one irrigation season and that is known in local language as 'Konkan Hangan', which is the non-monsoon season extending from beginning of December to end of April. In other words, the so called Konkan Hangan combines in itself the rabi season and the larger part of hot-weather season and the main crop grown in this season is paddy which is entirely irrigated. In the monsoon season also the main crop is paddy which is entirely grown on rain water, and traditionally irrigation for the monsoon crop is neither in demand nor is it supplied. The same practice is being followed under this scheme also ever since the system was commissioned for use. It again follows from this that the question of particularly low utilisation of kharif irrigation potential in this context does not make much sense.

5.8 There are, however, a number of important issues which need to be looked into. First of all it has to be ascertained from the time series data on daily rainfall from the relevant rain gauge station if the rainfall is reliable, adequate and fairly well distributed during the monsoon. This would

indicate if there is need for protective irrigation in kharif for improving the productive potential of monsoon crop.

Provision for kharif irrigation can then be made accordingly. Similarly the possibilities of introducing a change in cropping pattern may also be considered with a view to initiate kharif irrigation; this however would call for a change in the design of the distribution system. We shall examine all these issues in the subsequent sections.

6. Medium Irrigation Scheme (Asola-Mendha-Chandrapur)

6.1 We now examine the extent of utilisation in this medium irrigation scheme in the high rainfall zone. We begin with the area approach, i.e. area actually irrigated as against area proposed to be irrigated. As this is a very old project, potential created during the early years of the project is not relevant for our purpose. It is however found that the potential created data reported from as early as 1950-51 is the same as the ICA of the project mentioned in the project report. Hence we consider ICA of the project as the total potential created during the year and its distribution in different seasons as the potential created during different seasons.

6.2 The area proposed to be irrigated includes in its fold perennial crops in addition to kharif seasonal but rabi seasonal and hot weather seasonal are not included in the proposed cropping pattern. The gross cropped area proposed to be irrigated comprises 90 per cent of ICA under kharif seasonal (mainly paddy) and 10 per cent of ICA under perennials (Table 3.5). As against the proposed area to be irrigated in each season the

Table 3.5 : Area Proposed to be Irrigated as per Project Cropping Pattern

	Kharif	Rabi	Hot- Weather	Two seasonals	Perenn- ial	Total
1 Area (hectares)	9721	-	-	-	198	9919
2 Percent of ICA	(90.00)	-	-	-	(10.00)	(100.00)

actual area irrigated for the last 10 years, for which we have data, is presented in Table 3.6:

6.3 Table 3.6 clearly indicates that the extent of utilisation of kharif potential is very high ranging from around 85 per cent to 98 per cent; on an average it turns out to be around 93 per cent. In so far as rabi and hot weather seasons are concerned, although there is no provision for rabi and hot weather crops in the project cropping pattern, in practice some area is actually reported to be irrigated in most of the years during these seasons. The reason is that a part of the area reported to be irrigated in rabi and hot-weather seasons is under perennial crops for which there is provision in the project cropping pattern and the other part of the area is presumably under second crop of paddy which occupies the rabi and part of the hot-weather seasons and to which irrigation water is given if the storage permits. The overall extent of utilisation during different years (last column, Table 3.6) varies between 91 and 102 per cent with 96 per cent utilisation on an average. This is a very high utilisation figure by any standard. Let us now see if the extent of utilisation turns out to be so by the

other measure too.

6.4 It is to be noted here that information regarding the project water planning is not available in respect of this scheme because the scheme is very old and hence the extent of utilisation of potential created can not be estimated in terms

Table 3.6 : Yearwise and Seasonwise Area Actually Irrigated
(hectares)

Year	Kharif		Rabi		Hot-weather		Total	
	Area	% of pro-posed area	Area	% of pro-posed area	Area	% of pro-posed area	Area	% of pro-posed area
1975-76	8282	85.20	2	-	1449	-	9733	98.12
1976-77	8956	92.13	96	-	-	-	9052	91.26
1977-78	8994	92.52	16	-	600	-	9610	96.89
1978-79	9484	97.56	154	-	-	-	9638	97.17
1979-80	9005	92.63	-	-	-	-	9005	90.79
1980-81	9012	92.71	528	-	528	-	10068	101.50
1981-82	8929	91.85	92	-	91	-	9112	91.86
1982-83	9193	94.57	-	-	-	-	9193	92.68
1983-84	9227	94.92	527	-	527	-	10281	103.65
1984-85	9219	94.84	-	-	18	-	9237	93.12
Average	9030	92.89	202	-	535	-	9493	95.70

of water actually released as a percentage of water planned to be released. We may however take note of the water actually received during each of the last 7 years for which the data were made available to us.

Table 3.7 : Yearwise and Seasonwise Water Actually Released for Irrigation (Mm³)

Year	Kharif	Rabi	Hot-Weather	Total
1978-79	49.95	2.04	5.12	57.11
1979-80	56.50	-	-	56.50
1980-81	28.80	-	11.50	40.03
1981-82	48.10	4.39	8.75	61.24
1982-83	33.58	-	-	33.58
1983-84	10.70	2.32	9.09	22.11
1984-85	40.28	-	-	40.28
Average	38.27	2.92	8.62	44.41

6.5 Water actually released for irrigation in kharif season varies between 11 and 57 Mm³ during different years with an average release of around 38Mm³ which turns out to be around 67 per cent of the live storage capacity of the reservoir. Similarly, water released for irrigation during the entire irrigation year varies between 22Mm³ and 61Mm³ during different years with an average release of around 44Mm³ which turns out to be around 79 per cent of the live storage capacity of the reservoir. However, these utilisation percentages do not give a correct picture of the extent of utilisation; at best these may be considered as the lower limits of the extent of utilisation because the full live storage may not be available every year. We shall examine this aspect in the subsequent chapters.

6.6 Notwithstanding the fact that the project water planning information is not available and therefore utilisation of potential in terms of water released as proportion of water

planned to be released cannot be estimated, the utilisation percentage appears to be very high in the kharif season as well as for the entire irrigation year based on the area approach. In view of this the question of low utilisation of kharif potential in the case of this scheme does not arise.

6.7 It may be recalled that the main objective of starting the scheme was to provide protective irrigation to kharif paddy. The whole development of the scheme has also been towards meeting this end. The cropping pattern also shows that monsoon paddy is the most dominant crop to which the irrigation water is provided under long term agreement from September to November and the area irrigated every year during this period very well matches with the area proposed to be irrigated. There does not seem to be any underutilisation in this sense.

6.8 There are, however, a number of related issues which need to be examined. First of all the reliability, adequacy and distribution of rainfall have to be examined in the recent past based on the rainfall data. Secondly, the live storage available every year during different periods of kharif, rabi and hot-weather seasons has also to be examined to ascertain if water remains unused and may therefore be planned to be utilised better in kharif and other two seasons by developing a suitable cropping pattern etc. This may, however, call for a change in the distribution system. Some of these important issues are discussed in the subsequent chapters.

7. Medium Irrigation Scheme (Nirguna Akola)

7.1 As mentioned earlier this medium irrigation scheme falls in the assured rainfall zone. In order to estimate the extent of utilisation of irrigation potential we begin with the area approach. The following table gives the potential created in respect of this scheme.

Table 3.8: Yearwise and Seasonwise Potential Created.

(hectares)				
Year	Kharif	Rabi	Hot-weather	Total
1975-76	302	154	36	492
1976-77	984	473	110	1567
1977-78	1554	796	185	2535
1978-79	1671	855	199	2725
1979-80	2381	1219	283	3883
1980-81	2616	1346	312	4268
1981-82	3553	1818	465	5836
1982-83	3553	1818	465	5836
1983-84	3553	1818	465	5836
1984-85	3553 (60.57%)	1818 (31.15%)	465 (7.97%)	5836 (100.00%)

The irrigation started from the year 1975-76 and by 1981-82, i.e. within a period of 7 years the full potential of 138 per cent (5836 hectares) of ICA (4229 hectares) has been created. As against the potential created the actual area irrigated in different seasons in the last 10 years is as follows.

Table 3.9 : Yearwise and Seasonwise Area Irrigated (hectares)

Year	Kharif		Rabi		Hot-weather		Total	
	Area	% of potential created	Area	% of potential created	Area	% of potential created	Area	% of potential created
1975-76	Nil	Nil	135	87.66	-	Nil	135	27.44
1976-77	Nil	Nil	442	93.45	25	22.73	467	29.80
1977-78	Nil	Nil	651	81.78	55	29.73	706	27.85
1978-79	146	8.74	673	78.71	135	67.84	954	35.01
1979-80	14	0.59	813	66.69	148	52.30	975	25.11
1980-81	150	5.73	945	70.52	120	38.46	1215	28.47
1981-82	44	1.24	532	29.26	134	28.82	709	12.15
1982-83	195	5.49	783	43.07	58	12.47	1035	17.73
1983-84	-	Nil	1041	57.26	309	66.45	1350	23.13
1984-85	172	4.84	241	13.26	29	6.24	270	4.63
Average	120	5.06	626	51.69	113	37.80	782	20.15

7.2 Estimates of the extent of utilisation based on area approach clearly show that the utilisation percentage is particularly low in the kharif season. It varies between nil and 9 per cent during different years with 5 per cent as the average utilisation over a period of 10 years. Even the overall extent of utilisation for the whole irrigation year is also not high, varying between 5 per cent and 35 per cent during different years with 20 per cent as the average utilisation over a period of 10 years. In point of fact rabi season shows a better utilisation percentage followed by the hot-weather season; on an

average 52 per cent and 39 per cent respectively, but, since the extent of utilisation happens to be very low in kharif, with comparatively larger potential created, the overall utilisation percentage (over all seasons) turns out to be only 20 per cent on an average. During the first three years no utilisation of the potential created is reported in the kharif season and again in 1979-80 and in 1983-84, no utilisation is reported. Before we make further comments on the performance of kharif utilisation based on area approach let us examine the extent of utilisation by the other measure.

7.3 Even by the second measure, based on water reported to have been released for irrigation as against planned release, kharif utilisation is found to be particularly low compared to the rabi and hot-weather seasons. The kharif utilisation percentage is seen to vary between 2 per cent and 31 per cent in different years with average utilisation of around 20 per cent as against average utilisation of around 122 per cent and 42 per cent in rabi and hot-weather seasons respectively. Although the water planning proposed almost equal proportion of total water to be released in three seasons, water actually reported to have been released during different years show that much less water was actually released for kharif irrigation which naturally adversely affects the overall utilisation and we notice that even though rabi and hot-weather utilisation percentages on an average are around 122 and 42, the overall utilisation on an average is only 60 per cent. (Tables 3.10 and 3.11)

Table 3.10: Water Proposed to be Released for Irrigation as per Project Water Planning (Mm³)

Khharif	Rabi	Hot-Weather	Total
11.53	10.57	12.41	34.51
(33.41%)	(30.63%)	(35.96%)	(100.00%)

7.4 A comparison of the extent of utilisation estimated by the two measures shows that the extent of utilisation particularly in kharif season appears to be higher by the second measure. Apart from the possible change in the crop mix from the one proposed and the low water allowances assumed in water planning, the other important season for such a situation is the fact that while the water proposed to be released in kharif season is around 33 per cent of the total water proposed to be released during the year, the area proposed to be irrigated in kharif season is around 61 per cent of the total area proposed to be irrigated during the year. In this connection it would be instructive to note that although water proposed to be released in kharif season is reported to be around 11.53 Mm³, the storage requirement planned for kharif season is reported to be around 2.31 Mm³ (20 per cent of the requirement). Presumably the remaining 80 per cent of the kharif requirement is to be met by the rainfall during this period.

7.5 From all these accounts it appears that the extent of utilisation is particularly low in kharif season. To understand the reason behind such a state of affair it would be necessary to look into a number of important issues which have bearing on

the extent of utilisation. First of all it has to be ascertained if the rainfall is adequate and well distributed to take care of

Table 3.11 : Yearwise and Seasonwise Water Released (Mm^3)

Year	Kharif		Rabi		Hot-weather		Total	
	Q	%	Q	%	Q	%	Q	%
1978-79	3.61	31.33	-	-	-	-	-	-
1979-80	0.22	1.88	-	-	-	-	-	-
1980-81	2.82	24.46	18.65	176.47	2.59	20.86	24.06	69.71
1981-82	0.88	7.61	9.71	91.91	6.09	49.08	16.68	48.34
1982-83	2.58	22.38	13.51	127.86	3.75	30.20	19.84	57.49
1983-84	3.15	27.38	17.41	164.71	11.61	93.54	32.16	93.20
1984-85	2.83	24.54	5.09	48.17	2.29	18.45	10.21	29.59
Average	2.29	19.93	12.87	121.83	5.27	42.43	20.59	59.67

Q = Quantity of water in Mm^3

% = Per cent of water planned to be released.

the 80 per cent of kharif water requirement as well as of the live storage requirement in the reservoir for the remaining two seasons. Secondly the availability of live storage every year during different periods of kharif, rabi and hot-weather seasons has to be examined so as to ascertain if the water remains unused and may therefore be planned to be used by devising suitable cropping pattern etc. As mentioned earlier, we shall discuss some of these important issues in the subsequent chapters.

8. Medium Irrigation Scheme
(Manyad - Jalgaon)

8.1 As mentioned earlier, this medium irrigation scheme falls in the agro-climatic zone characterised by generally assured rainfall. First of all we shall estimate the extent of utilisation by the area approach. The following table gives the potential created in respect of the scheme.

Table 3.12: Yearwise and Seasonwise Potential Created (hectares)

Year	Kharif	Rabi	Hot-Weather	Total
1975-76	1993	1674	698	4365
1976-77	1993	1674	698	4365
1977-78	1993	1674	698	4365
1978-79	1993	1674	698	4365
1979-80	1993	1674	698	4365
1980-81	2658	2481	698	5837
1981-82	2658	2481	698	5837
1982-83	2658	2481	698	5837
1983-84	2658	2481	698	5837
1984-85	2658	2481	698	5837
Average	2362 (45.58%)	2122 (40.95%)	698 (13.47%)	5182 (100.00%)

The irrigation from the scheme started in the year 1975-76 and the full potential developed from the year 1980-81, i.e. within a period of 6 years full potential of 120 per cent (5837 hectares) of ICA (4864 hectares) is reported to have been created. As against the potential created the actual area reported to have

been irrigated in different seasons during the last 10 years is as follows:

Table 3.13 : Yearwise and Seasonwise Area Irrigated (Hectares)

Year	Kharif		Rabi		Hot-Weather		Total	
	Area	% of Potential Created	Area	% of Potential Created	Area	% of Potential Created	Area	% of Potential Created
1975-76	512	25.69	1717	102.57	349	50.00	2577	59.04
1976-77	696	34.92	1764	105.38	94	13.47	2555	58.54
1977-78	290	14.55	866	51.73	217	31.09	1372	31.43
1978-79	497	24.94	310	18.52	52	7.45	858	19.66
1979-80	45	2.26	1140	68.10	760	108.88	1944	44.54
1980-81	359	13.51	1411	56.87	772	110.60	2542	43.55
1981-82	255	9.59	811	32.69	284	40.69	1351	23.14
1982-83	520	19.56	253	10.20	18	2.58	791	13.55
1983-84	19	0.34	1130	45.55	900	128.94	2049	35.10
1984-85	20	0.75	941	37.93	415	59.45	1376	23.57
Average	321	13.59	1034	48.73	386	55.30	1741	33.60

8.2 The estimates of the extent of utilisation presented in Table 3.13 show that it is particularly low in kharif season, varying between less than 1 per cent in 1983-84 and 35 per cent in 1976-77 with an average estimate of around 14 per cent. Whereas the extent of utilisation is around 49 per cent on an average in rabi season and around 55% on an average in hot-weather

season. In fact the extent of utilisation is found to be more than 100 per cent during rabi and hot-weather seasons in some years. The overall extent of utilisation turns out to be around 34 per cent on an average. Since kharif area has comparatively a greater weight in the total potential created, even though the rabi season and hot-weather season utilisation percentages are higher, the overall utilisation percentage is lower because of lower percentage of utilisation in kharif. This is borne out by the observation that the extent of utilisation in kharif is as low as 0.33 per cent and 0.75 per cent in 1983-84 and 1984-85. Having examined the extent of utilisation based on the area approach we would now examine if the extent of utilisation estimated by other measure also shows similar result.

Table 3.14: Water Proposed to be Released for Irrigation as per Project Water Planning (M_m³)

Kharif	Rabi	Hot-Weather	Total
16.70	15.57	13.02	45.29
(36.87%)	(34.38%)	(28.75%)	(100.00%)

8.3 The water released as a percentage of the water planned to be released, the second measure of estimating the extent of underutilisation also shows that the extent of utilisation is particularly low in kharif. Table 3.15 shows that the extent of utilisation varies between 5 per cent and 66 per cent over the years in kharif season with average utilisation percentage of around 24 per cent, whereas the extent of utilisation is estimated to be around 80 per cent and 77 per cent on an average

Table 3.15 : Yearwise and Seasonwise Water Released for Irrigation
(Mm³)

Year	Kharif		Rabi		Hot-weather		Total	
	Q	%	Q	%	Q	%	Q	%
1975-76	-	-	19.41	124.73	2.49	19.13	21.90	48.35
1976-77	10.98	65.76	22.86	146.91	6.37	48.91	29.23	64.54
1977-78	6.17	36.95	7.64	49.09	7.05	54.13	20.86	46.06
1978-79	3.39	20.34	5.91	38.00	3.40	26.09	12.71	28.06
1979-80	0.88	5.25	12.25	78.73	17.83	136.96	30.08	66.42
1980-81	2.83	16.95	14.55	93.45	22.07	169.57	39.45	87.11
1981-82	2.91	17.45	14.60	93.82	7.84	60.22	25.36	55.99
1982-83	3.71	22.20	6.74	43.27	5.66	43.48	16.10	35.55
1983-84	0.82	4.92	8.43	54.18	16.98	130.43	25.41	56.11
Average	3.96	23.73	12.49	80.24	9.96	76.55	24.57	54.25

Q = Quantity released in Mm³

% = Per cent of water proposed to be released

in the rabi and hot-weather seasons. Even though the extent of utilisation is high in the rabi and hot-weather seasons, the overall extent of utilisation on an average turns out to be only 54 per cent because of the very low utilisation in the kharif season which according to the water planning accounts for around 37 per cent of the total water planned to be released.

8.3 A comparison of the extent of utilisation by the two measures suggests that the extent of utilisation turns out to be much higher when estimated by the second measure based on

water released approach than by the first measure based on area approach. The main reason for such an occurrence is the fact that while potential created in kharif season accounts for almost half of the total potential created the water proposed to be released in kharif season accounts for about one-third of the total water planned to be released during the year. In this connection it would be instructive to note that although water proposed to be released in kharif season is reported to be around 16.70 Mm^3 , the actual storage requirement planned for kharif season is only 3.31 Mm^3 (20 per cent of the requirement). Presumably for the remaining 80 per cent of the kharif requirement no storage is required as rainfall during this period would take care of this requirement.

8.4 From all these accounts it is clearly borne out that the kharif utilisation is particularly low in this region. Although the water planning provides for release of significant quantity of water for kharif irrigation, water actually released is much less; similarly although the area proposed to be irrigated in kharif is reported to be considerably high, the actual area irrigated is much less. It would be necessary to understand the reasons behind such a state of affair in order to bring about any change if necessary. First of all the adequacy and distribution of rainfall has to be examined to find out if 80 per cent of the kharif requirement and the adequate live storage requirement to meet the 100 per cent of rabi and hot-weather requirement can be met. Secondly the availability of live storage every year during different periods of kharif, rabi and hot-weather seasons has to be examined to find out if the

water remains unused and may therefore be planned to be used by devising suitable cropping pattern etc. Some of these important issues will be discussed in the subsequent chapters.

9. Medium Irrigation Scheme

(Nazare - Pune)

9.1 As has been mentioned earlier this medium irrigation scheme is in the scarcity zone of Western Maharashtra and hence providing protective irrigation is the main objective of the scheme. Like in respect of other schemes for this scheme also first we attempt to estimate the extent of the seasonal and overall utilisation of irrigation potential by both the measures.

9.2 In terms of area approach, area proposed to be irrigated as per project report is as presented in Table 3.16. It may be mentioned that full potential which in this case is the ICA of the project is reported to have been created by 1976-77, i.e.- within a period of 3 years from the time of commissioning the project. Since there is no separate account of the yearwise and seasonwise potential created we assume that the area proposed to be irrigated in different seasons as per project cropping pattern is also the respective potential created.

Table 3.16: Area Proposed to be Irrigated as per Project Cropping Pattern

	Kharif	Rabi	Hot- Weather	Two Seasonals	Total
1. Area (hectares)	1278	1426	-	492	3197
2 Per cent of ICA	(52)	(58)	-	(20)	(130)

Table 3.17: Yearwise and Seasonwise Area Irrigated (Hectares)

Year	Kharif		Rabi		Hot-weather		Total	
	Area	% of proposed area	Area	% of proposed area	Area	% of proposed area	Area	% of proposed area
1975-76	67	5.24	165	11.57	44	-	276	8.64
1976-77	264	20.66	752	52.73	118	-	1134	35.48
1977-78	190	14.87	646	45.30	156	-	992	31.04
1978-79	206	16.12	368	25.81	193	-	767	24.01
1979-80	152	11.90	261	18.30	132	-	545	17.06
1980-81	106	8.29	364	25.53	192	-	662	20.70
1981-82	150	11.74	439	30.79	186	-	775	24.27
1982-83	Nil	Nil	967	67.81	130	-	1097	34.30
1983-84	44	3.44	1139	79.87	122	-	1305	40.84
1984-85	225	17.61	1235	86.61	171	-	1631	51.03
Average	157	12.28	634	44.46	144	-	918	28.74

9.3 Table 3.17 clearly shows that kharif utilisation is relatively very low. In fact if the area under two seasons, separately reported in the area proposed to be irrigated, is added in kharif area proposed to be irrigated, the resulting estimates of kharif utilisation would be still lower. The estimates vary from as low as nil to somewhere around 21 per cent with an average utilisation of around 12 per cent in kharif over over the last 10 years. Even if last 5 years average is taken the situation would not change favourably at all. The extent of utilisation is around 44 per cent on an average in rabi season and the utilisation percentage would look up further if last

five years' average is taken instead of last ten years.

Utilisation is reported in hot-weather every year for the last 10 years even though the project planning did not show any area to be irrigated in the hot-weather. Presumably area actually reported to have been irrigated in hot-weather is the area under two seasonals (mainly L.S.Cotton) which, as we have seen, is provided for in the cropping pattern. The overall extent of utilisation is only around 29 per cent on an average because of particularly low utilisation in kharif season. Let us now examine if the extent of utilisation in kharif turns out to be so low even by the second measure of underutilisation.

Table 3.18: Water Proposed to be Released for Irrigation as per Project Water Planning (Mm³)

Kharif	Rabi	Hot-Weather	Total
7.30	7.70	-	15.00
(48.66%)	(51.34%)	-	(100.00%)

As against this the water released yearwise is given in table 3.19.

9.4 The extent of utilisation estimated by the second measure also shows that the utilisation percentage is particularly low in kharif, barely 16 per cent on an average over the last 10 years. It varies from zero utilisation in 1983-84 to around 33 per cent in 1977-78. In comparison in rabi and hot-weather seasons the extent of utilisation is relatively higher. In rabi season the extent of utilisation on an average turns out to be around 42 per cent and in hot-weather season considerable amount of water is released even though in the

water planning no such provision was made. Presumably water actually released every year in the hot-weather is meant for the two seasons for which there is provision in the proposed cropping pattern. On the whole the utilisation percentage is low around 39 per cent, because of very poor utilisation in kharif which as per Table 3.18 accounts for around 49 per cent of the water planned to be released during the year.

Table 3.19 : Yearwise and Seasonwise Water Released for Irrigation (Mm³)

Year	Kharif		Rabi		Hot-weather		Total	
	Q	%	Q	%	Q	%	Q	%
1975-76	0.71	9.69	0.82	10.65	1.13	-	2.66	17.72
1976-77	2.14	29.36	2.88	37.30	2.14	-	6.12	47.69
1977-78	2.40	32.89	5.60	72.69	1.02	-	9.01	60.11
1978-79	1.85	25.26	3.30	42.76	2.87	-	8.02	53.39
1979-80	0.14	1.94	1.81	23.49	1.42	-	3.37	22.50
1980-81	0.71	9.69	2.15	27.09	2.76	-	5.62	37.42
1981-82	0.99	13.56	2.07	26.80	2.41	-	5.47	36.38
1982-83	0.28	3.79	3.66	47.52	1.17	-	5.11	34.06
1983-84	-	-	5.18	67.25	0.73	-	5.91	39.39
1984-85	1.19	16.34	5.24	67.91	-	-	6.43	42.83
Average	1.16	15.84	3.27	42.43	1.74	-	5.88	39.15

9.5 If we compare the estimates of the extent of utilisation by the two measures presented in Tables 3.17 and 3.19 we find that the kharif utilisation percentages estimated by two measures on an average match fairly well with each other. It is only in

the years 1977-78, 1978-79 and 1979-80 that the estimates of utilisation are seen to be higher by the second measure. Apart from the fact that there may have only been a marginal change in the existing cropping pattern and the proposed cropping pattern, the main reason for such an occurrence is more or less equal weight of the kharif area in the total area to be irrigated and kharif water in the total water to be released during the year as per the project planning.

9.6 On the whole the extent of utilisation in kharif is found to be particularly low. This is a matter for concern in a scarcity area in which the scheme is located. The project storage planning suggests only 20 per cent storage for kharif season, the remaining 80 per cent of the kharif requirement is to be met by rainfall during the season. This raises a number of questions which have to be answered. It has to be examined if the rainfall every year is adequate and well distributed to meet not only the 80 per cent of kharif requirement but also the 20 per cent storage requirement in kharif in addition to 100 per cent storage requirement for rabi as well as for two seasonals in hot-weather. It has also to be examined if any part of live storage remained unutilised in any given year. Some of these important issues would be discussed in the subsequent chapters.

CHAPTER IV
SUBJECTIVE EVALUATION OF REASONS
FOR LOW KHARIF UTILISATION

1. Introduction

1.1 This chapter deals with the subjective evaluation of the factors responsible for particularly low utilisation of kharif irrigation potential. It is attempted through the opinion survey of the irrigators in the command area of the projects under study with a view to know how the farmers - the ultimate users and beneficiaries of the irrigation systems, view the question of kharif underutilisation. Accordingly, as proposed, relevant information are collected from the sample beneficiaries under the five schemes through field investigation with the help of the structured questionnaires as well^{as}/through the informal discussion with the beneficiaries of the schemes. The sampling procedure and the coverage for the field investigation are already presented in the first chapter; in what follows we discuss the results of the subjective evaluation so attempted.

2. Characteristic Features of the Sample Holdings

2.1 Before we take up the discussion of the factors responsible for the particularly low utilisation in kharif based on the subjective evaluation we present the characteristic features of the beneficiary households (holdings) whose opinion survey we have undertaken in this study.

2.2 Tables 5.1(a), 5.1(b), 5.1(c), 5.1(d) and 5.1(e) present the distribution of land of the beneficiary households by holding size-groups in respect of the five schemes under study. It is noted from these tables that the average size of holding considering all farms (total) is smallest in the very high rainfall zone under the command of the scheme Kalote-Mokashi in Raigad district and is highest under the command area of Asola-Mendha scheme in Chandrapur district characterised by high and assured rainfall. It may be recalled that the main crop grown in both these regions is paddy, but, the region of very heavy rainfall of Konkan is characterised by small holdings and the region of high and assured rainfall of Chandrapur area is characterised by large holdings. Command area under the Manyad scheme in Jalgaon district and the Nirguna scheme in Akola district characterised generally by assured rainfall, show similar land holding structure. The cropping pattern also is similar under these two medium irrigation schemes. In the scarcity zone in which the Nazare scheme in Pune district is situated the average size of holding is around two and quarter hectares.

2.3 As is generally observed, in the present study also we find that the proportion of irrigated land to total decreases with the increase in farm size in respect of all the schemes under study. The extent of irrigation is comparatively less under the scheme in the very high rainfall zone of Raigad district, whereas the same is very high for the holdings in respect of the scheme in the scarcity zone of Pune district. In the other three areas the

Table 4.1 (a): Distribution of Land by Holding Size Scheme
Kalote Mokashi - Raigad

Size Group	Number of beneficiaries	Total land (ha.)	Irrigated land (ha.)	Un-irrigated land (ha.)	Average size of holding (ha.)
1. Less than 1 hectare	13 (32.50)	6.67	4.34 (65.07)	2.33 (34.93)	0.51
2. 1 to 2 hectares	17 (42.50)	20.96	9.65 (46.04)	11.31 (53.96)	1.23
3. Above 2 hectares	10 (25.00)	28.79	11.14 (38.69)	17.65 (61.31)	2.88
All farmers	40	56.42	25.13 (44.54)	31.29 (55.46)	1.39

Table 4.1 (b): Distribution of Land by Holding Size Scheme
Asola Mendha - Chandrapur

Size Group	Number of beneficiaries	Total land (ha.)	Irrigated land (ha.)	Un-irrigated land (ha.)	Average size of holding (ha.)
1. Less than 1 hectare	56 (21.54)	34.51	32.71 (94.78)	1.80 (5.22)	0.61
2. 1 to 2 hectares	73 (28.08)	106.82	88.95 (83.27)	17.87 (16.73)	1.46
3. Above 2 hectares	131 (50.38)	593.60	346.46 (58.37)	247.14 (41.63)	4.53
All farmers	260	734.93	468.12 (63.70)	266.81 (36.30)	2.83

(Figures in brackets indicate percentages)

Table 4.1 (c): Distribution of Land by Holding Size Scheme
Nirguna - Akola

Size Group	Number of beneficiaries	Total land (ha.)	Irrigated land (ha.)	Un-irrigated land (ha.)	Average size of holding (ha.)
1. Less than 1 hectare	16	9.96	7.77 (78.01)	2.19 (21.99)	0.62
2. 1 to 2 hectares	30 (35.71)	42.00	28.12 (66.95)	13.88 (33.05)	1.40
3. Above 2 hectares	38 (45.24)	147.25	65.72 (44.63)	81.53 (55.37)	3.87
All farmers	84	199.21	101.61 (51.01)	97.60 (48.99)	2.37

Table 4.1 (d): Distribution of Land by Holding Size Scheme
Manyad - Jalgaon

Size Group	Number of beneficiaries	Total land (ha.)	Irrigated land (ha.)	Un-irrigated land (ha.)	Average size of holding (ha.)
1. Less than 1 hectare	13 (14.94)	7.46	6.85 (91.82)	0.61 (8.18)	0.57
2. 1 to 2 hectares	26 (29.89)	40.03	27.79 (69.42)	12.24 (30.58)	1.54
3. Above 2 hectares	48 (55.17)	186.08	100.66 (54.10)	85.42 (45.90)	3.88
All farmers	87	233.57	135.30 (57.93)	98.27 (42.07)	2.68

(Figures in bracket indicate percentages)

Table 4.1 (e): Distribution of Land by Holding Size
Scheme : Nazare - Pune

Size Group	Number of beneficiaries	Total land (ha.)	Irrigated land (ha.)	Un-irrigated land (ha.)	Average size of holding (ha.)
1. Less than 1 hectare	12 (20.00)	7.26	6.75 (92.98)	0.51 (7.02)	0.61
2. 1 to 2 hectares	17 (28.33)	25.15	22.60 (89.86)	2.55 (10.14)	1.48
3. Above 2 hectares	31 (51.67)	99.70	74.93 (75.16)	24.77 (24.84)	3.22
All farmers	60	132.11	104.28 (78.93)	27.83 (21.07)	2.20

Table 4.2 (a): Distribution of Irrigated Area by Source and Size of Holding
Scheme : Kalote Moka-shi - Raigad

Size Group	Irrigated by canal (ha.)		Irrigated by well (ha.)		Irrigated by other sources (ha.)		Total irrigated area (ha.)	
	Total	Per farm	Total	Per farm	Total	per farm	Total	Per farm
1. Less than 1 hectare	4.34 (100.00)	0.33	Nil	Nil	Nil	-	4.34	0.33
2. 1 to 2	9.65 (100.00)	0.57	Nil	Nil	Nil	-	9.65	0.57
3. Above 2 hectares	11.14 (100.00)	1.11	Nil	Nil	Nil	-	11.14	1.11
All farmers	25.13 (100.00)	0.63	Nil	Nil	Nil	-	25.13	0.63

(Figures in brackets indicate percentages)

proportion of irrigated and unirrigated land to total is more or less equal.

2.4 So far as source of irrigation is concerned land irrigated by canal dominates the total land irrigated under every scheme. This is quite natural because the holdings are selected from the beneficiaries in command area of the schemes under study. However, there is difference in the proportion of area irrigated by canal and by other sources from region to region. Tables 4.2(a), 4.2(b), 4.2(c), 4.2 (d) and 4.2(e) give this information. In the command area of Kalote-Mokashi scheme in Raigad district canal is the only source of irrigation and the same is more or less true of the Nirguná scheme in Akola district. In the case of Asola-Mendha scheme in Chandrapur district although the main source of irrigation is reported to be canal, small proportion of total area of such holdings is also irrigated by ponds, tanks etc., which accumulate and store water during heavy rainfall for use at the time of long gap and break in monsoon. In so far as the Manyad scheme in Jalgaon district and the Nazare scheme in Pune district are concerned, well irrigation accounts for around one-third and one-fourth of the total irrigated area of the holdings in the command area of these two schemes respectively.

2.5 Table 4.3 shows the distribution of beneficiaries as per the location of the farms (holdings) relating to the distribution system. As mentioned in the sampling procedure in chapter 1, the sample holdings are selected from all the reaches of the main distribution system hence we see from Table 4.3 that the proportion

Table 4.2 (b): Distribution of Irrigated Area by Source and Size of Holding
Scheme : Asola Mendha - Chandrapur

Size Group	Irrigated by canal (ha.)		Irrigated by well (ha.)		Irrigated by other sources (ha.)		Total irrigated area (ha.)	
	Total	Per farm	Total	Per farm	Total	Per farm	Total	Per farm
1. Less than 1 hectare	32.71 (100.00)	0.58	-	-	-	-	32.71	0.58
2. 1 to 2 hectares	86.28 (97.00)	1.18	-	-	2.67 (3.00)	0.04	88.95	1.22
3. Above 2 hectares	283.21 (81.80)	2.16 (0.57)	1.96 (0.07)	0.01	61.09 (17.63)	0.47	346.46	2.64
All farmers	402.40 (85.96)	1.55	1.96 (0.42)	0.75	63.76 (13.62)	0.24	468.12	1.80

Table 4.2 (c): Distribution of Irrigated Area by Source and Size of Holding
Scheme : Nirguna - Akola

Size Group	Irrigated by canal (ha.)		Irrigated by well (ha.)		Irrigated by other sources (ha.)		Total irrigated area (ha.)	
	Total	Per farm	Total	Per farm	Total	Per farm	Total	Per farm
1. Less than 1 hectare	7.77 (100.00)	0.49	Nil	Nil	Nil	Nil	7.77	0.49
2. 1 to 2 hectares	28.12 (100.00)	0.94	Nil	Nil	Nil	Nil	28.12	0.94
3. Above 2 hectares	60.61 (92.22)	1.60	5.11 (7.78)	0.13	Nil Nil	Nil Nil	65.72	1.73
All farmers	96.50 (94.97)	1.15	5.11 (5.03)	0.06	Nil	Nil	101.61	1.21

(Figures in brackets indicate percentages)

Table 4.2 (d): Distribution of Irrigated Area by Source and Size of Holding
Scheme : Manyad - Jalgaon

Size Group	Irrigated by canal (ha.)		Irrigated by well (ha.)		Irrigated by other sources (ha.)		Total irrigated area (ha.)	
	Total	Per farm	Total	Per farm	Total	Per farm	Total	Per farm
1. Less than 1 hectare	6.45 (94.16)	0.50	0.40 (5.84)	0.03	Nil Nil	Nil Nil	6.85	0.53
2. 1 to 2 hectares	19.49 (70.13)	0.75	8.30 (29.87)	0.32	Nil	Nil	27.79	1.07
3. Above 2 hectares	62.61 (62.20)	1.30	38.05 (37.80)	0.79	Nil	Nil	100.66	2.10
All farmers	88.55 (65.45)	1.02	46.75 (34.55)	0.54	Nil	Nil	135.30	1.56

Table 4.2 (e): Distribution of Irrigated Area by Source and Size of Holding
Scheme : Nazare - Pune

Size Group	Irrigated by canal (ha.)		Irrigated by well (ha.)		Irrigated by other sources (ha.)		Total irrigated area (ha.)	
	Total	Per farm	Total	Per farm	Total	Per farm	Total	Per farm
1. Less than 1 hectare	6.29 (93.19)	0.52	0.46 (6.81)	0.04	Nil	Nil	6.75	0.56
2. 1 to 2 hectares	17.18 (76.02)	1.01	5.42 (23.98)	0.32	Nil	Nil	22.60	1.33
3. Above 2 hectares	57.22 (76.36)	1.84	17.71 (23.64)	0.57	Nil	Nil	74.93	2.42
All farmers	80.69 (77.38)	1.34	23.59 (22.62)	0.39	Nil	Nil	104.28	1.74

(Figures in brackets indicate percentages)

Table 4.3: Distribution of Beneficiaries According to the Location of the Farm in Relation to the Canal

Name of the scheme	Number of beneficiaries			
	Head reaches	Middle reaches	Tail end	Total
1. <u>Kalote Mokashi</u> - Raigad	22 (55.00)	-	18 (45.00)	40
2. <u>Nazare</u> - Pune	20 (33.33)	20 (33.33)	20 (33.33)	60
3. <u>Manyad</u> - Jalgaon	24 (27.59)	30 (34.48)	33 (37.93)	87
4. <u>Nirguna</u> - Akola	40 (47.62)	21 (25.00)	23 (27.38)	84
5. <u>Asola Mendha</u> - Chandrapur	80 (30.77)	99 (38.08)	81 (31.15)	260

Table 4.4: Main Crops Grown in Kharif

Name of the scheme	Number of respondents growing different crops						Total no. of beneficiaries
	Hybrid jowar	Cot- ton	Ground- nut	Paddy	Hybrid Bajra	Others*	
1. <u>Kalote Mokashi</u> - Raigad	-	-	2	40	-	12	40
2. <u>Nazare</u> - Pune	12	-	3	1	24	26	60
3. <u>Manyad</u> - Jalgaon	77	2	34	12	85	9	87
4. <u>Nirguna</u> - Akola	84	75	5	-	-	47	84
5. <u>Asola Mendha</u> - Chandrapur	-	-	-	260	-	-	260

(Figures in brackets indicate percentages)

- * Others - 1. Kalote Mokashi - Inferior millets
 2. Nazare - Vegetable
 3. Manyad - Pulses
 4. Nirguna - Pulses

of holdings in the head, middle and tail reaches of the canal is more or less the same.

2.6 Number of respondents growing different crops in kharif in the command area of different schemes is presented in Table 4.4. Paddy is reported to be the most dominant crop in the command area of the Kalote-Mokashi scheme in Raigad district and the Asola-Mendha scheme in Chandrapur district. Incidentally one scheme is located in very heavy rainfall zone and the other is in the heavy and assured rainfall zone. The main crop grown in kharif in the scarcity zone of the Nazare scheme is hybrid bajra and vegetable in case adequate water is available. In the assured rainfall zone of the Nirguna scheme in Akola district hybrid jowar and cotton are the most important crops grown in kharif, where as in the rain shadow (less assured) region of Manyad scheme in Jalgaon district both hybrid jowar and hybrid bajra are the most important crops grown in kharif, followed by groundnut.

2.7 The structure of the land holdings and the other characteristics of the holdings in the command area of different schemes show that except in the case of the Kalote-Mokashi scheme in Raigad district, in respect of the command area of all other schemes large holdings dominate. In so far as source of irrigation is concerned only in the case of the command area of the Manyad scheme in Jalgaon district and the Nazare scheme in Pune district that a considerable proportion of the net holding is irrigated by well. Further the proportion of area irrigated by wells is seen to be increasing with the increase in farm size indicating thereby

that the small land holders depend mainly on the public source of irrigation, that is canal. It is also observed that the main crop grown in heavy and high rainfall areas is paddy, in the scarcity zone it is hybrid bajra and short duration vegetable and in the assured and less assured rainfall zones the main crops in kharif are hybrid jowar, hybrid bajra, cotton and groundnut.

3. Holdings Using/Not Using Canal Water for Kharif Irrigation

3.1 In order to make a subjective evaluation of the factors responsible for particularly low utilisation of irrigation facilities in kharif it is necessary to examine first the proportion of holdings not using canal water for kharif irrigation in the command area of different schemes.

3.2 Table 4.5 shows the distribution of beneficiaries on the basis of whether canal water is taken for kharif irrigation. We find two extreme cases, on the one hand no beneficiary is reported to be taking canal water for kharif irrigation in respect of Kalote-Mokashi scheme in Raigad district and on the other all the beneficiaries covered in our sample are reported to be using canal water for kharif crops in respect of the Asola-Mendha scheme in Chandrapur district. It would be instructive to recall at this stage that these two schemes are located in very heavy rainfall and high rainfall zones respectively and the main crop grown in the command area of these two schemes is paddy. Thus we find that, as opposed to the beneficiaries of Kalote-Mokashi scheme in heavy rainfall zone of Raigad district beneficiaries of the Asola-Mendha scheme in the high rainfall zone of Chandrapur district

Table 4.5: Distribution of Beneficiaries on the Basis of Whether Canal Water is Taken for Kharif Irrigation

Name of the scheme	Number of beneficiaries		
	Using canal water for kharif crops	Not using canal water for kharif crops	Total
1. <u>Kalote Mokashi</u> - Raigad	-	40 (100.00)	40
2. <u>Nazare</u> - Pune	14 (23.33)	46 (76.67)	60
3. <u>Manyad</u> - Jalgaon	3 (3.45)	84 (96.55)	87
4. <u>Nirguna</u> - Akola	13 (15.48)	71 (84.52)	84
5. <u>Asola Mendha</u> - Chandrapur	259 (99.62)	1 (0.38)	260

Table 4.6: Response to Whether Application is Made Every Year for Kharif Irrigation from Canal

Name of the scheme	Number of beneficiaries		
	Application made every year	Application not made every year	Total
1. <u>Kalote Mokashi</u> - Raigad	-	40 (100.00)	40
2. <u>Nazare</u> - Pune	8 (13.33)	52 (86.67)	60
3. <u>Manyad</u> - Jalgaon	32 (36.78)	55 (63.22)	87
4. <u>Nirguna</u> - Akola	37 (44.05)	47 (55.95)	84
5. <u>Asola Mendha</u> - Chandrapur	-	260 (100.00)	260

(Figures in bracket indicate percentages)

invariably use canal water in kharif for growing paddy. In respect of the Manyad scheme situated in less assured rainfall zone of the Jalgaon district number of cases reporting kharif irrigation by canal is almost negligible at around 3 per cent. Use of canal water for kharif irrigation is reported to be comparatively higher in respect of Nazare scheme in Pune district and Nirguna scheme of Akola district, being around 22 per cent and 15 per cent respectively.

3.3 A nother way of finding out if there is demand for canal water in kharif is to find out the number of irrigators submitting application every year to the canal authorities for the supply of water for kharif crops. Table 4.6 gives this information. We find that the irrigators do not demand water (no application made) in kharif season under Kalote-Mokashi scheme in Raigad district. Since, in the case of Asola-Mendha scheme in Chandrapur district, the irrigators enter into long term agreement for kharif irrigation, water applications are made only once in three years and not every year. In respect of Manyad scheme in Jalgaon district and Nirguna scheme in Akola district 37 per cent and 44 per cent of the irrigators respectively apply for kharif water supply, but, as seen in earlier table only 3 per cent and 15 per cent respectively actually take canal water for kharif crops. This means there is considerable rejection of the application by the scheme authorities for kharif irrigation. However, for Nazare scheme in Pune district number of applications made for kharif irrigation is smaller than the number of irrigators taking canal water for kharif irrigation. There seem to be some discrepancy in

the data for this scheme.

4. Factors Responsible for Particularly Low Utilization of Kharif Irrigation Potential

4.1 As mentioned earlier, in what follows we attempt a subjective evaluation of the factors accounting for particularly low utilisation of kharif irrigation potential. This evaluation is based on the opinion survey of the sample irrigators under each of the five schemes.

4.2 Table 4.7(a) lists the main reasons given by the irrigators for not using canal water for kharif irrigation for each of the five schemes. Large number of reasons expressed by the irrigators in various forms have been classified into six broad classes. Because of the differences in agro-climatic complex between the regions chosen for study the importance of the reasons for low utilisation in kharif would in general be different in different regions, which we have tried to identify. Table 4.7(b) lists the most important reason out of the number of reasons mentioned for not resorting to irrigation for kharif cultivation.

4.3 In so far as Asola-Mendha scheme in Chandrapur district is concerned since all the irrigators demand and use canal water the above question does not arise for them. We shall first therefore examine why is it so.

4.4 As per the experience of the farmers the monsoon generally sets in this region during the 2nd or 3rd week of June. The farmers thereafter prepare their land for raising seedlings. Seedlings are raised (grown) entirely on rain water and after

Table 4.7 (a): Reasons for Non Using Canal Water for Kharif Irrigation

Reasons for not using canal water	Number of respondents				
	<u>Kalote</u> <u>Mokashi</u> <u>Raigad</u>	<u>Nazare</u> <u>Pune</u>	<u>Manyad</u> <u>Jalgaon</u>	<u>Nirguna</u> <u>Akola</u>	<u>Asola</u> <u>Mendha</u> <u>Chandra-</u> <u>pur</u>
1. Kharif water rate is high	-	-	16 (18.39)	19 (26.76)	-
2. Adequate well water available	-	3 (6.52)	11 (13.10)	2 (2.81)	-
3. Water is not made available/not made available in time when required	-	46 (100.00)	73 (86.90)	59 (83.10)	1 (100.00)
4. No need for irrigation because of adequate rain	40 (100.00)	-	9 (10.71)	28 (39.44)	-
5. No need for applying for canal water because water is automatically available through leakage and through overflow	-	-	-	3 (4.23)	-
6. In this region Rabi crop is most important. Farmers do not bother much about kharif cultivation	-	27 (58.69)	-	-	-
* Total number of beneficiaries not using canal water in kharif season	40	46	84	71	1

* Total number of respondents may be more than the total number of beneficiaries because a beneficiary may give more than one reason. Fig (Figures in brackets indicate percentage to total number of beneficiaries)

Table 4.7 (b): Most Important Reason for Not Using Canal Water for Kharif Irrigation

Name of the scheme	Number of respondents		
	Water is not made available/not made available in time when required	No need for irrigation because of adequate rain	Total number of beneficiaries not using canal water
1. <u>Kalote Mokashi</u> - Raigad	-	40 (100.00)	40
2. <u>Nazare</u> - Pune	35 (76.09)	-	46
3. <u>Manyad</u> - Jalgaon	58 (69.05)	-	84
4. <u>Nirguna</u> - Akola	40 (56.34)	-	71
5. <u>Asola Mendha</u> - Chandrapur	- Not applicable -		

(Figures in brackets indicate percentages)

transplantation the crop solely depends on rain for its growth. Generally the rain starts receding from the middle of August and thereafter the irrigation is demanded by the farmers from the scheme and the water is supplied to the standing crop of paddy. The irrigators enter into long term agreement with the irrigation department, renewable every three years, and the canal authorities are committed to provide water to the farmers until the crop is harvested by the middle of November.

4.5 Over the last 60 years the irrigation development has materialised in such a way that only paddy is suitable in this region; soil is reported to be not suitable for growing any other crop. Even if it is possible to grow any other crop in rabi and not weather seasons, there is no assurance of availability of water from the reservoir. In fact, there is a provision to carry over 15 to 20 per cent of water for irrigation in early kharif in case the monsoon is delayed and happens to be uneven in the initial period because the objective of the scheme is to provide protective irrigation to kharif crops.

4.6 Though the irrigation schedule should begin (as per irrigation year) on 1st of July every year, in actual practice the 1st watering for kharif season begins in 1st week of September and irrigation continues upto the middle of November. During this period 4 to 5 waterings are provided to the paddy crop. The rotation period of each watering is normally 15 days; this practice is followed considering the distribution of rainfall.

4.7 The irrigators under Kalote-Mokashi scheme in Raigad district give only one reason for not using canal water for kharif

crops and that is, 'no need of irrigation because of adequate rain during kharif season'. This reason is naturally the most important reason for not taking canal water for kharif cultivation (Table 4.7(b)). This response clearly indicates that given the cropping pattern that is practised by the irrigators, in which paddy is the only crop grown during kharif season, irrigation in kharif season is not required because of adequate rainfall. It may be recalled that the scheme is located in the heavy rainfall region and the main crop (in fact the only crop) grown during the monsoon (kharif) season is paddy. In fact the main crop grown during the post monsoon season (known as 'Konkan Hangan') is also paddy. Irrigation is required for the rabi, hot weather season paddy, but, not for kharif paddy.

4.8 The farmers wait for the rain and the entire kharif cultivation is reported to be dependent on rain. Even when there is break in monsoon in mid-September or so for a period of 10 to 12 days, irrigators do not demand canal water. The farmers are of the opinion that kharif rice production is not affected adversely because of occasional and periodic interruption in rain. The farmers prepare the land and sow paddy seed for raising seedlings generally by the end of May or 1st week of June depending upon the moisture in the field. The monsoon generally sets in by the 1st or 2nd week of June in this region. Even if the break of monsoon is delayed farmers wait for the rain because the seed once sown is expected to remain so and finally when the rain comes germination takes place, though very late. This naturally leads to late transplantation and late harvesting

and therefore late beginning of the next-season. The farmers report that even if rain is delayed for a longer period the paddy seeds already sown are not affected and germinate after the first shower, hence even if the irrigation department makes provision for pre-monsoon irrigation for raising seedlings the farmers may not avail of the facility. Thus it is the demand factor which is most crucial in this region.

4.9 In respect of Nazare scheme in Pune district, the reasons given by the irrigators for not using canal water in kharif season are unavailability of water when required, importance of rabi crop, hence kharif crop neglected and availability of adequate well water. Naturally many irrigators have given more than one reason for not using canal water for kharif cultivation. We note from Table 4.7(a) that all the irrigators not resorting to irrigation in kharif season give unavailability of water from the canal system as one of the reasons for not asking for canal water, 59 per cent of the irrigators also report about the importance of rabi crop and hence kharif cultivation neglected (left to the vagaries of monsoon) and only 7 per cent mention availability of alternate source of irrigation as the reason for not demanding canal water. The most important reason as listed in Table 4.7(b) is unavailability of water when required; around 76 per cent of the irrigators not resorting to canal irrigation assign this as the most important reason.

4.10 As noted earlier the crops grown in kharif in this scarcity zone are hybrid bajra, hybrid jowar and groundnut, mainly of course hybrid bajra. The irrigators opine that because

canal water is released for kharif irrigation (if at all) only by the middle of July, there is no demand for water from the irrigators. The irrigators would like to get canal water during last week of May and/or 1st week of June so that after the kharif harvest land is available for rabi cultivation. But the canal authorities do not supply water at that time. They further opine that in case water is made available when they demand (beginning from the end of May) they would take canal water in kharif for 50 per cent of grain crops, 25 per cent of groundnut and 25 per cent of vegetable. The crop rotation then may be hybrid bajra to be followed by jowar and groundnut to be followed by wheat and gram.

4.11 However, quite a few irrigators also opine that the region is characterised by the importance of rabi crops (mainly jowar) and hence kharif irrigation would be preferred only after full provision for rabi season requirement is assured. They do not want kharif irrigation at the cost of irrigation for rabi season crops.

4.12 It appears from the above account that it is mainly the supply factor which seems to be responsible for very low demand for kharif irrigation. If the irrigators are not assured of the availability (supply) of water when they need, naturally there would not be any demand from the irrigators for the same. There is some element of demand factor also in so far as importance is assigned by the irrigators to the irrigated rabi crops in preference to kharif crops.

4.13 In respect of Manyad scheme in Jalgaon district the reasons

assigned by the irrigators for not resorting to kharif irrigation are (i) unavailability of water for kharif irrigation, (ii) high water rates for kharif crops, (iii) availability of adequate well water and (iv) adequate rain. Of these reasons around 87 per cent of the irrigators not using canal water for kharif irrigation give unavailability of canal water for kharif crops as one of the reasons, around 18 per cent, 13 per cent and 11 per cent of the irrigators not using canal water also give the other three reasons respectively mentioned earlier. If we look into the most important reason listed in Table 4.7(b) we find that around 69 per cent of the irrigators not using canal water for kharif irrigation assign unavailability of canal water when required as the most important reason for not demanding water for kharif cultivation.

4.14 It may be recalled that the important crops grown in kharif season in this region are jowar, groundnut and pulses and to some extent cotton. The irrigators report that the water for kharif irrigation is released (if at all) as a rule around middle of July, which according to them is very late for sowing kharif crops considering the follow-up crops to be grown in rabi and hot weather seasons. The irrigators would like to get water for kharif sowing much earlier, i.e. by the end of May or at best by the 1st week of June and the impression that is created is that in case water made available in time when it is required there would be significant increase in the demand for canal water for kharif irrigation.

4.15 The first thing that the irrigators mention is that there

is no guarantee of assured water supply during kharif season hence they do not demand water even though they would very much like to get water which helps to increase the yield of the crop. It is opined that by the time first water is released (around July, 15) monsoon has already set in and the farmers do not need water at that time because of availability of adequate rain water. In point of fact the fields are prepared in such a way that these can receive rain water (no field channels) and afterwards when the crop is already grown it becomes difficult to make field channels to receive canal water, hence they do not demand canal water even afterwards.

4.16 What the farmers want is the assured supply of water during the first and second week of June for land preparation and sowing of hybrid jowar, groundnut and cotton; by 10th June these crops should have been sown (ideal period). Groundnut is a crop of around 96 to 100 days and is harvested by the middle of September making land available for rabi cultivation. Hybrid jowar remains in the field upto October and cotton upto November. Hot-weather groundnut is taken up on the area occupied by hybrid jowar and/or cotton in kharif. Farmers are prepared to fill in the water application form by the end of May for kharif irrigation so that water can be given to them during the 1st week of June. According to them if the above practice is followed demand for kharif irrigation would increase very considerably.

4.17 It is clear from the above discussion that the issue of particularly low response for kharif irrigation is very much related to the supply factor. Early sowing (pre-monsoon) of kharif

crops, as desired by the irrigators, requires assured supply of canal water during this period, at least of one watering without fail. Thereafter the crop does not require water for another 2 to 3 weeks and thereafter the monsoon sets in and the farmers may require 2 to 3 waterings during July, August and September depending upon the amount and distribution of rainfall. Meeting these requirements from supply side would certainly induce the farmers to respond very favourably to kharif irrigation. In this connection a very important factor should not be lost sight of, that is increasing demand for the supply of canal water for hot-weather groundnut by the irrigators. Over the years hot weather groundnut has become very popular crop with the farmers in this area, and if irrigation is provided to this crop there may not be enough water available in the storage for pre-monsoon kharif irrigation. Along with this aspect it needs to be examined if the kharif water rates are high considering the fact that the irrigators may take only 2 to 3 waterings during the entire season.

4.18 Nirguna scheme in Akola district, as mentioned earlier, is located in assured rainfall zone and it is seen in Table 4.7(a) that around 40 per cent of the irrigators not using canal water for kharif irrigation do so because of the availability of adequate rain water for kharif cultivation. However, around 83 per cent of those who do not use canal water for kharif cultivation assign unavailability of canal water as the reason for doing so. Around 27 per cent of them also mention about the high water rates for kharif irrigation in view of fewer number of waterings

taken for kharif crops. Most important reason pointed out by the irrigators and listed in Table 4.7(b) shows that unavailability of water when required is reported to be the most important reason by more than 56 per cent of the irrigators not using canal water for kharif crops.

4.19 It may be recalled that the important crops grown in kharif season in this region are hybrid jowar and cotton and to an extent pulses (mostly unirrigated). Of these crops, as per farmers' opinion, hybrid jowar does not require much irrigation and it can withstand fairly long period of dry spell and the yield is reported not to be very much affected. The monsoon generally sets in by the 2nd or 3rd week of June. Land is kept ready for kharif sowing and as soon as there is first monsoon rain, sowing operation is completed. The crop rotation followed is generally of three types, (i) cotton in kharif is followed by groundnut in rabi-hot weather. Cotton is sown in mid-June depending on rain and harvested in mid November or so and then groundnut is sown on the same land in mid-January and harvested by the end of April or beginning of May. (ii) unirrigated pulses in kharif followed by wheat or gram in rabi and (iii) hybrid jowar in kharif followed by wheat/gram in rabi or summer groundnut in mid-January. The combination which the farmers choose depends upon time of onset of monsoon because the farmers depend upon rain for kharif sowing. Since the farmers depend upon rain for kharif sowing, if the onset of monsoon is delayed, the kharif cultivation is delayed and hence the following rabi and summer seasons are delayed which affect the production of crops adversely.

4.20 At present, as we have noted, there is negligible demand for kharif watering. In case there is dry spell in the month of September/October, some farmers may demand canal water mainly for cotton. As mentioned earlier, main reason for the lack of demand for water in kharif season is that water is not released for early sowing and also that there is no assurance of the availability (supply) of canal water even during the dry spell in kharif season. The reason next in importance is the high water rates for kharif. The farmers opine that the water charges are made for the entire kharif season even though a farmer may have taken only 1 or 2 waterings during the entire kharif season. In fact, there is great resentment by the irrigators of the fact that the water charges are made for two seasons for the same crop if the irrigation happens to get spread over two seasons.

4.21 From our discussion with the cultivators it is clear that they are ready to take canal water for early sowing, without waiting for rains and subsequently during dry spells in kharif season if there is a complete assurance about the availability of water and also if the charges are made per watering rather than for the season. This will not only ensure kharif utilisation but will also ensure timely rabi sowing.

4.22 It may be deduced from the above account that the issue of particularly low utilisation in kharif arises out of both supply factor and demand factor. For early sowing assured supply of water is required (may be for 2 waterings), thereafter assured water supply during dry spell is also required to induce the irrigators to demand water for kharif irrigation. It is, however,

necessary that the demand for kharif irrigation comes in bulk and in contiguous block. In this connection the popularity of summer groundnut with the irrigators has to be kept in view. It has to be evaluated objectively if the water for early sowing (pre-monsoon) in kharif will be available in case water is released for hot-weather groundnut. Further, from the demand side feasibility of adjusting the water rates for kharif crops in order to make the irrigators more responsive to kharif irrigation has also to be taken note of.

4.23 Factors responsible for particularly low utilisation of kharif irrigation potential can also be conveniently discerned by analysing the responses of those who use canal water in kharif season and the difficulties they face in doing so. As mentioned earlier, most of the irrigators under Nazare scheme in Pune district, Nirguna scheme in Akola district and Manyad scheme in Jalgaon district do not use canal water and again under Kalote-Mokashi scheme no irrigators use canal water for kharif cultivation, thus only a few use canal water for raising kharif crops. In what follows we examine the responses of these small number of users to ascertain the nature of difficulties they face which may be deterrent for other farmers to go for kharif irrigation.

4.24 Table 4.8 shows the number of irrigators (from amongst those who use canal water for kharif cultivation) taking water in each rotation. It is seen that quite a large proportion of irrigators do not take water in each rotation the reasons for which is presented in Table 4.9. We once again find that because water is not made available when required the irrigators do not

Table 4.8: Response to Whether Water was Taken in Each Rotation
(only for those who take canal water in kharif)

Name of the scheme	Number of beneficiaries		
	Water taken in each rotation	Water not taken in each rotation	Total
1. <u>Kalote Mokashi</u> - Raigad	N.A.	N.A.	N.A.
2. <u>Nazare</u> - Pune	7 (50.00)	7 (50.00)	14
3. <u>Manyad</u> - Jalgaon	-	3 (100.00)	3
4. <u>Nirguna</u> - Akola	8 (61.54)	5 (38.46)	13
5. <u>Asola Mendha</u> - Chandrapur	192 (74.13)	67 (25.87)	259

. N.A. = Not Applicable

(Figures in brackets indicate percentages)

Table 4.9: Main Reasons for Not Taking Water in Each Rotation for Kharif Crops (only for those who take canal water in kharif)

Reasons	Number of respondents schemewise				
	<u>Kalote</u> <u>Mokashi</u> <u>Raigad</u>	<u>Nazare</u> <u>Pune</u>	<u>Manyad</u> <u>Jalgaon</u>	<u>Nirguna</u> <u>Akola</u>	<u>Asola</u> <u>Mendha</u> <u>Chandrarur</u>
1. Water is not made available/not made available when required	N.A.	7 (100.00)	3 (100.00)	2 (40.00)	60 (89.55)
2. No need of irrigation water because of adequate rain	N.A.	-	-	3 (60.00)	7 (10.45)
Total	-	7	3	5	67

N.A. = Not Applicable

(Figures in brackets indicate percentages)

take water in each rotation. The other reason, that of adequate rain, is confined to Nirguna scheme in Akola district only.

Presumably those who do not take irrigation water in kharif season are influenced by the observation that water is not made available when required hence better not to resort to kharif irrigation.

4.25 Similarly when we examine the area that is sanctioned by the irrigation department as against the area for which demand applications are made by the irrigators resorting to kharif irrigation (Table 4.10) it is observed that for a considerably large number of irrigators in respect of each of the three schemes in Pune, Akola and Jalgaon districts sanctioned area is reported to be less than the area demanded to be irrigated by the irrigators. This again discourages the irrigators from asking (demanding) for kharif irrigation.

4.26 Table 4.11 shows if the demand applications of the irrigators taking canal water for kharif irrigation depends upon rain. It is noted that it is only in the case of Nirguna scheme in Akola district that the irrigators apply for the supply of canal water depending upon rain, and may wait for rain varying from upto June 30 to August 15 before applying for the supply of canal water. Most likely consequence of late application is the inadequate supply of water from the distribution system, and that is what is being observed from the responses tabulated in Table 4.12. Most of the irrigators under Nazare scheme in Pune district and Manyad scheme in Jalgaon district and sizable proportion of irrigators under Nirguna scheme in Akola district

Table 4.10: Distribution of the Beneficiaries (Taking Water in Kharif from Canal) on the Basis of Area Sanctioned for Kharif Irrigation as Against Area Demanded to be Irrigated

Name of the scheme	Number of beneficiaries			Total
	With sanctioned area equal to demand area (ha.)	With sanctioned area less than demand area (ha.)	With sanctioned area more than demand area (ha.)	
1. <u>Kalote Mokashi</u> - Raigad	N.A.	N.A.	N.A.	N.A.
2. <u>Nazare</u> - Pune	6 (42.86)	8 (57.14)	-	14
3. <u>Manyad</u> - Jalgaon	-	3 (100.00)	-	3
4. <u>Nirguna</u> - Akola	8 (61.54)	5 (35.46)	-	13
5. <u>Asola Mendha</u> - Chandrapur	235 (90.74)	20 (7.72)	4 (1.54)	259

N.A. = Not Applicable

(Figures in brackets indicate percentages)

Table 4.11: Response to Whether the Demand Application Depends Upon the Rain
(only for those who take canal water for kharif irrigation)

Name of the scheme	Number of beneficiaries		Total
	Application depends on rain	Application does not depend on rain	
1. <u>Kalote Mokashi</u> - Raigad	N.A.	N.A.	N.A.
2. <u>Nazare</u> - Pune	-	14 (100.00)	14
3. <u>Manyad</u> - Jalgaon	-	3 (100.00)	3
4. <u>Nirguna</u> - Akola	12 (92.31)	1 (7.69)	13
5. <u>Asola Mendha</u> - Chandrapur	-	259 (100.00)	259

N.A. = Not Applicable

(Figures in brackets indicate percentages)

Table 4.12: Response to Whether the Adequate Supply of Water Available, if Applied Late for Canal Water (only for those, who take canal water in kharif irrigation)

Name of the scheme	Number of beneficiaries			Total
	Adequate water available	Adequate water not available	Not applicable	
1. <u>Kalote Mokash</u> - Raigad	N.A.	N.A.	N.A.	N.A.
2. <u>Nazare</u> - Pune	4 (28.57)	10 (71.43)	-	14
3. <u>Manyad</u> - Jalgaon	-	3 (100.00)	-	3
4. <u>Nirguna</u> - Akola	9 (69.23)	4 (30.77)	-	13
5. <u>Asola Mendha</u> - Chandrapur	-	-	259 (100.00)	259

N.A. = Not Applicable

(Figures in brackets indicate percentages)

do not get adequate water because of submitting the applications late for water supply. The natural tendency of the farmers, at least in the assured rainfall areas, is to largely depend on rain for kharif cultivation. However, they would like to sow the crop with the help of canal water if the monsoon is delayed and also to save the crop during long dry spell. But, if there is no certainty of the availability of adequate water from the schemes when demanded (even if late) the irrigators naturally are discouraged from depending on canal water for kharif cultivation.

4.27 So far as yield of the crops grown in kharif season is concerned, all the irrigators taking canal water in kharif season in respect of Manyad, Nirguna and Asola-Mendha schemes in Jalgaon, Akola and Chandrapur districts respectively opine that the yield gets adversely affected because of inadequate and delayed application of water. In respect of Nazare scheme around 43 per cent of the irrigators taking water for kharif cultivation opine that there is no significant adverse effect on kharif production of delayed and inadequate supply of water (Table 4.13). This opinion is mainly because of less importance given by the irrigators to kharif cultivation and also because of the nature of crop grown in kharif (withstanding adverse condition) in this scarcity zone. Since, these irrigators think that the yield gets adversely affected because of delayed and inadequate water supply they do not entirely depend upon rain but try to supplement it with canal water as when required. This is what should be the objective of the protective irrigation in kharif season but, since in practice

Table 4.13: Response to Whether Yield Gets Adversely Affected because of Delayed Application of Canal Water (only for those who take canal water on kharif)

Name of the scheme	Number of beneficiaries		
	Yes	No	Total
1. <u>Kalote Mokashi</u> - Raigad	N.A.	N.A.	-
2. <u>Nazare</u> - Pune	8 (57.14)	6 (42.86)	14
3. <u>Manyad</u> - Jalgaon	3 (100.00)	-	3
4. <u>Nirguna</u> - Akola	13 (100.00)	-	13
5. <u>Asola Mendha</u> - Chandrapur	259 (100.00)	-	259

N.A. = Not Applicable

(Figures in brackets indicate percentages)

this does not happen, as noted earlier, majority of the irrigators do not demand canal water for kharif irrigation under Nazare, Manyad and Nirguna schemes in Pune, Jalgaon and Akola districts respectively. In so far as irrigators under Kalote-Mokashi scheme in heavy rainfall district of Raigad is concerned since there is no practice of using canal water for kharif crop (paddy), the irrigators do not have any opinion in this regard. It may also be mentioned that as per the irrigators' opinion the range of adverse effect due to delayed application of water varies from 20 per cent to around 50 per cent of normal (good) yield depending upon the length of the dry spell and the stage of the growth of the crops.

4.28 In some cases, as noted earlier (Table 4.7(a)), the farmers may prefer to keep the land, that can be irrigated in kharif, fallow for rabi crops. Table 4.14 shows that except in the case of irrigators from Nazare scheme Pune no such case is reported in the case of the irrigators from other schemes. As noted earlier Nazare scheme is located in the scarcity zone of Western Maharashtra where the farmers in general give preference to rabi crops, mainly jowar, which is sown in late September. The kharif crop (which is dependent on rain water and is hardly possible to be supplemented by canal water) may keep the land occupied and come in the way of timely sowing of rabi crops. This is the reason why around 50 per cent of the irrigators prefer to keep the irrigable land fallow in kharif.

4.29 It may be recollected that one of the reasons cited for not using canal water in kharif season is the availability of

Table 4.14: Response to Whether the Land that Can be Irrigated in Kharif is Kept Fallow for Rabi Irrigation

Name of the scheme	Number of beneficiaries		
	Yes	No	Total
1. <u>Kalote Mokashi</u> - Raigad	-	40 (100.00)	40
2. <u>Nazare</u> - Pune	29 (48.33)	31 (51.67)	60
3. <u>Manyad</u> - Jalgaon	-	87 (100.00)	87
4. <u>Nirguna</u> - Akola	-	84 (100.00)	84
5. <u>Asola-Mendha</u> - Chandrapur	-	260 (100.00)	260

(Figures in brackets indicate percentages)

alternate source of irrigation, viz., well (Table 4.7(a)). We now examine this aspect in detail to ascertain the extent of applicability of such a statement.

4.30 Table 4.15 presents the distribution of beneficiaries on the basis of having wells or not having wells for irrigation on the farms. We find that 50 per cent of the irrigators under Nazare scheme in Pune district and Manyad scheme in Jalgaon district have wells on the farm for irrigation. While irrigators under Kalote-Mokashi scheme in Raigad district do not have wells for irrigation, only around 5 per cent of irrigators under Nirguna scheme in Akola district and Asola-Mendha scheme in Chandrapur district have wells for irrigation in farms. Some irrigators under Asola-Mendha scheme irrigate a small area by sources other than well, but that is mostly small pond water accumulated from rain (Table 4.2(b)). The size-group-wise distribution of the irrigators having wells shows that most of the wells are confined to large sized farms, e.g. 2 hectares and above. This indicates the facility with which big land holders can exploit ground water and own private means of irrigation in addition to getting supply of water from public source.

4.31 Tables 4.16(a), 4.16(b), 4.16(c) and 4.16(d) give the information on irrigation by well in the command area of Nazare, Manyad, Nirguna and Asola-Mendha schemes respectively. In terms of area irrigated perennial crops seem to be the important crop under well irrigation in respect of all the schemes except Asola-Mendha where mainly rabi and hot weather

Table 4.15: Distribution of Beneficiaries by Having and Not Having Wells on Farm

Name of the scheme	Number of beneficiaries sizegroupwise											
	Less than 1 ha.	1 to 2 ha.	Above 2 ha.	Total	Less than 1 ha.	1 to 2 ha.	Above 2 ha.	Total	Less than 1 ha.	1 to 2 ha.	Above 2 ha.	Total
1. <u>Kalote Mokashi Raigad</u>	-	-	-	-	13 (32.5)	17 (42.5)	10 (25.0)	40 (100.0)	13	17	10	40
2. <u>Nazare - Pune</u>	5	13	17	35 (50.33)	7	4	14	25 (49.67)	12	17	31	60
3. <u>Manyad - Jalgaon</u>	2	15	34	51 (50.62)	11	11	14	36 (49.38)	13	26	48	87
4. <u>Nirguna - Akola</u>	-	-	4	4 (4.76)	16	30	34	80 (95.24)	16	30	38	84
5. <u>Asola-Mendha - Chandrapur</u>	-	2	12	14 (5.38)	56	71	119	246 (94.62)	56	73	131	260

(Figures in brackets indicate percentages)

Table 4.16 (a): Information on Irrigation by Wells

Size Group	Area under well irrigation in different seasons							
	Perennial		Kharif		Rabi		Hot weather	
	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)
1. Less than 1 ha. (av.)	-	-	1	0.20 (0.20)	2	1.06	-	-
2. 1 to 2 ha. (av.)	4	1.05 (0.26)	8	2.49 (0.31)	9	2.29 (0.25)	-	-
3. Above 2 ha. (av.)	4	4.05 (1.01)	14	8.40 (0.60)	9	6.48 (0.72)	2	0.51 (0.26)
Total (av.)	8	5.10 (0.64)	23	11.09 (0.48)	20	9.83 (0.49)	2	0.51 (0.26)

(Figures in brackets indicate average area)

Table 4.16 (b): Information on Irrigation by Wells

Scheme : Manyad - Jalgaon

Size Group	Area under well irrigation in different seasons							
	Perennial		Kharif		Rabi		Hot weather	
	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)
1. Less than 1 ha. (av.)	2	0.74 (0.37)	-	-	-	-	-	-
2. 1 to 2 ha. (av.)	11	7.40 (0.67)	6	3.46 (0.58)	5	3.64 (0.73)	4	2.43 (0.61)
3. Above 2 ha. (av.)	27	32.73 (1.21)	9	9.11 (1.01)	11	10.93 (0.99)	3	2.83 (0.94)
Total	40	40.87 (1.02)	15	12.57 (0.84)	16	14.57 (0.91)	7	5.26 (0.75)

(Figures in brackets indicate average area)

Table 4.16 (c) Information on Irrigation by Wells

Scheme : Nirguna - Akola

Size Group	Area under well irrigation in different seasons							
	Perennial		Kharif		Rabi		Hot weather	
	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)
1. Less than 1 ha. (av.)	-	-	-	-	-	-	-	-
2. 1 to 2 ha. (av.)	-	-	-	-	-	-	-	-
3. Above 2 ha. (av.)	3	4.30 (1.43)	1	1.21 (0.40)	-	-	-	-
Total (av.)	3	4.30 (1.43)	1	1.21 (0.40)	-	-	-	-

(Figures in brackets indicate average area)

Table 4.16 (d): Information on Irrigation by Wells

Scheme : Asola-Mendha - Chandrapur

Size Group	Area under well irrigation in different seasons							
	Perennial		Kharif		Rabi		Hot weather	
	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)	No. of cases	Area (ha)
1. Less than 1 ha. (av.)	-	-	-	-	-	-	-	-
2. 1 to 2 ha. (av.)	-	-	-	-	1	0.05 (0.05)	1	0.20 (0.20)
3. Above 2 ha. (av.)	1	0.04 (0.04)	-	-	5	1.82 (0.36)	6	0.67 (0.11)
Total	1	0.04 (0.04)	-	-	6	1.87 (0.31)	7	0.87 (0.12)

(Figures in brackets indicate average area)

crops are irrigated by well water.

4.32 A number of irrigators using wells for irrigation have land which can be irrigated both by well and canal. Table 4.17 gives the distribution of well users by the land that can and cannot be irrigated by both the sources. It is observed that most of the well users have land that can be irrigated both by canal and well. Table 4.18 depicts what is actually being practised by these irrigators and we find that almost 100 per cent of the irrigators with well and with land irrigable both by well and canal also actually irrigate those area both by canal and well in all the schemes except Manyad scheme in Jalgaon district where the proportion of the same is around 90 per cent. This indicates that the irrigators having wells in the command area of the Nazare, Manyad, Nirguna and Asola-Mendha schemes use well water in kharif season mainly as a supplementary source of irrigation and not necessarily a main source of irrigation. This is also borne out by the reasons given by these irrigators for doing so. They express that since adequate water is not available either from the well or from the canal there is canal and well mix-up in providing irrigation water to the crops. On the basis of this observation we may presume that one of the reasons for not using canal water for kharif irrigation, that of availability of adequate well water for irrigation, assigned by the irrigators, does not seem to be very strong and tenable.

4.33 It is generally expected that with the on set of irrigation the beneficiary farmers in the command area of an

Table 4.17: Distribution of Well Users by Land Which can be Irrigated
Both by Canal and Well

Name of the scheme	Number of well users			If by both the sources	
	Area irri- gable both by canal and well	Area not irrigable both by canal and well	Total	Area (ha.)	Average area (ha.)
<u>Kalote Mokashi</u> Raigad	-	-	-	-	-
<u>Nazare</u> Pune	24 (68.57)	11 (31.43)	35	34.71	1.45
<u>Manyad</u> Jalgaon	37 (72.55)	14 (27.45)	51	70.27	1.90
<u>Nirguna</u> Akola	2 (50.00)	2 (50.00)	4	5.50	2.75
<u>Asola-Mendha</u> Chandrapur	11 (78.57)	3 (21.43)	14	27.70	2.52

(Figures in brackets indicate percentages)

Table 4.18: Distribution of Irrigators (with Land Irrigable Both by Canal and Well) by Actual Source of Irrigation

Name of the scheme	Number of cases by source of irrigation			Total
	By well only	By canal only	By both canal & well	
1. <u>Kalote Mokashi</u> Raigad	-	-	-	-
2. <u>Nazare</u> Pune	-	-	24 (100.00)	24
3. <u>Manyad</u> Jalgaon	4 (10.81)	-	33 (89.19)	37
4. <u>Nirguna</u> Akola	-	-	2 (100.00)	2
5. <u>Asola-Mendha</u> Chandrapur	-	-	11 (100.00)	11

107

(Figures in brackets indicate percentages)

irrigation project would begin to incorporate high yielding and fertilizer responsive varieties of crops in the cropping pattern in order to take advantage of the controlled water distribution. It is with this view that the irrigators covered under our field investigation were asked to indicate their awareness about the prevailing high yielding varieties of different crops that can be grown in kharif along with the time of sowing and application of recommended doses of fertilizer.

4.34 Table 4.19 shows that around 70 or more than 70 per cent of the irrigators under every scheme is aware of the prevailing improved varieties, improved cultivation practices and application of fertilizer for kharif crops. However, even though the irrigators are by and large aware of the recent development, on asked if they receive any help or guidance from the Agricultural department in that regard, more than 50 per cent of the irrigators replied in negative (Table 4.20). From this observation it would not be very unreasonable to surmise that since most of the irrigators are already aware of the development of new variety, improved cultivation practices and application of fertilizer, it would not be difficult to convince the irrigators to adopt a suitable crop sequence under assured supply of water in order to improve the utilisation of kharif irrigation, if at all.

4.35 It may be recalled that around 18 per cent and 27 per cent of the irrigators not using canal water for kharif cultivation in respect of Manyad scheme in Jalgaon district and Nirguna scheme

Table 4.19: Response to the Awareness About the High Yielding Varieties, Application of Fertilizer and Improved Practices for Kharif Cultivation

Name of the scheme	Number of beneficiaries		
	Aware	Not aware	Total
1. <u>Kalote Mokashi</u> - Raigad	28 (70)	12 (30)	40
2. <u>Nazare</u> - Pune	49 (81.67)	11 (18.33)	60
3. <u>Manyad</u> - Jalgaon	84 (96.55)	3 (3.45)	87
4. <u>Nirguna</u> - Akola	75 (89.29)	9 (10.71)	84
5. <u>Asola-Mendha</u> - Chandrapur	179 (68.85)	81 (31.15)	260

(Figures in brackets indicate percentages)

Table 4.20: Response About the Availability of Help and Guidance from the Agricultural Department

Name of the scheme	Number of beneficiaries		
	Yes	No	Total
1. <u>Kalote Mokashi</u> - Raigad	25 (62.5)	15 (37.5)	40
2. <u>Nazare</u> - Pune	36 (60)	24 (40)	60
3. <u>Manyad</u> - Jalgaon	30 (34.48)	57 (65.52)	87
4. <u>Nirguna</u> - Akola	30 (35.71)	54 (64.29)	84
5. <u>Asola-Mendha</u> - Chandrapur	90 (34.62)	170 (65.38)	260

(Figures in brackets indicate percentages)

in Akola district respectively attribute high water rate to be the reason for not resorting to kharif irrigation (Table 4.7(a)). Subsequently, all irrigators surveyed were specifically asked if they thought kharif season water rates for different crops were high. The response of the irrigators is tabulated in Table 4.21. It is seen that more than 80 per cent of the irrigators under the command of Manyad scheme in Jalgaon district and Nirguna scheme in Akola district opine that the kharif water rate is on the higher side. Their argument is that since these schemes are located in generally assured rainfall zone normally only 2 or at the most 3 irrigation (waterings) are required for raising kharif crops, but once sanction is given the charges for different crops per unit of land is for the entire season irrespective of the number of watering the irrigator avails of. They are therefore of the opinion that the water charges in kharif season at least should be on the basis of number of watering rather than on the basis of the season (Table 4.22, for Manyad and Nirguna schemes). It is further opined that this changed practice would not only make them take water as and when required but will also reduce the total water charges payable for kharif irrigation (Table 4.23, Nirguna and Manyad schemes).

4.36 In respect of Kalote-Mokashi scheme in heavy rainfall zone of Raigad district, the irrigators are generally indifferent to the question of water rates in kharif because there is no irrigation in kharif season. In respect of Nazare scheme in scarcity zone of Pune district, irrigators consider rabi crops to be more important, kharif season crops are left to the vagaries

Table 4.21: Response to Whether Water Rates are Exorbitant for Kharif Crops

Name of the scheme	Number of beneficiaries			
	Yes	No	NA	Total
1. <u>Kalote Mokashi</u> - Raigad	8 (20)	26 (65)	6 (15)	40
2. <u>Nazare</u> - Pune	7 (11.67)	12 (20)	41 (68.33)	60
3. <u>Manyad</u> - Jalgaon	70 (80.46)	11 (12.64)	6 (6.90)	87
4. <u>Nirguna</u> - Akola	72 (85.71)	3 (3.57)	9 (10.72)	84
5. <u>Asola-Mendha</u> - Chandrapur	191 (73.46)	67 (25.77)	2 (.77)	260

NA = Not Applicable

(Figures in brackets indicate percentages)

Table 4.22: Distribution of Beneficiaries Based on the Opinions for Fixing Water Rates for Kharif Crops

Name of the scheme	Number of beneficiaries			
	On number of watering basis	On seasonal basis	Not given	Total
1. <u>Kalote Mokashi</u> - Raigad	8 (20)	32 (80)	-	40
2. <u>Nazare</u> - Pune	-	60 (100)	-	60
3. <u>Manyad</u> - Jalgaon	75 (86.21)	12 (13.79)	-	87
4. <u>Nirguna</u> - Akola	83 (98.81)	1 (1.19)	-	84
5. <u>Asola-Mendha</u> - Chandrapur	8 (3.08)	250 (96.15)	2 (.77)	260

(Figures in brackets indicate percentages)

Table 4.23: Reasons for Preparing Water Rates on Number of Watering Basis

Reasons	Number of respondents schemewise				
	<u>Raigad- Kalote Mokashi</u>	<u>Pune- Nazare</u>	<u>Jalgaon- Manyad</u>	<u>Akola- Nirguna</u>	<u>Chandrapur- Alosa- Mendha</u>
1. Water can be taken as per requirement	8 (100)	-	69 (92)	41 (49.40)	7 (87.50)
2. Water charges will be less, particularly in kharif	-	-	6 (8)	42 (50.60)	1 (12.50)
Total	8	-	75	83	8

(Figures in brackets indicate percentages to respective totals)

of monsoon; and they are also convinced that there is hardly any possibility of getting canal water for kharif cultivation even if they demand. Hence these irrigators opine that water charges for kharif season are not high if adequate water is made available by the canal authorities for kharif cultivation and that it does not matter even if the changes are made on seasonal basis than on the basis of number of watering. The situation is different in respect of irrigators in the command area of Asola-Mendha scheme in Chandrapur district. We have seen earlier that the irrigators under this scheme entirely depend upon canal water for growing paddy in kharif and that they enter into a long term agreement for this purpose with the irrigation department. Their reason for mentioning that the kharif water rates are high is presumably different and they naturally want the kharif water rates to be on seasonal basis (although lower than the existing) because they generally need all the waterings supplied from canal during the kharif season.

5. Summing Up

5.1 The subjective evaluation of the factors responsible for particularly low utilisation of kharif irrigation water based on the farmers opinion survey indicates that the main reason for not using canal water for kharif cultivation in the generally assured rainfall zone of Manyad and Nirguna schemes in Jalgaon and Akola districts and in the scarcity zone of the Nazare scheme in Pune district is the unavailability of water, particularly when required, from the distribution systems of these schemes. This opinion of the farmers has to be checked with factors responsible for low kharif utilisation based on the objective evaluation in

order to ascertain if required and projected quantities of water is released and/or is possible to be released every year for kharif irrigation and the reasons there-of. Other reasons assigned for low kharif utilisation by the irrigators also need to be corroborated with the factors arising out of objective evaluation.

5.2 Similarly, in respect of Kalote-Mokashi scheme the reason attributed by the irrigators for not at all using canal water for kharif cultivation (mainly paddy) because of heavy and fairly well distributed rainfall also has to be checked with the objective evaluation of time series data on rainfall and the live storage available at the end of Konkan hangam.

CHAPTER V

OBJECTIVE EVALUATION OF THE REASONS FOR LOW KHARIF UTILISATION

1. Introduction

1.1 The objective evaluation of the reasons for particularly low utilisation of kharif irrigation is undertaken with a view to identify the major factors responsible for such a situation on the basis of the analysis of the time series data on a number of important variables affecting the demand for and supply of irrigation water. As mentioned earlier, the idea behind undertaking both objective and subjective evaluations is to find out the extent to which the findings of these evaluations correspond and/or match with each other.

2. Change in Crop-Mix and Underutilisation

2.1 It may be recollected that according to the methodology presented in Chapter I underutilisation of irrigation water in a particular project can be measured in two ways; in the first place, if the actual area irrigated under different crops during the kharif season turns out to be less than the area visualised, proposed and designed by the project planners to be irrigated during the season, it may be termed underutilisation. Alternatively, if the volume of irrigation water used by farmers during the kharif season turns out to be less than the quantity of water designed to be supplied during the season then it may be termed underutilisation.

2.2 We have examined and found that the extent of utilisation is considerably low, particularly in kharif season, estimated by both the measures of underutilisation (Chapter III). It has

also been noted that between the two measures, underutilisation estimated by the conventional measure of area actually irrigated as against planned is lower than that estimated by the other measure. Since the measure based on area approach considers the area proposed to be irrigated on the basis of the projected cropping pattern, it would be instructive to examine if the cropping pattern that has actually developed over the years corresponds with the project. cropping pattern (proposed originally) in respect of each scheme under study.

2.3 One of the reasons for low utilisation percentage estimated by the conventional area approach may be the change in cropping pattern from the one proposed originally. This may affect the utilisation percentage, thus estimated, adversely in as much as the existing cropping pattern incorporates heavy water using crops anew or allocates larger area under heavy water using crops compared to what was projected. Naturally, greater the area under heavy water using crops smaller would be the area that can be irrigated with the given quantity of water, and hence, higher would be the underutilisation percentage. In what follows therefore we examine the cropping pattern that has actually developed over the years against what was proposed in respect of each scheme.

2.4 It may, however, be mentioned here that since there is no irrigation in kharif season under the Kalote-Mokashi scheme in heavy rainfall zone of Raigad district the question of comparing projected crops to be irrigated with the crops actually irrigated does not arise in this case. Similarly, since

more than 90 per cent of the proposed area is actually reported to be irrigated in respect of Asola-Mendha scheme in high rainfall zone of Chandrapur district, the question of underutilisation itself does not arise hence no comparison of actual area under crops with that of the projected one is necessary. We shall therefore confine our discussion on this issue only in respect of Manyad scheme in Jalgaon district, Nirguna scheme in Akola district and Nazare scheme in Pune district.

3. Medium Irrigation Scheme (Nirguna Akola)

3.1 The cropping pattern proposed in the project report and the actual cropping pattern that has developed (average of the last 5 years) are presented in Table 5.1. A comparison of the cropping pattern thus presented brings out the change that has taken place in the cropping pattern that is practised from the one that was proposed.

3.2 The first thing to be noted is that although groundnut is taken as canal irrigated crop in kharif and rabi seasons as per the existing cropping pattern there was no provision for the same in the project cropping pattern. Similarly under the existing cropping pattern green manure is not grown in kharif although it is provided for in this season in the project cropping pattern. Apart from this minor change the existing cropping pattern matches well with the proposed one in terms of crops incorporated. However, the area under different crops irrigated in kharif is considerably smaller than what was proposed as seen in column 4 of the Table (per cent of ICA) and

Table 5.1: Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of Nirguna Scheme

Crops	Proposed Cropping Pattern		Existing Cropping Pattern		
	Area (ha)	Per cent of ICA	Area (ha)	Per cent of ICA	Per cent of actual area irrigated
Light Perennials	42	1.00	23	0.54	3.06
Two Seasonals					
L.S.Cotton	1692	40.00	90	2.12	11.98
Chilly	254	6.00	10	0.24	1.33
Paddy	211	5.00	1	0.02	0.13
Hybrid jowar	1057	25.00	6	0.14	0.80
Green Manure	338	8.00	-	-	-
Groundnut	-	-	3	0.07	0.40
Vegetable	-	-	1	0.02	0.13
Wheat	973	23.00	427	10.10	56.86
Gram	212	5.00	69	1.63	0.10
Jowar/Maize	634	15.00	2	0.05	0.27
Groundnut	-	-	7	0.17	0.93
Vegetable	-	-	8	0.19	1.07
Groundnut	423	10.00	104	2.46	13.85
Irrigated cropped area	5836	138.00	751	17.75	100.00

cannot be explained in terms of change in cropping pattern. In fact, the areas under perennials, two seasonals and hot weather groundnut, which are higher water consuming crops, are much smaller than what was proposed (per cent of ICA). Same is the case with the rabi season crops also.

3.3 If we look into the per cent of each crop irrigated to the total cropped area actually irrigated (instead of ICA) we find in column 5 that the perennials occupy around 3 per cent (instead of stipulated 1 per cent of ICA), wheat occupies around 57 per cent (instead of stipulated 23 per cent of ICA) and hot weather groundnut occupies around 14 per cent (instead of 10 per cent of ICA). To that extent if the proportion of total area irrigated under these crops are brought down to the stipulated per cent of ICA, water thus saved may be used for larger kharif irrigation. But, this proposition is neither here nor there because the absolute area irrigated under these crops is much smaller than what is proposed in the project cropping pattern, as noted earlier.

4. Medium Irrigation Scheme (Manyad-Jalgaon)

4.1 The cropping pattern proposed and the existing cropping pattern that has developed over the years are presented in Table 5.2 for comparison.

4.2 Hot-weather groundnut which is not provided for in the project cropping pattern occupies around 9 per cent of ICA in the existing cropping pattern that has developed over the years. In fact no hot weather crop is provided for in the project cropping pattern. Similarly in rabi season also groundnut

Table 5.2: Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of Manyad Scheme

Crops	Proposed Cropping Pattern		Existing Cropping Pattern		
	Area (ha)	Per cent of ICA	Area (ha)	Per cent of ICA	Per cent of actual area irrigated
Two Seasonals					
L.S.Cotton	1216	25.00	-	-	-
Chillies/ Vegetable	389	8.00	11	0.23	0.71
Hy.Jowar/Maize	535	11.00	77	1.58	4.94
Groundnut	1216	25.00	15	0.31	0.96
Paddy	-	-	35	0.72	2.25
Bajra	-	-	97	1.99	5.58
Wheat	486	10.00	316	6.50	20.60
Gram	-	-	202	4.15	12.97
Pulses	973	20.00	6	0.12	0.39
Hybrid Jowar	535	11.00	22	0.45	1.41
Vegetable/Onion	486	10.00	5	0.10	0.32
Groundnut	-	-	328	6.74	21.05
Hot-weather groundnut	-	-	444	9.13	28.80
Irrigated Cropped Area	5836	120.00	1558	32.03	100.00

occupies around 7 per cent of ICA even though there is no provision for the same in the project cropping pattern. Growing

hot-weather groundnut under canal irrigation may to a considerable extent be affecting the availability of water for kharif irrigation (particularly for early sowing).

4.3 However, the area under different crops irrigated in kharif season is considerably smaller than what was proposed as seen in column 4 of the Table (per cent of ICA). Even though 25 per cent of ICA was proposed to be irrigated under cotton, in actual practice irrigated area under cotton in kharif is nil. Thus a change in crop mix cannot largely explain the low utilisation of irrigation potential in kharif in terms of area alone. In rabi season also the area under different crops irrigated is much smaller than what was proposed.

4.4 If we look into the per cent of each crop irrigated to the total cropped area actually irrigated (instead of ICA) we find in column 5 of the Table that wheat occupies around 20 per cent (instead of stipulated 10 per cent of ICA), groundnut in rabi season occupies around 20 per cent (instead of zero per cent of ICA) and hot-weather groundnut occupies around another 29 per cent (instead of zero per cent of ICA). To that extent if the proportion of total area irrigated under these crops are brought down to the stipulated per cent of ICA, water thus saved may be used for larger kharif irrigation, at least, theoretically. But, on the whole, looking at the cropping pattern, that has developed over the years, it can not be said that because of the introduction of very heavy water using crops less area is brought under irrigation than what is stipulated, particularly in the kharif season.

5. Medium Irrigation Scheme (Nazare-Pune)

5.1 The cropping pattern proposed in the project report and the existing cropping pattern that has developed over a period of last 5 years are presented in Table 5.3 in order to have a comparative picture.

5.2 The cropping pattern that has developed over the last 5 years seems to be substantially different from what was originally proposed. On the one hand 'two seasonal chillies' do not find place in the existing cropping pattern, although provided for in the original (proposed) cropping pattern, and, on the other, sugarcane (perennial), not provided for in the project cropping pattern finds a place in the existing cropping pattern, although very marginal (only 0.28 per cent of ICA).

5.3 The most noticeable change in kharif season crops is the virtual absence of hybrid bajra and hybrid maize in the existing cropping pattern that has developed although these crops were incorporated in the project cropping pattern. Similarly cotton which is not provided for in the original (proposed) cropping pattern finds place in the existing one, although occupying only 2 per cent of ICA. It may also be noted that area under each crop actually irrigated in kharif season is significantly smaller than what was originally proposed and that the area under heavy water using crops is virtually non-existent.

5.4 Existing crop-mix in rabi season matches fairly well with what was proposed in the project cropping pattern. However, except in the case of jowar, irrigated area under other crops is considerably lower than what was proposed. Jowar occupies around

Table 5.3: Proposed Cropping Pattern and the Existing Cropping Pattern (Average 1980-81 to 1984-85) in Respect of Nazare Scheme

Crops (1)	Proposed Cropping Pattern		Existing Cropping Pattern		
	Area (ha) (2)	Per cent of ICA (3)	Area (ha) (4)	Per cent (5)	Per cent of actual area irrigated (6)
Perennial	-	-	7	0.28	0.64
Two Seasonals					
Chillies	492	20	-	-	-
Hybrid Bajra	246	10	2	0.08	0.18
Bajra	-	-	27	1.10	2.45
Hybrid Maize	320	13	-	-	-
Hybrid Jowar	-	-	5	0.20	0.45
Groundnut	515	21	17	0.69	1.54
Vegetables	196	8	20	0.81	1.81
Cotton	-	-	49	1.99	4.45
Paddy	-	-	3	0.12	0.27
Wheat	246	10	123	5.00	11.16
Jowar	442	18	657	26.73	59.62
Gram	492	20	25	1.11	2.27
Vegetables	246	10	26	1.06	2.36
Hot weather groundnut	-	-	107	4.35	9.71
Fodder	-	-	13	0.53	1.18
Vegetables	-	-	21	0.85	1.91
Irrigated cropped area	3195	130	1102	44.83	100.00

27 per cent of ICA in the existing cropping pattern whereas only 18 per cent of ICA was proposed to be under this crop in the project cropping pattern.

5.5 No hot weather crop was included in the project cropping pattern, but, we find that hot-weather groundnut is an important crop in the existing cropping pattern and occupies around 4 per cent of ICA. Further, fodder and vegetable together account for more than 1 per cent of ICA in hot-weather in the existing cropping pattern.

5.6 Proportion of area irrigated under different crops to total area actually irrigated (instead of ICA) shows that jowar occupies around 60 per cent of total irrigated cropped area (instead of 27 per cent of ICA), similarly hot-weather groundnut occupies around 10 per cent of total irrigated cropped area (instead of around 4 per cent of ICA).

5.7 From the above account it may be surmised that although substantial change is observed in the existing cropping pattern from the one proposed, heavy water using crops virtually do not find place in the existing cropping pattern (as recommended in the project report) and to that extent smaller area irrigated compared to what was proposed, particularly in kharif season, can not be explained in terms of change in crop mix. However, to the extent hot-weather crops are irrigated under the existing cropping pattern for which no provision was made in the project cropping pattern, kharif season irrigation may be getting adversely affected, specially for kharif crops requiring early

sowing and to that extent it may be responsible for particularly low utilisation of kharif irrigation potential.

5.8 Having examined the existing cropping pattern against what was proposed and also the extent to which the change in crop-mix may be adversely affecting kharif irrigated area we now analyse other variables likely to be affecting kharif irrigation.

6. Supply and Demand Constraints and Underutilisation

6.1 While the extent of utilisation is estimated by comparing every year the water actually released for irrigation seasonwise with the water planned to be released as per project planning, it may so happen that in some years there may not be enough water in the reservoir to be released for irrigation. Under such circumstances underutilisation can be explained in terms of supply constraints. Similarly, in some other years it may so happen that because of more than normal rainfall, necessity of releasing water for irrigation particularly in kharif season may not arise. Again under such circumstances underutilisation can be explained in terms of demand constraints. In what follows we examine constraints, if any, arising out of supply and demand factors.

7. Minor Irrigation Scheme (Kalote-Mokashi - Raigad)

7.1 So far as this scheme is concerned, as mentioned earlier, water is not released for kharif irrigation. It is contended by the officials of this scheme that unlike in non-ghat areas there are only two crop seasons in the Konkan

areas of the Western Ghat. These two seasons are (i) rainy season and (ii) non-rainy season. The rainy season extends from June to October and the non rainy season extends from the end of November to the end of April. The main crop grown in both these seasons is paddy; one crop is entirely rainfed and the other is entirely dependent on irrigation.

7.2 Table 5.4 gives some relevant information on release of available water for irrigation which may throw some light on the reasons for the existing practice of irrigation.

Table 5.4: Availability and Utilisation of Irrigation Water in Respect of Kalote-Mokashi Scheme

Year	Rain-fall (mm)	Date of water released for irrigation	Gross storage available on date of releasing water (Mm ³)	Water used for irrigation (Mm ³)	Water balance (April end) (Mm ³)
1976-77	3022	15.12.76	3.56	2.24	1.32
1977-78	3212	20.12.77	3.64	2.56	1.08
1978-79	2550	25.12.78	3.50	2.89	0.61
1979-80	3060	24.12.79	3.69	3.53	-0.16
1980-81	3102	16.12.80	3.52	3.23	0.29
1981-82	2618	26.12.81	3.69	3.14	0.55
1982-83	3578	13.12.82	3.98	3.10	0.88
1983-84	3364	10.12.83	3.86	3.39	0.47
1984-85	3364	10.12.84	3.72	3.70	0.02
Average	3097		3.68	3.09	0.59

7.3 Every year the first water is released during the month of December, either in the second or in the third week. This is in keeping with the practice of Konkan hangam followed in this area. During Konkan hangam, which extends from December to April paddy, is grown as an irrigated crop. The irrigators use canal water only during this season and, as noted earlier, canal authorities also provide water during this season only.

7.4 The difference between the water storage available at the beginning of the irrigation season every year (column 3) and the corresponding water released for irrigation (column 4) gives the water balance every year at the end of the Konkan hangam (i.e. by the end of April every year) which remains unused at the end of the irrigation year. We find that the water balance varies considerably from year to year, ranging from 1.32 Mm^3 in 1976-77 to only 0.02 Mm^3 in 1984-85. However, in most of the years the water balance is around 0.50 Mm^3 or more resulting into an average water balance of around 0.59 Mm^3 over a 9 year period.

7.5 We have earlier noted that the dead storage of the scheme is around 0.15 Mm^3 . Hence live water balance available at the end of Konkan hangam, on an average, is around 0.44 Mm^3 and since the kharif irrigation requirement as per the project water planning is only 0.33 Mm^3 , it seems this can easily be met by using the Live storage, otherwise remaining unused, earlier in the kharif season. It may, however, be noted that in 3 out of 9 years it would not have been possible to meet the total kharif irrigation provision because of shortfall in water balance.

7.6 Another point to be considered in this respect is that as per project water planning the water requirement for the Konkan hangam (rabi + hot weather) is around 3.59 Mm^3 and if the entire quantity is provided then water balance available on an average, gets reduced to only 0.09 Mm^3 , which is less than even the dead storage required. Hence, if the water requirement of the rabi and hot-weather seasons is to be met fully (instead of to the extent of around 86 per cent on an average, Table 3.3) water balance available at the end would be very marginal for any use earlier in kharif season.

7.7 We may also examine the water content in the reservoir at different dates during the year to explain the availability of water for irrigation in different seasons. Table 5.5 presents data in this regard.

7.8 The gross capacity of the reservoir, as noted in Chapter II is around 4.34 Mm^3 . Last 6 years data show that full capacity (gross storage) of the reservoir was attained every year by the 2nd or 3rd week of July and the same remains more or less constant till the middle of October every year. This happens mainly because no water is let out for irrigation and also because the evaporation loss is very small (estimated around 0.63 Mm^3) during this period. The reservoir content however starts declining from the end of October till the irrigation starts sometime in December mainly because of increased evaporation loss and thereafter till April end because of both water released for irrigation and evaporation, and finally, the decrease in water content in the reservoir from May to the middle

Table 5.5: Water Content of the Reservoir at Different Dates During the Years in Respect of Kalote - Mokashi Scheme

Year	Water content in the reservoir (Mm ³)									
	15-5	1-6	15-6	1-7	15-7	31-7	15-10	31-10	15-11	1-12
1979-80	0.15	0.15	0.67	2.86	4.34	4.37	4.31	4.22	3.95	3.74
1980-81	0.20	0.18	0.15	1.23	4.37	4.41	4.35	4.28	4.13	3.98
1981-82	0.46	0.33	0.21	1.10	1.45	4.28	4.25	4.25	4.25	4.10
1982-83	0.85	0.78	0.70	1.71	2.67	4.41	4.27	4.28	4.17	4.01
1983-84	0.44	0.39	0.28	1.61	4.41	4.37	4.34	4.22	4.07	3.90
1984-85	0.29	0.28	0.44	1.22	2.41	4.44	4.34	4.28	4.08	3.95

of June is only due to high evaporation loss. The reservoir starts gaining water from around the middle of June every year; that is presumably the period when the monsoon sets in.

7.9 As noted earlier, every year full storage is attained by the end of July which is carried through till first water is let out for irrigation in 2nd week of December. The average evaporation loss during this period works to around 0.60 Mm^3 and we have also noted earlier that on an average around 0.44 Mm^3 of live water remains unused in the storage at the end of the irrigation season. Therefore, instead of carrying the entire storage from the end of July to the end of November, it is possible to release around 0.33 Mm^3 of water for kharif irrigation (as per project water planning) without adversely affecting the water requirements for the Konkan Hangan (rabi + hot weather). This will also reduce the Lake losses due to evaporation.

7.10 We have so far discussed only the supply side of the problem of underutilisation. It is quite likely that even if water is available for irrigation in kharif season, there may not be any demand for it by the irrigators. This would be the case if the rainfall during the kharif season is adequate for the crops and is also well distributed without any long break.

8. Distribution of Rainfall Affecting Demand for and Supply of Water

8.1 Tables 5.A1 and 5.A2 present detailed information on weekly precipitation, number of rainy days in a week and the variations in these two variables over the years affecting the intensity of rainfall. The statistics computed are:

\bar{X} = i) average precipitation every week ending over the number of years for which data are available.

ii) average number of rainy days every week ending over the number of years for which data are available.

S.D. = i) Standard deviation of the week ending precipitation.

ii) Standard deviation of the week ending number of rainy days.

C.V. = i) Coefficient of variation in week ending precipitation.

ii) Coefficient of variation in week ending number of rainy days.

M.D. = i) Mean deviation week ending precipitation.

ii) Mean deviation in week ending number of rainy days.

8.2 Data from Kalote Mokashi (Raigad) rain-guage station are available from 1979-80 to 1984-85. Although no trend can be analysed with such a few years' data some observations can be made on the intensity of rainfall and its distribution.

These data show that the monsoon breaks in this area by the end of 1st week of June, although in 3 out of 6 years no rain was reported even by the week ending June 11. Once the monsoon sets in the precipitation continues every week uninturrupted till the week ending October 1 every year, thereafter the monsoon becomes weak and it more or less ceases by the week ending October 22.

8.3 There seems to be comparatively more variation in the amount of precipitation than in the number of rainy days for every week ending (See S.D. and C.V.). Further, the variation in both week ending precipitation and number of rainy days is greater in the first fortnight of June and in the month of October. However, since the amount of total precipitation and the precipitation in each fortnight along with the number of

rainy days are on considerably higher side, the variations in the weekly precipitation and in the number of rainy days do not matter so much as it would have, had the total rainfall been scanty.

8.4 From this observation it may be inferred that there would not be any demand for water from the irrigators during the period from the middle of June to almost middle of October. As noted earlier, paddy is the only crop grown during this period which is of around 120 days duration (varying from 90 to 135 days). If the monsoon breaks during the 1st week of June then the seedlings are ready for transplantation between the last week of June and 1st week of July and the crop is then harvested by the end of October. In case the monsoon is delayed till the 3rd week of June (the probability of which is 50 per cent), all the operations get delayed and the crop is harvested by the middle of November.

8.5 It is clear from the weekly rainfalls data that dry spell prevails during the 1st fortnight of June and during the entire October. The standing paddy crop needs supplementary watering during the month of October. The farmers are reported to have taken recourse to irrigation during this period by drawing accumulated water from Nala, etc., for their low lying paddy land. Similarly, there would be demand for irrigation water (if there is assured supply) during the 1st 2 weeks of June (2 to 3 waterings) to help raise paddy seedlings.

8.6 We have noted earlier (Table 5.4) that around 0.44 Mm^3 of water remains unused at the end of irrigation year and irrigation requirement of kharif is only 0.33 Mm^3 (as per project

water planning). This can easily be met by providing around 2 waterings during the 1st fortnight of June for raising seedlings and around 2 waterings during the dry spell in the month of October. However, it must be mentioned that for irrigation water to be supplied during the first 2 weeks of June for raising seedlings the irrigators should agree to raise seedlings in contiguous blocks within the mid-reach of the distributory, otherwise transmission and distribution losses would be very heavy and it would perhaps not be possible to meet the demand from the entire command area.

8.7 Although the irrigators do not think that there would be any significant difference in yield even with some dry spells at the end (partly because they draw water from low lying Nala during this period), the experts at the Agricultural Research Station at Karjat opine that this dry spell would significantly reduce the yield of paddy if no irrigation is provided during this period. Experiment conducted at Konkan Krishi Vidyapeeth, Dapoli (Ratnagiri) on protective irrigation during monsoon found that the production of paddy and fodder grown under protective irrigation were 10 per cent and 6 per cent higher than those under **unirrigated condition**.

8.8 The present system of irrigation under the scheme is field to field irrigation which naturally results in considerable loss in transmission and distribution. Irrigation through well laid out field channels is not possible because of heavy downpour which destroys the field channels during the monsoon season. Under the prevailing conditions paddy is the only suitable crop.

A change in crop mix to growing long duration perennial cash crops like coconut, etc., in addition to the stable crop of paddy to give boost to the agricultural economy of the command area requires a change in the design of the entire distribution system. Controlled water distribution required for this change would involve laying water pipes for irrigation.

9. Medium Irrigation Scheme
(Asola-Mendha - Chandrapur)

So far as this scheme is concerned, as examined in Chapter III, kharif irrigation potential is fully utilised and there does not seem to be any evidence of particularly low utilisation in kharif season. The irrigation system is located in the high rainfall zone of the state and paddy is the most important crop grown in kharif season by the irrigators. Irrigation is normally provided during the months of August/September and October. If there is any left over water in the reservoir at the end of the kharif season, the second crop grown by the irrigators is also paddy which spreads over rabi and hot weather seasons and is known as summer paddy.

9.2 Table 5.6 gives some relevant information on release of available water for irrigation yearwise for last few years which may throw some light on the pattern of irrigation water use in respect of this scheme.

9.3 Water is released every year for the first time for kharif irrigation sometime in the month of August; generally the first water is released during the 2nd week of August. Kharif irrigation is completed by the end of October every year; in

Table 5.6 : Availability and Utilisation of Irrigation Water in Respect of Asola-Mendha Scheme

Year	Rain-fall (mm)	Date of water released for kharif irrigation	Gross storage available on the date of releasing water (Mm ³)	Water used for kharif irrigation (Mm ³)	Gross storage available at the end of kharif season (Mm ³)	Water used for rabi season (Mm ³)	Gross storage available at the end of rabi season (Mm ³)	Water used for hot-weather season (Mm ³)	Balance storage (end of May) (Mm ³)
1978-79	1478	2.8.78	53.54	49.95	30.24	2.04	26.36	5.12	17.49
1979-80	941	15.8.79	68.49	56.50	20.22	Nil	17.88	-	11.94
1980-81	1193	20.9.80	66.07	28.20	41.30	Nil	32.35	11.50	20.21
1981-82	1169	20.8.81	69.47	48.10	39.86	4.39	32.05	8.75	23.26
1982-83	952	3.9.82	25.47	33.58	24.34	Nil	22.06	-	16.30
1983-84	1355	28.8.83	58.86	10.70	50.94	2.32	43.12	9.09	28.53
1984-85	792	8.8.84	66.40	40.28	18.96	-	17.29	-	12.62
Average	1126		58.33	38.19	32.27	2.92	27.30	8.62	18.62

exceptional circumstances the same may continue till the 1st week of November. During this period on an average 6/7 waterings are provided.

9.4 Gross storage available at the time of releasing water for kharif irrigation is generally found to be near full capacity. Out of 7 years only in 1982-83 gross storage available at the time of starting kharif irrigation was only 25.47 Mm³, otherwise it varied between 54 Mm³ and 68 Mm³ with an average gross storage of around 58 Mm³. It is difficult to explain why gross storage available was so low when the rainfall during that year was not particularly deficient (column 1). Water used for kharif season on an average turns out to be around 38 Mm³ and varies between as low as 11 Mm³ to as high as 56 Mm³.

9.5 There does not seem to be any correlation between water available at the time of starting kharif irrigation and the total quantity of water released for kharif irrigation. For instance, in 1982-83 water available on the data of releasing water was only 25.47 Mm³ but the total quantity of water released during kharif season was 33.58 Mm³, on the contrary in 1983-84 water available at the beginning was 58.86 Mm³ but the total quantity of water released for kharif irrigation was only 10.70 Mm³.

9.6 Presumably, quantity of water released for kharif irrigation depends upon the amount of precipitation and its distribution. Normally, the monsoon is reported to be receding and tending to become weak by the end of August, however, particularly in 1980-81 and 1983-84 fairly well distributed and heavy

precipitation must have continued even during August and September thereby reducing the requirement of irrigation water considerably. This deduction is strengthened by the fact that area reported to be irrigated every year is around 90 per cent of the proposed area under kharif irrigation (Table 3.6) even though the quantity of water released for kharif irrigation varies widely. This conclusion however has to be checked with the detailed data on rainfall and its distribution.

9.7 Average gross storage available at the end of kharif season, at the beginning of November, works out to around 32 Mm^3 with a minimum of around 19 Mm^3 and a maximum of around 51 Mm^3 . The same available at the end of rabi season is around 27 Mm^3 , with a minimum of around 17 Mm^3 and a maximum of around 43 Mm^3 . It may be recalled that there is no provision for growing irrigated crops during rabi and hot weather seasons under this scheme. In case sufficient live storage is available at the end of kharif season a decision is taken to release water for the following season's crop. Irrigators under this scheme prefer to take summer paddy if irrigation water is made available, which spreads over the rabi and summer seasons (December-January to April-May).

9.8 We have noted earlier that the dead storage of the reservoir is around 11 Mm^3 , so it seems that on an average around 20 Mm^3 of live storage is available at the end of kharif season which may be used for irrigating summer paddy. It may, however, be noted from Table 5.6, that in the years 1979-80, 1982-83 and in 1984-85 no water was released for irrigation during the subsequent seasons as the gross storages available at the end of kharif season were considerably smaller (column 5).

9.9 Balance of storage available (column 9) by the end of May every year, when the irrigation for the summer paddy is generally completed, is around 19 Mm^3 on an average, though it varies from 12 Mm^3 to 29 Mm^3 during different years. After accounting for the dead storage (11 Mm^3), the average live storage available turns out to be around 8 Mm^3 , which varies from around 1 Mm^3 to 18 Mm^3 during different years. It, therefore, appears that balance of unused water remains in the storage in most of the years which may be fruitfully used to improve the extent of utilisation further. However, it may be recalled that under this scheme a provision has been made to carry over 15 to 20 per cent of live storage (around 10 Mm^3) for irrigation in early kharif, if the monsoon is delayed and/or uneven in the initial period (Chapter II, para 3.2 last sentence).

9.10 We may also examine the water content (gross) in the reservoir at different dates during the year to explain the availability of water for irrigation in different seasons, particularly in kharif season. Table 5.7 gives this information.

9.11 The gross capacity of the reservoir, as noted in Chapter II is around 67 Mm^3 . Last 8 years data show that the full capacity is attained mostly by the end of August every year. In most of the years the reservoir has attained near full capacity, it is only in 1982-83 that the near full capacity is not attained. In fact in 1982-83 only around one-third of the gross capacity of the reservoir was attained. This observation is also borne out by the yearwise overflow data for the last 5 years. The dates of

Table 5.7 : Water content of the Reservoir at Different Dates During the Year in Respect of Asola-Mendha Scheme

Year*	Water Content in the Reservoir (Mm ³)									
	30-4	31-5	15-6	30-6	15-7	31-7	15-8	31-8	31-10	28-2
1976-77	28.30	26.26	14.80	15.17	18.10	21.60	30.55	68.00	38.84	31.45
1977-78	22.29	19.15	17.69	19.57	41.67	53.54	51.55	73.95	32.96	26.36
1978-79	19.99	17.49	16.90	39.52	44.25	46.96	68.49	60.53	24.94	17.88
1979-80	14.98	11.94	11.63	16.30	19.99	24.77	49.73	59.19	41.30	32.35
1980-81	23.53	20.21	18.94	21.60	36.81	52.27	70.47	66.54	39.86	32.05
1981-82	25.83	23.26	22.54	23.53	23.28	25.30	25.01	23.53	24.52	22.06
1982-83	18.94	16.30	17.88	21.16	22.06	30.24	54.39	58.75	53.96	43.48
1983-84	33.58	28.53	27.99	27.42	29.40	31.75	64.65	63.74	21.60	117.49

* Irrigation year = 1st July to 30th June.

overflow reported are 11-8 for 1979, 19-9 for 1980, 10-8 for 1981 and 9-9 for 1983. There was no overflow in 1982.

9.12 The water content of the reservoir is seen to be decreasing from the end of August every year and it continues to decrease till the middle of June and thereafter it begins to rise which continues till the end of August. The decrease in the water content from the end of August to the end of October is mainly due to release of water for irrigating kharif paddy and thereafter the decrease in the water content till the middle of June is due to the release of water for irrigating summer paddy (in some years) and also due to evaporation loss from the tank. The evaporation loss in fair weather is reported to be around 80 per cent of the total evaporation loss.

9.13 The gain in the water content from the 3rd week of June onwards is presumably due to the monsoon which sets in every year during this period and continues normally till the end of August. No water is let out for irrigation during this period unless the monsoon is very late and there happens to be a very long break in it. These observations are to be checked with the details of rainfall data in the catchment and the command areas of the project.

9.14 As mentioned earlier, the balance of excess live storage is carried through for any contingency arising out of delayed monsoon, hence cannot be used for fair weather irrigation. The evaporation loss in carrying over this balance presumably is very high. Based on the analysis of the time series data it should be possible to ascertain the probability of the occurrence of delayed monsoon, and if that is significantly low, it may be advisable to

release a large part of the balance live storage for kharif irrigation thereby reducing evaporation loss to a considerable extent.

9.15 The foregoing account indicates a very favourable supply position of irrigation water, mainly for kharif irrigation during the later half of kharif season when the monsoon starts receding. From the demand side there does not seem to be any problem because the irrigators want water during that period and as mentioned in Chapter III they enter into a long term agreement with the Irrigation Department for that purpose. That is the reason for nearly full utilisation of kharif irrigation potential under this scheme.

9.16 The pattern of demand (use) of irrigation water, particularly for kharif season irrigation may be ascertained by analysing the detailed data on rainfall and/or availability of alternative source of irrigation, e.g., wells, ponds, etc.

10. Distribution of Rainfall Affecting Demand for and Supply of Water

10.1 Information regarding weekly precipitation, number of rainy days in a week and the variations in these two variables over the years for which data are available are presented in Tables 5.B1 and 5.B2. Data from the rain-guage station at Asola-Mendha tank site are available from 1976-77 to 1982-83. It may be mentioned that although no trend can be studied from the rainfall data for such a limited number of years, we may observe the intensity and periodicity of rainfall during different years.

10.2 It is noted from the Table that the monsoon sets in every year during the week ending June 18 and continues uninterrupted till the week ending September 24. In fact in the week ending September 24, the precipitation and number of rainy days are considerably reduced. There is also considerable variation both in the amount of precipitation and in number of rainy days in a week from year to year as observed from the estimated Standard Deviation and Co-efficient of Variation. The variations seem to be more pronounced at the beginning and at the end of rainy season. The other point to be noted is that there is comparatively less variation in the week ending number of rainy days than in the week ending precipitation.

10.3 The rainfall is seen to be mainly concentrated during the months of July and 1st week of August. The monsoon appears to become weaker by mid-August. On matching the date of first release of water for kharif irrigation (Table 5.6 column 2) with the weekly rainfall data we find that kharif irrigation began every year when the monsoon started becoming weak. As mentioned earlier kharif irrigation continues normally upto the end of October and we see from the weekly rainfall data that there is hardly any rain during the whole of October and thereafter.

10.4 From these observations it is clear that as a part of protective irrigation for kharif paddy there is bound to be demand for kharif irrigation generally from mid-August to the end of October and at times till the 1st week of November, and this precisely what happens every year and that is the reason why the irrigators enter into a long term agreement with the Irrigation Department.

10.5 We have noted earlier that the release of water every year for kharif irrigation is not necessarily related to the availability of water at the time of starting kharif irrigation. Presumably it depends upon the rainfall in the command area and its distribution and hence on the demand for water. Tables 5.B3 and 5.B4 give weekly rainfall with number of rainy days and variations in these based on the rainfall data collected from the rain-gauge stations located in the command area of the scheme. Out of 3 rain-gauge stations in the command area data for the last 9 years (1976-77 to 1984-85) are available for the rain-gauge station at Saoli. From the other two stations the data are available only for the last 4 years. Hence we have used the data pertaining to Saoli raingauge station only. We find, for instance, that in 1982-83 more water was released for kharif irrigation than in 1983-84 even though water available in the storage at the time of 1st release of water was much larger in 1983-84 (Table 5.6), because of the long dry spell, particularly from the week ending September 3 in 1982-83 compared to 1983-84 (Tables 5.B3 and 5.B4). Similarly in 1979-80 considerably large quantity of water was released for kharif irrigation (Table 5.6 column 4) because there was a very long dry spell in the command area beginning from the week ending July 9 (Tables 5.B3 and 5.B4). Number of waterings given also depends upon the duration of the dry spell every year. Thus it may be surmised that there is no dearth in demand for water for kharif irrigation by the irrigators, on the contrary, canal authorities are unable to meet the local demand.

10.6 The question of shortfall in production for not providing irrigation when required does not arise in respect of this scheme because the irrigators do irrigate their crop during the dry spell. However, the general impression is that the yield per hectare is 4 to 5 quintals higher in the case of irrigated paddy (protective irrigation) compared to the unirrigated one.

10.7 The present system of irrigation under the scheme is field to field irrigation which naturally leads to considerable loss in transmission and distribution. Under the present system the only suitable crop is paddy not only in kharif season but also during fair weather season.

10.8 It may be possible to bring about a change in cropping pattern for the better. If enough storage is available after kharif irrigation the irrigators may be induced to grow gram, groundnut or wheat on the up-lands. But, for such a change to occur two conditions must be fulfilled. Firstly, the distribution system must be modified by constructing field channels, providing measuring device to distributory/minor/outlets etc., reducing chak size up to 20 hectares, conducting soil survey to know actual water requirement of crops and reducing seepage losses. Secondly, feasibility of introducing a modified crop-mix by the Agricultural Scientist, in terms of duration of different crops, water requirement, soil suitability and yield etc., has to be ascertained.

10.9 As has been mentioned earlier, well irrigation is not a very common feature in the command area of this scheme. Table 5.8 presents information on well irrigation from 1978-79 to 1983-84.

Table 5.8 : Statement Showing Wells in the Command and Area Irrigated in Respect of Asolamendha Project

Year	No. of wells in the command Asolamendha Project	Area Irrigated from Wells in Different Crops and Season							Total
		Sugarcane	Other perennials	Kharif season	Rabi season	Hot weather season	Two season	Summer paddy	
1978-79	59	1 Ha.	nil	nil	10 Ha.	5 Ha. vegetables	-	-	16 Ha.
1979-80	59	0.52 Ha.	nil	nil	8 Ha.	6 Ha. vegetables	-	-	14.52 Ha.
1980-81	53	nil	nil	nil	nil	5 Ha.	-	2 Ha.	7 Ha.
1981-82	53	0.50 Ha.	nil	nil	nil	6 Ha.	-	3 Ha.	9 Ha.
1982-83	53	0.52 Ha.	nil	nil	nil	12.04 Ha. vegetables	-	2.4 Ha.	15 Ha.
1983-84	53	-----no irrigation done during this year -----							

10.10 It is seen that the use of well water for irrigation is confined mainly to hot-weather season vegetable and summer paddy. Perennial crops are almost negligible, and even the area irrigated by well in fair weather is considerably small. On the whole well irrigation does not seem to count much in the command area of this scheme.

11. Medium Irrigation Scheme
(Nirguna - Akola)

11.1 Under this scheme, as noted in Chapter III, utilisation of irrigation potential is particularly low in kharif season by both the measures of estimating the extent of utilisation. As has been mentioned earlier, this scheme is located in assured rainfall zone and the main crops grown in kharif under irrigated condition are hybrid jowar and cotton; and further, groundnut is the most preferred crop under irrigation in the hot-weather season.

11.2 Table 5.9 presents some relevant information on release of water from the reservoir for irrigation for the last few years which is likely to throw some light on the availability and pattern of irrigation water used in respect of this scheme.

11.3 The first water released for kharif varies considerably from year to year. In 3 out of 7 years first water was released for kharif irrigation around the 2nd week of September, in 2 out of 7 years first water for kharif irrigation was released around the 3rd week of August and in the remaining 2 years the same was released around the 3rd week of July. Presumably release of water for kharif irrigation is dependent upon the rainfall and

Table 5.9 : Availability and Utilization of Irrigation Water in Respect of Nirguna Scheme

Year	Rain-fall (mm)	Date of water released for kharif irrigation	Gross storage available on the date of releasing water (Mm ³)	Water used for kharif irrigation (Mm ³)	Date of release of water for rabi season	Gross storage available on the date of releasing water (Mm ³)	Water used for rabi season (Mm ³)	Date of release of water for hot weather season	Gross storage available on the date of releasing water (Mm ³)	Water used for hot weather season (Mm ³)	Balance storage (end of June) (Mm ³)
1978-79	761	13.9.78	32.32	3.61	29.10.78	29.75	N.A.	2.3.79	9.38	N.A.	3.56
1979-80	756	26.8.79	29.20	0.22	16.10.79	32.78	N.A.	2.3.80	11.81	N.A.	5.27
1980-81	891	20.7.80	5.35	2.82	19.10.80	29.85	18.65	8.3.81	9.00	2.59	3.45
1981-82	982	26.7.81	4.30	0.88	29.10.81	21.54	9.71	2.4.82	9.15	6.09	4.18
1982-83	706	5.9.82	21.90	2.58	1.11.82	23.48	13.51	1.4.83	7.78	3.75	5.13
1983-84	1406	12.8.83	32.70	3.15	1.12.83	32.29	17.41	1.4.84	11.37	11.61	5.24
1984-85	690	16.9.84	9.95	2.83	2.12.84	11.24	5.09	3.4.85	5.23	2.29	32.40
Average	885		19.39	2.29		25.85	12.87		9.10	5.27	8.46 (4.47)*

* Average excluding the year 1984-85.

its intensity. We shall examine this aspect while examining the detailed rainfall data in respect of this scheme. The kharif irrigation is normally completed by the middle of October every year.

11.4 Gross storage available on the date of releasing water every year for kharif irrigation also shows a tremendous variation from year to year. As mentioned earlier in Chapter II, the gross storage capacity of the reservoir is around 32.29 Mm^3 and we find that only in 3 out of 7 years the full capacity or near full capacity of the storage is attained on the date of releasing water for kharif irrigation. In 1980-81 and 1981-82 the gross storage available at that period was barely above the dead storage of the reservoir. However, it should be mentioned that during those 2 years first water for kharif irrigation was released early and with the monsoon rain the reservoir was likely to get filled more. This is what is found when we examine column 6 of the Table for almost all the years except 1984-85 when only one-third of the storage capacity was filled.

11.5 On an average around 2.30 Mm^3 of water is released for kharif irrigation though the same varies from 0.22 Mm^3 in 1979-80 to more than 3 Mm^3 in 1983-84. Normally if the season extends from 1st of July to the middle of October, 6 to 7 waterings are given, but since the first watering begins late only 3 to 4 waterings are provided during this season, if at all. Since full storage is required to be achieved at the beginning of the rabi season it is most unlikely that full irrigation requirement of the kharif can be met.

11.6 Date of beginning of irrigation in rabi season shows that the irrigation for rabi crops begins late, this in particular is observed in 1983-84 and 1984-85. Conventionally the rabi irrigation begins around 15th of October, but of late, it appears that the rabi season begins in the 1st week of December and continues up to the end of March or so. This happens because of the late sowing of kharif crops. On an average around 13 Mm^3 of irrigation water is released for rabi irrigation which incidentally turns out to be slightly more than what was planned to be released (10.57 Mm^3). It is only in 1984-85 that actual release is considerably smaller than the proposed one.

11.7 Of late the date of release of water for the hot-weather season has turned out to be the middle of April rather than 1st week of March because of delayed rabi season. However, it is very difficult to distinguish between water released for rabi crops in hot-weather season waterings and water released for hot-weather season crops in rabi season waterings because of overlap. For instance, hot-weather groundnut is generally sown in the month of January and harvested by end April or May, hence it receives irrigation water both in rabi season watering and summer season watering. Similarly, wheat sown late receives irrigation in rabi season watering as well as in summer season watering.

11.8 On an average around 5.27 Mm^3 of water is released for the so called hot-weather irrigation. Since there is considerable overlap between the two seasons it is best to consider these two

seasons together and it may be noted that on an average around 18 Mm^3 of irrigation water is released between these two seasons which works out to around 80 per cent of what was proposed (good utilisation percentage considering everything).

11.9 Balance of water remaining in the storage at the end of the irrigation year on an average turns out to be 8.46 Mm^3 . In fact the average balance of storage water works out to only 4.47 Mm^3 by excluding the year 1984-85, which seems to be out of trend. As mentioned earlier, the dead storage of the reservoir is 3.45 Mm^3 and it is seen that every year the balance of water is nearer the dead storage indicating no surplus water in the storage after the completion of the irrigation.

11.10 We may also examine the water content in the reservoir at different dates during the year to explain the availability of water for irrigation in different seasons, particularly in kharif. We present the relevant data in this regard in Table 5.10.

11.11 The gross capacity of the reservoir, as noted in Chapter II, is 32.29 Mm^3 . The full capacity is seen to be attained in most of the years by the middle of September. Out of 9 years full storage or near about has not been achieved only in 3 years (1981-82, 1982-83 and 1984-85). It may be noted from column 1 of Table 5.9 that the rainfall was deficient during those years. The overflow data of the reservoir confirm this observation. No data are available on the overflow for the initial 2 years, i.e. 1976 and 1977. In 1978 the first overflow was on August 5, which continued upto August 17, it again occurred on August 26 and continued upto September 13. This is the reason for the full

Table 5.10 : Water Content of the Reservoir at Different Dates During the Year in Respect of Nirguna Scheme

Year	Water Content in the Reservoir (Mm ³)									
	31-5	15-6	30-6	15-7	31-7	15-8	31-8	15-9	31-10	28-2
1976-77	20.90	20.01	23.29	27.69	32.07	32.07	32.07	32.72	32.72	16.57
1977-78	14.01	14.00	24.00	16.05	32.27	32.52	32.52	32.29	29.44	9.38
1978-79	6.50	6.03	9.07	5.13	8.53	25.32	29.13	32.29	32.07	11.81
1979-80	3.56	3.24	3.56	5.41	5.31	13.69	32.40	32.29	28.82	9.00
1980-81	5.20	5.31	5.27	4.15	4.29	8.56	11.71	12.56	21.78	11.66
1981-82	4.15	3.62	3.45	4.60	17.78	18.36	21.54	21.78	23.48	9.15
1982-83	5.34	4.00	4.19	7.49	12.59	32.63	32.40	32.52	32.29	16.26
1983-84	1.41	4.24	5.13	5.66	8.01	9.66	9.90	9.95	11.30	6.39
1984-85	4.19	5.38	5.24	32.18	33.09	32.40	32.29	31.86	28.82	-

* Irrigation Year = 1st July to 30th June.

capacity of reservoir being maintained upto the middle of October in 1978. In 1979 the first overflow occurred on September 18 and continued upto the 2nd of October, that is why we see full storage being achieved by the middle of September and maintained till the middle of October. In 1980 the first overflow occurred on August 25 and it continued upto September 8, hence in 1980 full storage was attained by the end of August and was maintained till the middle of September. No overflow was reported during 1981 and 1982 and as noted full storage was not attained during these two years. In 1983 the first overflow occurred on August 13 and continued upto October 18, hence the reservoir attained its full capacity of storage by the middle of August and continued to hold that till the end of October. There was no overflow of the reservoir during the year 1984 and hence during that year full capacity of the reservoir was not attained. This fact is also borne out by the annual rainfall in 1984 (Table 5.9 column 1) which was only 690 mm.

11.12 The water contents of the reservoir begins to increase very slowly from the middle of June every year and continues to increase till the end of August or middle of September. The increase is seen to be more rapid during the months of July and August. This is presumably due to heavy rainfall during this period, and because of this the first water for kharif irrigation is normally released every year during the last week of August or first week of September.

11.13 The water content of the reservoir starts declining from the end of October every year and continues to decline till the 1st week of June. This happens mainly because of release of water for irrigation of rabi and hot-weather crops and also to some extent because of loss due to evaporation, which is around 4.89 Mm^3 per annum and 75 per cent of which occurs during the fair weather season.

11.14 The balance of storage at the end of the irrigation year, as seen earlier, varies between 3.56 Mm^3 and 5.24 Mm^3 from 1978-79 to 1983-84 which barely maintains the dead storage of the reservoir. In the initial years (1976-77, 1977-78) the balance of unused water is seen to be very high but that is because full scale irrigation from the scheme had not yet started, although full storage was created, owing to lack of distribution net work.

11.15 The foregoing account indicates a constraint in the supply of water which is dependent on monsoon and since a full storage is required to be acquired before the irrigation for rabi crops begin, availability of water for kharif irrigation during long breaks in monsoon, particularly from the end of August till the end of September, is conditional and seems to be uncertain.

11.16 We have so far discussed only the supply side of the problem of underutilisation. It is quite likely that even if water is available for irrigation in kharif season, there may or may not be demand for it by the irrigators. This would be the

case if the rainfall during the kharif season is adequate for the crops grown and is also well distributed without any long break.

12. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water

12.1 Rainfall data from the rain gauge station, Chondi, which is located in the vicinity of the catchment area of the scheme were made available for the years 1977-78 to 1983-84. Tables 5.C1 and 5.C2 present the information on weekly rainfall, number of rainy days in a week and the estimated variations in these two variables over the years for which data are available.

12.2 We note that in this area the monsoon generally sets in by the week ending June 25; it is concentrated in the months of July and August and starts receding by week ending August 27. Rainfall during the months of September and the first 2 weeks of October seem to be erratic, irregular and insufficient.

Some sporadic rainfall is also reported during the months of November, December, January and February in every year except in 1982-83, 1983-84 and 1984-85. Further, it is also noted that during 1977-78 rainfall was very deficient and there were long periods of dry spell during the monsoon season.

12.3 Standard Deviation (SD) and the Coefficient of Variation (CV) estimated for the amount of precipitation and the number of rainy days for each week ending show a very high variation in both the variables in all the weeks during the year. This means that the year to year variations in weekly rainfall and number of rainy days are very large although the

variation in number of rainy days in a week is smaller than the same in the amount of precipitation. This gives rise to an uncertainty regarding the period by which the reservoir will be filled to its full capacity as noted earlier in Table 5.10.

12.4 We have also collected rainfall data from the command area of the scheme, one from the Tuljapur rain-gauge station for which data were made available for 1980-81 to 1984-85 and the other from Malegaon rain-gauge station for which data were made available for 1976-77 to 1984-85. The week ending amount of precipitation, week-ending number of rainy days and the estimated variations in these two variables are presented in Tables 5.C3, 5.C4 and 5.C5, 5.C6. Although no trend can be established from such a short series of data some observations regarding precipitation and its distribution can be made.

12.5 The date of release of water for kharif season (Table 5.9, column 2) fairly matches with the long and short dry spells experienced in rainfall in the catchment and command areas of the scheme (Tables 5.C1, 5.C2, 5.C3, 5.C4 and 5.C5, 5.C6). It is also clear that there would not be any significant demand for kharif irrigation during the months of June, July and August. Since the proper monsoon is seen to be setting in by week ending June 25, the irrigators are convinced that no water can be made available for early sowing, hence no demand for water is made in June; thereafter because of adequate and fairly well distributed rainfall irrigation is not demanded during July and August except occasional irrigation during short dry spell in July and/or August.

12.6 The main demand for kharif irrigation would come from the week ending September 3 till the week ending November 12, at the most. During this period rainfall is scanty and is also most uncertain with long gaps. The standing kharif crops require protective irrigation during this period.

12.7 Since full storage is to be created by mid-October for subsequent rabi and hot-weather irrigation it may not be possible to release required amount of water for protective kharif irrigation. This leads to uncertain supply of water for this purpose which the farmers resent, and hence, most of the irrigators do not demand water for kharif irrigation.

12.8 We have also examined the demand for kharif irrigation by the irrigators and the actual sanction by the canal authorities. In the years 1978-79 and 1979-80 14 hectares and 153 hectares respectively were sanctioned although there was no demand from the irrigators. In 1980-81, 1981-82, 1982-83 less than 40 per cent of the demanded area by the irrigators was actually sanctioned for kharif irrigation. In 1983-84 there was no demand and no sanction also. In 1984-85 the sanctioned area was around 50 per cent of the demanded area. This lack of demand is directly related to the unreliability of the timely availability of the required amount of water as observed earlier.

12.9 Information on well irrigation in the command area of the scheme suggests that the extent of well irrigation is very limited and in kharif season its use is restricted to perennial crops like sugarcane, citrus, other fruits and to growing vegetable on a very limited scale. Hence availability of well

water is not a factor constraining the demand for canal water particularly in kharif.

12.10 As per some studies conducted by the Department of Soil and Water Management, Punjabrao Krishi Vidyapeeth, Akola, the yield differences of cotton grown with and without protective irrigation turns out on an average to 30 per cent. Similarly average yield of hybrid jowar is found to be 20 to 25 per cent more with protective irrigation. As noted earlier these are the two main crops grown in kharif and the magnitude of yield differences between growing these crops with and without protective irrigation suggests the importance of providing protective irrigation for kharif season cultivation. Farmers are also aware of this yield difference but they are reluctant to resort to kharif irrigation because of the considerable uncertainty in the supply of water to take advantage of the protective nature of irrigation.

12.11 From the above observations it is clear that there is need for providing protective irrigation to kharif crops, particularly during the last week of August, whole of September and October. In case it is possible to supply water for early sowing of kharif in the 1st week of June, farmers, would be prepared to resort to early kharif sowing without waiting for the monsoon to break in and which may allow them to sow rabi season crops in proper time, as discussed in Chapter IV. But, as we have noted from Table 5.10 the possibility of providing irrigation to pre-monsoon early sown kharif crops is very remote because of lack of live storage in the reservoir during

this period. It seems under this scheme it is the reason arising out of supply factor which governs the extent of utilisation in kharif season and the reason arising out of demand factor is very much related to the uncertainty in the supply of water.

13. Medium Irrigation Scheme (Manyad - Jalgaon)

13.1 As estimated in Chapter III utilisation of irrigation potential is particularly low in kharif season under this scheme. This scheme is located in less assured rainfall zone of the state and we have noted earlier that the main crops grown under irrigation in kharif season are hybrid jowar and to some extent cotton and groundnut. The farmers however prefer to grow summer groundnut which is reported to be very paying crop and there is a great demand for irrigation for this crop in the hot-weather.

13.2 Table 5.11 depicts some relevant information on release of water from reservoir for irrigation for last few years which we presume would throw some light on the availability and pattern of irrigation water used in respect of this scheme.

13.3 The date of release of water for kharif irrigation varies considerably over the years. The variation ranges from 1st week of July to 2nd week of September in different years. In fact, it is only in 1976-77 and in 1983-84 that water was released in the 1st week of July. In 1978-79 and 1980-81 it was released in the 3rd week of July, in 1977-78 and 1982-83 it was released in the 1st week of August and in 1979-80 and

Table 5.11 : Availability and Utilisation of Irrigation Water in Respect of Manyad Scheme

Year	Rain-fall (mm)	Date of release of water for kharif irrigation	Gross storage available on the date of releasing water (Mm ³)	Water used for kharif irrigation (Mm ³)	Date of release of water for rabi season	Gross storage available on the date of releasing water (Mm ³)	Water used for rabi season (Mm ³)	Date of release of water for hot-weather season	Gross storage available on the date of releasing water (Mm ³)	Water used for hot-weather season (Mm ³)	Balance storage (end of June) (Mm ³)
1975-76	-	-	-	-	N.A.	N.A.	19.41	1.3.76	34.33	2.49	31.85
1976-77	448	3.7.76	32.55	10.98	1.11.76	48.13	22.86	2.3.77	25.62	6.37	19.24
1977-78	265	1.8.77	22.07	6.17	5.11.77	20.97	7.64	21.3.78	22.11	7.05	26.60
1978-79	338	21.7.78	26.72	3.39	10.11.78	23.35	5.91	15.3.79	16.41	3.40	13.73
1979-80	680	9.9.79	52.36	0.88	15.11.79	53.91	12.25	9.3.80	39.62	17.83	22.64
1980-81	431	19.7.80	22.07	2.83	2.11.80	53.49	14.55	6.3.81	38.63	22.07	17.26
1981-82	300	10.9.81	20.38	2.91	16.11.81	39.90	14.60	8.3.82	25.53	7.84	27.34
1982-83	250	7.8.82	28.38	3.71	7.12.82	33.00	6.74	20.3.83	25.19	5.66	19.81
1983-84	807	7.7.83	19.81	0.82	25.11.83	53.83	8.43	12.3.84	43.86	16.98	27.45
1984-85	440	-	-	-	1.11.84	53.91	N.A.	5.3.85	34.67	N.A.	18.37
Average	440		28.04	3.96 (2.96)*		42.28	12.49		30.60	9.97	22.43

* Average (deleting 1976-77)

1981-82 the same was released during the 2nd week of September. Presumably the date of release of first water for kharif irrigation depends upon the onset of monsoon and the intensity of precipitation. We shall examine this aspect while examining the detailed rainfall data in respect of this scheme.

13.4 As mentioned in Chapter II, the gross storage capacity of the reservoir under this scheme is around 56 Mm^3 . We find that in 6 years out of 8 the reservoir is filled only upto around 40 per cent of its gross capacity at the time of letting out water for kharif irrigation even when the first water is released in the 2nd week of September.

13.5 On an average around 4 Mm^3 of water is used for kharif irrigation, in fact, if we delete the figure for the year 1976-77 (which shows an abnormally large release) the average water release for kharif irrigation is estimated to be around 3 Mm^3 . There appears to be considerable variation though in the release of water for kharif irrigation from one year to another.

Presumably this variation occurs either because of the lack of demand for irrigation water owing to adequate rainfall or because of the supply constraint owing to inadequate rainfall. We shall consider this aspect later while analysing in detail the rainfall data in respect of this scheme.

13.6 Kharif irrigation is completed every year normally by the end of October and again the number of waterings provided, if at all, varies considerably (from 1 to 4) depending upon the periodicity and the intensity of rainfall.

13.7 Water is released for rabi irrigation generally by the 2nd or 3rd week of November, in some years it has also been released as late as in December 1st week. On the whole it can be said that the rabi season irrigation begins 3 to 5 weeks later than what is stipulated (October, 15) and continues upto the end of March or so. This presumably happens because of the resulting impact of the delayed kharif season, which, as we have noted, seems to be dependent on the monsoon.

13.8 Gross storage available on the date releasing water for rabi season crops varies considerably from year to year. It is only in 1979-80, 1980-81, 1983-84 and 1984-85 that full storage is attained on the dates of releasing water for rabi crops. In fact in 1977-78, 1978-79, 1981-82 and in 1982-83 only around 40 to 60 per cent of the full storage was attained on the date of release of water for rabi irrigation. On an average the storage level at that time is around 42 Mm^3 which is around 80 per cent of the gross capacity.

13.9 Water released for rabi irrigation turns out to be around 12.5 Mm^3 on an average, which is around 80 per cent (15.57 Mm^3) of the water planned to be released as per project water planning (fairly good utilisation percentage), although in 1977-78, 1978-79 and in 1982-83 only around 6 to 7 Mm^3 water was released for rabi crops because of inadequate storage, as noted earlier (column 6). Total number of watering given during the rabi season varies between 5 and 7 and since the rabi season begins late it continues till the end of March.

13.10 Water is released for hot-weather season crops around the 2nd week of March and since watering for the rabi season crops still continues then, there is considerable overlapping between these two seasons.

13.11 On an average around 31 Mm³ of gross storage is available at the time of release of water (column 9) and except in the year 1978-79, in all other years around 50 per cent or more of the gross storage is available at the time of release of water for hot-weather irrigation.

13.12 Release of water for hot-weather irrigation, on an average, turns out to be around 10 Mm³ (column 10), which is around 77 per cent of what was planned (13 Mm³). As mentioned earlier, since there is considerable overlap between irrigation for rabi and hot-weather crops it is more meaningful to consider the water released for these two seasons together, instead of separately. On doing so it appears that on an average around 22.5 Mm³ of water is released during these two seasons which works out to around 79 per cent of water planned to be released as per the project water planning (reasonably good utilisation percentage).

13.13 Balance of water remaining in the storage every year at the end of the irrigation year varies between 14 Mm³ and 27 Mm³, except in 1975-76 when the irrigation was not fully developed (column 11). On an average around 22 Mm³ of balance storage is estimated to be available at the end. As presented in Chapter II the dead storage of the reservoir is around 13.68 Mm³. Considering this every year the balance of water remaining unused varies between

5 and 13 Mm³. It is only during 1978-79 that there was no balance of live storage remaining unused. On an average around 9 Mm³ of water is estimated to be remaining unused at the end of irrigation season which may be used particularly for early sown crops in kharif so that not only the extent of utilisation in kharif season improves but also that the rabi season can begin in time.

13.14 We may also examine the water content in the reservoir at different dates during the year to explain the availability of water for irrigation in different seasons, particularly in kharif. We present the relevant data regarding this in Table 5.12.

13.15 The gross capacity of the reservoir, as noted earlier, is around 54 Mm³. We find that out of 9 years full capacity of the reservoir was attained only in 4 years. In other words, only in 50 per cent of the years the reservoir was full, in the remaining 50 per cent of the years only 40 to 60 per cent of the full capacity of the reservoir was attained. Further, full capacity, whenever attained, is seen to be attained latest by the middle of October or so. The overflow information confirms this observation. There was no overflow from the dam in the years 1977, 1978, 1981, 1982 and 1985. In 1979 overflow started in the middle of September and continued upto mid-October. In 1983 the overflow occurred in the 2nd week of August and continued uninterrupted till mid-November. In 1984 the first overflow occurred in the end of September and continued till mid-October. Thus we see that there is considerably uncertainty about the availability of full storage every year which indicates a supply constraint.

Table 5.12 : Water Content of the Reservoir at Different Dates During the Year in Respect of Manyad Scheme

Year	Water content in the reservoir (Mm ³)									
	31-5	15-6	30-6	15-7	31-7	15-8	31-8	15-9	31-10	28-2
1976-77	14.57	13.07	19.24	19.19	22.07	20.98	20.40	22.27	20.97	22.65
1977-78	15.51	23.46	26.60	27.03	26.15	23.35	23.26	24.62	23.21	17.29
1978-79	12.68	12.31	13.73	15.25	27.88	45.56	49.95	54.59	54.59	41.86
1979-80	21.51	21.45	22.64	22.50	19.84	19.95	54.53	54.31	53.71	39.31
1980-81	21.65	18.11	17.26	17.23	17.43	17.97	18.34	24.08	39.51	25.58
1981-82	19.05	17.55	27.34	28.38	28.44	26.94	24.42	25.89	32.83	25.44
1982-83	20.57	19.75	19.81	34.78	40.75	53.91	53.91	53.91	53.91	45.53
1983-84	32.23	29.46	27.45	48.11	50.88	51.96	52.58	53.91	53.91	35.38
1984-85	17.83	17.63	18.37	17.80	24.08	25.16	25.55	26.80	32.74	-

* Irrigation Year = 1st July to 30th June.

13.16 The reservoir begins gaining water slowly from the third week of June or so every year and it continues to gain water in most of the years till mid-October. The gain is more rapid (if at all) during the months of July and August. This pattern of gain is presumably because of the rain in the catchment area in spite of the release of some water for kharif irrigation during this period and a modest evaporation loss (around 25 per cent of the annual evaporation loss). As noted earlier, first water for kharif irrigation is released every year either in July or in August or September.

13.17 The water content of the reservoir starts declining from the end of October every year and continues to decline till the middle of June. This happens mainly because of release of water for rabi and hot-weather irrigation and also on account of evaporation loss which is estimated to be around 10.81 Mm^3 annually, 75 per cent of which occurs during fair weather.

13.18 The balance of water available in the storage in most of the years, as noted earlier, is larger than the dead storage required to be maintained. This happens inspite of the fact that full storage is not achieved in most of the years. Thus, although there is some supply constraint, some amount of water remain unused in the reservoir which may be released for early kharif sowing.

13.19 The foregoing account shows that even though there is balance of unused water at the end of every irrigation year it cannot be said in certain terms that there is no supply constraint because if fair weather (rabi + summer) season water requirement

is to be fully met, instead of to the extent of around 80 per cent (as is the existing situation), live storage balance is likely to get reduced considerably at the end. Yet water for early sowing of kharif crops would be available (around 3 to 4 Mm³). Hence, even after providing full water requirement for rabi and hot-weather seasons, (although hot-weather season crop was not provided for in the original cropping pattern), water for early sowing in the kharif season can be made available to the irrigators with proper water planning.

13.20 In what is discussed, in the preceding paragraphs deals only with supply side of the problem of underutilisation. It is also necessary to examine it from the demand side. It is quite possible that even if water is available for irrigation in kharif season, there may not be demand for it by the irrigators. This would be the case if the rainfall during the kharif season is not only adequate for the crops, but is also well distributed.

14. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water

14.1 For this scheme rainfall data were made available from two raingauge stations, one from the command area of the scheme at Talode for 7 years, from 1978-79 to 1984-85 and the other at Manyad dam for 9 years from 1976-77 to 1984-85. Weekly precipitation along with the number of rainy days in a week and the estimated variations in these two variables over the years are presented in Tables 5.D1, 5.D2 and 5.D3, 5.D4. Although no trend analysis can be done with data for such a limited number of

years we can make some observation about the intensity and periodicity of rainfall.

14.2 At the outset it may be noted that there is considerable variation from year to year in annual rainfall and number of rainy days in respect of rainfall data made available from the records of the rain gauge station at Manyad dam site (Tables 5.D3, 5.D4). One is likely to develop a nagging suspicion about the reliability of these data.

14.3 On examining the week ending rainfall and number of rainy days it appears that the monsoon sets in sometime between the 2nd week and the last week of June. In 4 out of 9 years it seems to break by the week ending June 11, in 3 out of 9 years it seems to break by week ending June 25 and in remaining 2 years the monsoon seems to have set in as late as week ending July 9. Further, in a number of years after the first shower, there appeared a long dry spell, particularly so in 1980-81, 1981-82 and 1983-84. Similarly in some years the rains continue upto week ending October 15 (1983-84 and 1984-85) and in some other years the same continue upto week ending September 24. Rainfall cannot be said to be concentrated during any particular period; in different years it is spread over June end to September end with long and short dry spells in between.

14.4 Very considerable variation from one year to another in every week ending rainfall and in number of rainy days can be seen from the estimates of Standard Deviation (SD) and the Co-efficient of Variation (CV). It may therefore be reasonable to conclude that a very high degree of uncertainty is attached to the week to

week precipitation and number of rainy days which leads to an uncertainty regarding the period by which the reservoir will be filled to its capacity, if at all, as noted earlier in Table 5.11. When the rainfall is deficient, as is seen to be the case in respect of this scheme, and there is considerable variations in the week ending precipitation and number of rainy days, the situation becomes more difficult.

14.5 We have noted earlier (Table 5.11, column 2) that there is considerable year to year variation in the date of release of first water for the kharif season. It is now clear that this uncertainty arises largely due to the uncertainty in the onset of monsoon and in its distribution. This is borne out by comparing these dates every year with the corresponding week ending dry spells in the command area of the scheme (Table 5.D1, 5.D2).

14.6 Although the demand for kharif irrigation is likely to be more in the last week of September and the whole of October, irrigators would also demand water during the months of July, August and early September because of short or long dry spells during these periods every year when the standing kharif crops need protective irrigation.

14.7 Since full storage is to be created by mid-October for irrigation in rabi and hot-weather seasons and, as seen earlier, since there is no certainty of creating the same every year, it may not always be possible to release required quantity of water for protective kharif irrigation. As a result of this the release

of water for protective irrigation in kharif is uncertain and inadequate which deters the irrigators from demanding water for kharif irrigation.

14.8 We have also examined the demand made by the irrigators for kharif irrigation and actual sanction given by the canal authorities.

Table 5.13: Demand for Kharif Irrigation by the Irrigators and Sanctioned by the Canal Authorities

Year	Number of applications made	Number of applications sanctioned	Area demanded to be irrigated (hectares)	Area sanctioned to be irrigated (hectares)
1980-81	650	504	434	311
1981-82	493	329	323	195
1982-83	742	649	547	479
1983-84	28	19	27	18
1984-85	31	7	30	7
1985-86	34	15	18	8

14.9 In the early eighties number of irrigators demanding kharif irrigation was comparatively large which has come down very substantially during the last 3 years. Even during early eighties all the applications demanding kharif irrigation were not sanctioned, similarly there was considerable reduction every year in the area actually sanctioned for kharif irrigation from the area in demand to be irrigated. This practice of the canal authorities

along with uncertain and inadequate supply of canal water for the sanctioned area for kharif irrigation led to a considerable reduction in the demand for kharif irrigation in the recent years.

14.10 The other aspect of the demand for kharif irrigation by the irrigators is the availability of well water. It is argued that if adequate well water is available the irrigators will not demand canal water for protective irrigation. To examine this aspect we have collected information on well irrigation in the command area from the canal officials. It is found that the number of wells used for irrigation increased from 493 to 538 in the last five years (from 1980 to 1985) and the area irrigated increased from 450 hectares to 550 hectares during the same period. The main crops irrigated by wells are sugarcane, wheat, gram, groundnut and vegetables. Bajra in kharif is also grown to some extent. From this account it may be surmised that available well water is mainly used for irrigating cash crops and not for protective irrigation.

14.11 Finally, another important aspect affecting the demand for kharif irrigation is whether there is significant adverse impact on the yield of crop because of not providing protective irrigation. It is reported by the Agricultural Extension personnel that groundnut, jowar and cotton sown early in June and raised with protective irrigation give yields which are 40 to 50 per cent higher than those grown under unirrigated conditions. Such a yield difference should normally induce the

irrigators to demand water for protective irrigation, but they do not do so because of the experience of no certainty of getting water at the required time and in required quantity; which in any case is going to affect the yield of these crops adversely.

14.12 From the above accounts it is clearly borne out that there is a need to provide protective irrigation to kharif crops, and for more and more farmers to take to kharif irrigation, canal authorities need to fully assure the farmers about the timely availability of the required quantity of water. In case it is possible to supply water for early kharif sowing in the 1st week of June, farmers would be prepared to take up early sowing without waiting for the monsoon to set in. This would not only improve the productivity of the kharif crops but would also ensure timely sowing of rabi crops. As we have noted from Table 5.12 the possibility of providing irrigation to pre-monsoon early sowing kharif crops is very much there even after meeting the water requirement of hot-weather groundnut which was not provided for in the project cropping pattern. Along with providing water for early sowing if assured and timely water can be provided to kharif crops during the dry spells in July, August and September there is bound to be an increase in demand for kharif irrigation. It may be possible to do so with proper water planning. Thus, it is the reasons arising out of supply factors which are largely responsible for particularly low utilisation in kharif because the reasons arising out of demand factor are very much related to the uncertain supply of canal water for kharif irrigation.

15. Medium Irrigation Scheme (Nazare - Pune)

15.1 The extent of utilisation of irrigation potential as estimated in Chapter III, seems to be particularly low in kharif season. As has been noted earlier, this scheme is located in the scarcity zone of the state and the main crops grown in kharif season under irrigation in this zone are bajra, groundnut and cotton. We have also noted that the farmers are more interested traditionally in rabi cultivation, particularly jowar, and introduction of irrigation (protective irrigation) does not seem to have brought about much change in the traditional outlook yet.

15.2 Table 5.14 presents some relevant information on release of water for irrigation for last few years which we presume would throw some light on the availability and pattern of irrigation water used in respect of this scheme.

15.3 It is seen from the Table that the date of release of water for kharif season is between 1st and 2nd week of August every year. It is further observed that no water was released for kharif irrigation in 1979-80 and 1983-84 mainly because of lack of availability of water in the reservoir. Even by the end of the 1st week of August in those two years water available in the reservoir was adequate only for the dead storage required to be maintained (around 6 Mm³).

15.4 The gross storages available at the time of releasing water for kharif season in the other seven years seem to vary considerably. Only in 4 out of 9 years full storage capacity was

Table 5.14 : Availability and Utilisation of Irrigation Water in Respect of Nazare Scheme

Year	Rain-fall (mm)	Date of release of water for kharif irrigation	Gross storage available on the date of releasing water (Mm ³)	Water used for kharif irrigation (Mm ³)	Date of release of water for rabi season	Gross storage available on the date of releasing water (Mm ³)	Water used for rabi season (Mm ³)	Date of release of water for hot weather season	Gross storage available on the date of releasing water (Mm ³)	Water used for hot-weather season (Mm ³)	Balance of storage (end of June) (Mm ³)
1976-77	595	7.7.76	16.31	2.14	13.10.76	16.16	2.88	3.4.77	10.47	2.14	14.00
1977-78	455	14.7.77	16.23	2.40	18.10.77	16.13	5.60	6.4.78	9.34	1.02	9.96
1978-79	325	1.7.78	9.91	1.85	20.10.78	14.85	3.30	5.3.79	11.89	2.87	6.34
1979-80	754	-	6.79 (7.8.79)	-	29.10.79	16.16	1.81	10.3.80	14.15	1.42	10.56
1980-81	578	13.7.80	16.16	0.71	20.10.80	16.16	2.15	10.3.81	13.59	2.76	7.66
1981-82	637	17.7.81	16.16	0.99	11.11.81	16.16	2.07	19.3.82	11.75	2.41	7.62
1982-83	415	1.7.82	7.57	0.28	1.11.82	16.16	3.66	16.4.83	8.94	1.17	6.12
1983-84	522	-	5.67 (7.8.83)	-	25.10.83	16.16	5.18	24.4.84	7.64	0.73	5.76
1984-85	489	10.7.84	7.36	1.19	13.11.84	16.16	5.24	16.4.85	9.06	-	5.97
Average	530		12.81	1.16		16.01	3.27		10.76	1.74	8.22

attained before water was released for kharif irrigation. In other 3 years only around 50 to 60 per cent of the gross capacity of the reservoir was filled till that time.

15.5 On an average around 1.16 Mm^3 of water is released for kharif season irrigation, although there is wide variation in the same from one year to another. In the initial 2 years of the project relatively larger amount of water was released for kharif season irrigation, but during the last 6 years only around 1 Mm^3 of water has been released every year except in 1978-79 and 1983-84 when, as mentioned earlier, no water was released, and further, in 1982-83 only 0.28 Mm^3 of water was released. It seems that the quantity of water released for kharif season irrigation depends upon the possibility of the availability of full storage by the end of kharif season. We shall examine this aspect when we analyse the detailed rainfall data in respect of this scheme.

15.6 Kharif season irrigation, if any, is completed by the middle of October every year and the number of waterings given during this period varies between 2 to 4 depending upon the availability of water and periodicity and intensity of rainfall.

15.7 For rabi season irrigation water is released normally between the 2nd and the 3rd week of October every year which continues till the end of February. During this period normally 5 to 6 waterings are given. In some years the onset of rabi irrigation is seen to be during the 2nd week of November.

15.8 Full storage capacity of water is seen to be available every year at the time of release of first water for rabi season

irrigation (column 6). Even during 1979-80 and 1983-84, when the onset of monsoon was presumably delayed, full storage was attained before the onset of rabi season irrigation.

15.9 On an average around 3.27 Mm^3 of water is released for rabi season irrigation which turns out to be less than 50 per cent of what was planned to be released (7.70 Mm^3). There appears to be fairly wide variation in the quantity of water released from year to year, even though full storage was available every year before the irrigation was started. As noted earlier, the main crops grown in this season under irrigation are jowar and wheat.

15.10 The date of release of water for hot-weather season irrigation varies between the years from the 1st week of March to the last week of April. Considerable overlap is reported in the release of water for crops grown in rabi and hot-weather seasons hence it is difficult to distinguish between the water released for rabi season crops and hot-weather season crops. Main crop grown in hot-weather is groundnut which is sown sometime during the end of January or beginning of February when irrigation for rabi season crop still remains in progress.

15.11 Gross storage available at the time of releasing water for hot-weather crops varies between 9 Mm^3 and 14 Mm^3 in different years which is very much in excess considering no hot-weather irrigation proposed in the project water planning. This happens mainly because less than 50 per cent of the water planned for rabi season is actually released even though full storage is available every year before rabi irrigation begins.

15.12 On an average around 1.74 Mm^3 of water is released for hot-weather irrigation even though in the project water planning hot-weather crops are not provided for. As mentioned earlier, since there is considerable overlap between rabi and hot-weather seasons irrigation it may be more meaningful to consider the combined water released for these two seasons instead of considering these separately. By doing so we find that on an average around 5 Mm^3 of water is released which turns out to be 65 per cent of what was planned to be released (not a very good utilisation percentage).

15.13 Balance of storage available at the end of irrigation every year varies between 6 Mm^3 and 14 Mm^3 with an average balance of around 8 Mm^3 (column 11). As noted earlier, the dead storage of the reservoir is 5.66 Mm^3 and considering this we find that in 4 out of 9 years balance of water in the reservoir is only adequate to meet the dead storage, hence no unused water remained in the storage during those years. However, in 4 out of 9 years live water balance to the extent of 2 to 5 Mm^3 remained unused in the storage which could either be used for improving rabi utilisation or could be supplied to kharif crops to help early sowing thereby reducing the dependence on monsoon for kharif sowing.

15.14 We may now examine the water content in the reservoir at different dates during the years to explain the availability of water for irrigation in different seasons, particularly in kharif. We present the relevant data regarding this in Table 5.15.

Table 5.15: Water Content of the Reservoir at Different Dates During the Year in Respect of Nazare Scheme

Year	Water Content in the Reservoir (Mm ³)									
	31-5	15-6	30-6	15-7	31-7	15-8	31-8	30-9	31-10	28-2
1976-77	6.93	6.42	14.00	16.22	16.16	16.30	16.16	15.62	15.62	10.24
1977-78	10.36	9.85	9.96	8.97	8.07	7.78	9.96	14.66	14.91	12.08
1978-79	7.58	7.05	6.34	5.66	5.80	14.23	16.22	16.16	16.16	14.63
1979-80	10.78	10.81	10.56	16.16	16.05	16.16	16.16	16.16	15.99	13.16
1980-81	7.82	7.70	7.66	16.16	16.16	16.16	16.16	16.16	16.16	12.47
1981-82	8.51	7.95	7.62	6.74	6.31	6.11	6.11	14.63	16.16	10.10
1982-83	6.61	6.29	6.12	5.85	5.68	6.31	8.94	10.50	16.10	9.37
1983-84	6.24	5.78	5.76	7.68	11.63	14.80	16.16	16.16	16.16	10.22
1984-85	6.52	6.12	5.97	5.75	5.74	9.62	9.01	7.64	8.84	N.A.

* Irrigation year = 1st July to 30th June.

15.15 The gross capacity of the reservoir, as noted earlier, is 16.17 Mm³. We find that except in the irrigation year 1985 in all other years full capacity of the reservoir was attained. It is also seen that the full capacity was attained in most of the years by the end of October. In 1979-80 and 1980-81 full storage capacity of the reservoir was achieved by the 2nd week of July itself. The overflow information confirms this observation. In the year 1977 the first overflow occurred by mid July and continued till the end of August and then occurred again for a week each in the 1st week of September, 2nd week of October and again in the first week of December. There was no overflow in the year 1978. In 1979 overflow occurred on 1st of September and then again on September 12 and continued till the 3rd week of October; thereafter overflow took place again in the 3rd week of November and continued till middle of December. In the year 1980 the first overflow occurred in the 2nd week of July and then on August 3 which continued till mid-October and thereafter it occurred again for 4 days in the last week of November. In 1981 also first overflow occurred in the 2nd week of July and continued till end of July. It occurred again during the last week of August and continued till the end of September. In 1982 the first overflow occurred only in the end of September and continued till October 9, thereafter it occurred again for a week from October 24 and again for 3 days in mid-November. In 1983 also the first overflow occurred on the 3rd week of September and continued uninterrupted till

mid-October, and in 1984 the first overflow occurred in mid-September and continued with some interruption till almost mid-November.

15.16 From the above account it is clear that the pattern of rainfall in this region is such that overflow of the reservoir takes place even during the months of October and November. This happens presumably because full storage is required to be achieved every year before the ensuing rabi irrigation (by October 15) and the rainfall that takes place after that period may naturally lead to overflow. Thus there does not seem to be any uncertainty in getting the reservoir filled to its capacity. We shall also check this observation with the detailed rainfall data in respect of this scheme.

15.17 In most of the years the reservoir begins gaining water slowly from the 1st week of July; in some years of course, gain in water content begins only by mid-August until the end of October. The gain is comparatively more mostly in the months of August and September, even after releasing some water for kharif irrigation and accounting for a modest evaporation loss (around 25 to 30 per cent of annual evaporation loss of 2.92 Mm^3).

15.18 The water content of the reservoir starts declining every year from generally the middle of November and continues to do so till the end of June. In 2 years out of 9 the water content started declining only by the end of November or 1st week of December. Faster decrease in water content takes place from the end of January. This seems to be in keeping with the release of water for rabi and hot-weather irrigation. We may recall our

earlier observation that water actually released every year for rabi season crops is much less than what was planned as per project water planning and that even though no provision was made for hot-weather irrigation in project water planning considerable amount of water is released for the same. There is of course some loss during this period (fair weather) due to evaporation which is estimated to be 75 per cent of the annual evaporation loss.

15.19 The balance of water at the end of irrigation year is seen to be more every year than the dead storage required to be maintained (except in the last two years). Not only full storage was achieved every year (except in 1985) but the overflow also occurred in most of the years during November. However, it may be mentioned that as the situation exists, only around 5 Mm³ of water is released for irrigation during fair weather instead of 7.70 Mm³ planned to be released. Hence if the entire planned water is released for fair weather irrigation, no surplus live storage will be available in the reservoir. So, there does not seem to be an easy supply position for kharif irrigation particularly if the full storage is required to be attained before the rabi season irrigation begins, and further, if the water planned to be released in the rabi season is fully released and in addition some water is also released for hot-weather irrigation, even though not provided for in the original water planning.

15.20 It is instructive to note that the aforementioned account deals only with the supply side of the problem of underutilisation.

It would also be necessary to discuss it from the demand side for it is quite possible that even though water is made available for kharif irrigation there may not be demand for it by the irrigators. This situation may arise if the rainfall during the kharif season is not only adequate for the crops but is also well distributed and/or there is alternate source of irrigation, viz., wells.

16. Distribution of Rainfall Affecting Demand for and Supply of Irrigation Water

16.1 Rainfall data from two rain-gauge stations are available in respect of this scheme. Data from one raingauge station, located at the dam site Nazare and covering the catchment area of the scheme, are available for 10 years, i.e. from 1976-77 to 1985-86. Data from the other raingauge station, located at Saswad covering large part of the command and catchment area, are available for 6 years, i.e. from 1980-81 to 1985-86. Weekly precipitation along with number of rainy days in a week and the estimated variations in these two variables over the years are presented in Tables 5.E1, 5.E2, 5.E3, 5.E4 and 5.E5, 5.E6. We are aware that no trend analysis can be attempted with rainfall data for such a few years, however, we shall make some observations regarding the intensity and periodicity of rainfall.

16.2 Statistics presented show that the monsoon generally sets in by the week ending June 11 every year and continues upto the week ending October, 1. In terms of total precipitation and its distribution year 1978-79 and 1985-86 seem to be particularly bad.

Some long and short dry spells are also seen to be occurring in different years mainly during the months of July and September. Concentration of monsoon during any particular month or so cannot be discerned because, as mentioned earlier, it is generally spread over three and half months from around mid-June to the end of September, and in some years it has continued even upto the month of November with long breaks in between.

16.3 Variations in the week ending amount of precipitation and in number of rainy days can be noted from the estimated Standard Deviation (SD) and Co-efficient of Variation (CV). It is noted that year to year variations both in week ending precipitation and in number of rainy days in a week are considerably high, though to some extent the estimated variations in week ending number of rainy days is smaller than those in the week ending amount of precipitation. These estimated variations show that there is considerable uncertainty regarding the intensity of rainfall and its distribution affecting the period by which the reservoir will be filled to its capacity every Year. Because the scheme is located in the scarcity zone the variation in week ending precipitation and in number of rainy days **matter more**.

16.4 As noted earlier, the date of release of water for kharif irrigation every year begins with the 1st or 2nd week of July (Table 5.14, column 2). On comparing these dates with the week ending rainfall data (Tables 5.E1, 5.E2 and 5.E5 and 5.E6) we find that the first release of water generally coincides with the short dry spell in July. Since the long or short dry spells seem to be occurring during almost all the months of rainy season the

demand for water for kharif irrigation by the irrigators is likely to spread over the months of July, August and September and first fortnight of October.

16.5 Since full storage is to be created in the reservoir by mid-October for irrigation in rabi and hot-weather seasons and, as discussed earlier, since rabi crops are considered to be very important in this region, it may not be possible by the canal authorities to release timely and adequate water for protective irrigation in kharif. This results into a very unsatisfactory, uncertain and irregular supply of water for such protective irrigation during kharif season which makes the farmers turn away from resorting to irrigation for kharif crops.

16.6 In order to stress the demand factor we have also examined the demand made by the irrigators for kharif irrigation and the actual sanction given by the canal authorities in different years.

16.7 Table 5.16 shows that by and large the applications made for kharif irrigation have been sanctioned and also that the sanctioned area every year is more or less equal to the area demanded. It cannot be said therefore that the irrigators are discouraged to take to kharif irrigation because of rejection of large number of applications made for this purpose or because of less area being sanctioned by the canal authorities against what is demanded.

16.8 The other aspect affecting demand for irrigation, particularly in kharif season, is the availability of well water.

Table 5.16: Demand for Kharif Irrigation by the Irrigators and Sanctioned by the Canal Authorities

Year	Number of applications made	Number of applications sanctioned	Area demanded to be irrigated (hectares)	Area sanctioned to be irrigated (hectares)
1977-78	433	399	463	453
1978-79	357	288	490	453
1979-80	259	257	375	375
1980-81	146	143	249	246
1981-82	401	381	576	564
1982-83	-	-	-	-
1983-84	N.A.	N.A.	N.A.	110
1984-85	271	264	511	496

We have examined this aspect also. Number of wells in the command area of the scheme seem to have increased from around 140 to around 250 and the area irrigated under well also appears to have increase from around 110 hectares to 250 hectares during the years 1977-78 to 1984-85. Main crops grown under well irrigation particularly during kharif season are sugarcane, vegetable and foodgrains like jowar and bajra. Thus, we find that the farmers do irrigate kharif crops with the well water although the extent of such irrigation is not very high. Nevertheless, to the extent use of alternative sour of water is made for kharif irrigation, demand for canal water woul be less. This point was also made in Chapter IV while dealing with the farmers' opinion survey.

16.9 Finally, the demand for kharif irrigation is also related to the yield of the crops grown during kharif season. If there is significant difference in yield between crops grown under protective irrigation and under rainfed condition farmers are likely to resort to kharif irrigation. It is reported by the Agricultural Scientist that the hybrid jowar and bajra grown in kharif season under protective irrigation give yield which are 20 to 30 per cent higher than those grown under unirrigated conditions. Such an yield difference should normally induce the irrigators to demand water for kharif irrigation, but, a large number of them do not do so because of the experience of uncertain and irregular supply of canal water from the irrigation system, which does not fulfill the requirement in terms of quantity and timely supply. This in any case affects the yield of the crops adversely.

16.10 From the above discussions it may be surmised that there is a need to provide protective irrigation to kharif crops, and in order to encourage more and more irrigators to resort to kharif irrigation, canal authorities need to fully assure the farmers about the timely availability of the required quantity of water. In case it is possible to supply water for early kharif sowing in the 1st week of June, and also to supply required quantity of water in time during the short and/or long dry spells in the months of June, July, August and September, farmers are likely to show willingness to take up early sowing with irrigation without waiting for monsoon to set in. This would not only improve the productivity of the kharif crops but

would also ensure timely sowing of rabi crops. But as we have noted earlier in Table 5.15 the possibility of providing irrigation to pre-monsoon early sown kharif crops is very remote because of inadequate live storage in the reservoir during this period particularly if full water requirement of rabi season is met and in addition water is also released for hot-weather irrigation. This problem is likely to bother the irrigators as well as the canal authorities because there is likely to be a trade off between using water for hot-weather crops and early sown kharif crops. It is the reasons arising out of supply factor which are mainly responsible for particularly low utilisation in kharif because the reasons arising out of demand factor are very much related to the uncertain supply of canal water for kharif irrigation.

17. Summing Up

17.1 The objective evaluation of the factors responsible for particularly low utilisation of kharif irrigation potential based on the analysis of the data collected from the official records indicate that the main reason for such a state of affair in the generally assured rainfall zone of Manyad and Nirguna schemes in Jalgaon and Akola districts and in the scarcity zone of the Nazare scheme in Pune district is the uncertain supply of canal water, particularly when required, from the distribution systems of these schemes. In other words, the reasons for particularly low utilisation of kharif potential is rooted into the supply factors and not so much into the demand factors. Lack of demand

for kharif irrigation from the irrigators is very much related to the inadequate and uncertain supply of canal water in respect of these schemes. This is borne out by the quantity of live storage available in the reservoir at different dates during the year.

17.2 In the case of Nirguna scheme in assured rainfall zone the balance of water available in most of the years at the end of the irrigation year was enough only to maintain the dead storage of the reservoir, hence the possibility of making water available for early kharif sowing was remote. There seems to be a trade off between the use of water for hot-weather crops and early sown kharif crops.

17.3 In respect of Manyad scheme in less assured rainfall zone the balance of water in the reservoir would be considerably higher (by around 3 Mm³) even after meeting the full water requirement of rabi and hot-weather seasons (as per water planning) to provide water for early sown kharif crops in most of the years. This possibility may be explored with proper water planning.

17.4 In the case of Nazare scheme in scarcity zone the availability of balance of water to resort to early kharif irrigation seems to be considerably less particularly after meeting the full water requirement of rabi in addition to meeting the water requirement of hot-weather season crop. It may also be noted that in the case of Nazare scheme demand factor is only marginally responsible for low kharif utilisation in as much as the irrigators in this zone attach importance to rabi cultivation, and under the present circumstances would leave

kharif cultivation to the vagaries of monsoon. Also the prevalence of well irrigation marginally comes in the way of demanding canal water for kharif cultivation.

17.5 In respect of Kalote-Mokashi scheme in very heavy rainfall zone of Raigad district the main reason for the absence of kharif irrigation is the availability of heavy and fairly well distributed rainfall in the command area of the scheme. The availability of storage in the reservoir at different points in time indicates that there is no supply constraint. Absence of any utilisation of canal water arises mainly out of demand factor owing to availability of rain water as borne out by the rainfall data.

Table 5.A1:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 1. KALOTE MOKASHI-RAIGAD
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
RAINFALL	2541.15	3067.75	3067.27	2205.93	3902.21	3412.40:
DAYS	80	99	97	95	105	105:
1 7 MAY	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0:
2 14 MAY	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0:
3 21 MAY	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0:
4 28 MAY	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0:
5 4 JUN	0.00	25.75	0.00	0.00	0.00	0.00:
	0	3	0	0	0	0:
6 11 JUN	0.00	313.25	0.00	32.62	0.00	25.40:
	0	5	0	1	0	3:
7 18 JUN	0.00	34.00	41.25	177.07	41.22	289.74:
	0	6	1	6	4	7:
8 25 JUN	145.00	314.75	181.57	237.49	335.28	33.78:
	7	4	4	6	7	6:
9 2 JUL	307.05	467.25	526.24	15.78	110.48	400.05:
	7	7	7	2	6	7:
10 9 JUL	142.03	228.25	315.13	105.41	59.69	368.26:
	7	7	7	5	6	7:
11 16 JUL	12.36	44.00	119.53	16.87	199.85	287.10:
	7	7	7	6	7	5:
12 23 JUL	47.09	82.50	371.63	69.85	476.03	523.51:
	7	6	7	7	7	7:
13 30 JUL	413.50	226.25	127.15	166.12	248.56	389.29:
	5	7	7	7	7	7:
14 6 AUG	450.00	647.50	408.78	37.03	332.75	120.85:
	6	7	7	7	7	7:
15 13 AUG	347.89	111.00	156.21	298.68	580.83	201.99:
	7	7	6	7	7	7:
16 20 AUG	43.32	59.50	95.17	334.53	577.47	97.87:
	3	5	7	7	7	7:
17 27 AUG	0.00	189.75	81.20	192.54	72.80	83.06:
	0	7	6	7	6	7:
18 3 SEP	48.00	99.25	42.07	34.03	179.69	79.99:
	3	7	4	4	7	7:
19 10 SEP	25.50	46.00	62.69	121.93	90.75	70.06:
	2	5	3	6	6	7:
20 17 SEP	170.75	30.75	151.13	3.04	78.74	285.75:
	4	2	7	1	4	6:
21 24 SEP	179.00	84.25	191.98	135.82	139.06	5.08:
	7	3	6	4	7	1:
22 1 OCT	127.75	51.25	43.18	95.06	207.59	120.14:
	5	3	6	3	3	5:
23 8 OCT	3.00	12.50	58.42	0.00	95.22	25.40:
	1	1	1	0	4	1:
24 15 OCT	5.25	0.00	60.92	0.00	76.20	0.00:
	1	0	2	0	3	0:
25 22 OCT	73.66	0.00	0.00	53.32	0.00	0.00:
	1	0	0	2	0	0:

(Continued)

Table 5.A1: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 1. KALOTE MOKASHI-RAIGAD
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
26 29 OCT	0.00	0.00	0.00	3.81	0.00	5.08:
	0	0	0	1	0	1:
27 5 NOV	0.00	0.00	33.02	22.86	0.00	0.00:
	0	0	2	2	0	0:
28 12 NOV	0.00	0.00	0.00	52.07	0.00	0.00:
	0	0	0	4	0	0:

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.A2:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 1. KALOTE MOKASHI-RAIGAD
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	XBAR	S.D.	C.V.	M.D.
1 7 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
6 11 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
7 18 JUN	97.21	102.60	105.54	90.79
	4.00	2.65	66.14	2.33
8 25 JUN	207.98	102.86	49.46	87.86
	5.67	1.25	22.01	1.11
9 2 JUL	304.48	185.20	60.83	160.90
	6.00	1.83	30.43	1.33
10 9 JUL	203.13	111.28	54.78	100.75
	6.50	0.76	11.75	0.67
11 16 JUL	113.29	101.67	89.75	88.88
	6.50	0.76	11.75	0.67
12 23 JUL	261.77	200.64	76.65	195.29
	6.83	0.37	5.45	0.28
13 30 JUL	261.81	106.45	40.66	93.06
	6.67	0.75	11.18	0.56
14 6 AUG	332.82	204.51	61.45	169.28
	6.83	0.37	5.45	0.28
15 13 AUG	282.77	155.66	55.05	126.37
	6.83	0.37	5.45	0.28
16 20 AUG	201.31	194.20	96.47	169.79
	6.00	1.53	25.46	1.33
17 27 AUG	103.23	68.24	66.10	58.61
	5.50	2.50	45.45	1.83
18 3 SEP	80.51	49.80	61.87	39.31
	5.33	1.70	31.87	1.67
19 10 SEP	69.49	30.92	44.49	24.76
	4.83	1.77	36.66	1.56
20 17 SEP	120.03	95.19	79.31	82.52
	4.00	2.08	52.04	1.67
21 24 SEP	122.53	62.88	51.32	51.91
	4.67	2.21	47.38	2.00
22 1 OCT	107.50	54.84	51.02	44.33
	4.17	1.21	29.12	1.17
23 8 OCT	32.42	34.11	105.21	29.60
	1.33	1.25	93.54	0.89
24 15 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

Table 5.B1:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 9. ASDLA MENDHA TANK-CHANDRAPUR
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
RAINFALL	1105.00	1073.60	1478.40	941.40	1192.60	1168.90	951.80:
DAYS	57	66	70	50	73	61	55:
1 7 MAY	0.00	0.00	0.00	0.00	0.00	10.40	0.00:
	0	0	0	0	0	2	0:
2 14 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0	0:
3 21 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0	0:
4 28 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0	0:
5 4 JUN	0.00	0.00	0.00	1.00	8.00	0.00	0.00:
	0	0	0	1	1	0	0:
6 11 JUN	11.00	0.00	0.00	0.00	21.80	0.00	0.00:
	1	0	0	0	2	0	0:
7 18 JUN	18.00	4.40	93.20	3.00	62.20	16.00	20.60:
	1	2	4	1	4	1	2:
8 25 JUN	38.60	45.40	116.40	185.60	78.20	120.40	16.60:
	3	4	5	5	5	5	2:
9 2 JUL	23.90	94.00	62.00	113.00	77.00	112.60	39.60:
	3	7	3	4	6	6	2:
10 9 JUL	99.50	120.20	147.80	49.60	93.00	137.20	16.20:
	6	5	6	1	6	7	1:
11 16 JUL	187.30	57.20	178.20	44.60	99.60	90.40	30.40:
	6	5	5	5	5	6	4:
12 23 JUL	205.40	29.80	114.20	29.40	6.20	33.00	71.80:
	7	2	5	2	1	2	6:
13 30 JUL	44.00	47.60	116.60	76.00	106.80	190.20	90.00:
	5	5	3	2	6	5	5:
14 6 AUG	164.50	126.00	34.80	115.20	180.80	107.40	58.60:
	4	7	5	4	7	5	4:
15 13 AUG	7.20	71.40	19.00	119.00	61.40	131.60	74.00:
	3	3	3	6	4	3	5:
16 20 AUG	41.00	1.60	152.00	8.00	68.60	69.00	112.00:
	3	1	6	3	4	5	5:
17 27 AUG	38.40	191.80	156.00	0.00	126.00	43.20	9.80:
	3	6	7	0	5	1	2:
18 3 SEP	147.60	115.60	110.20	16.00	47.20	6.20	28.80:
	5	5	2	1	2	1	3:
19 10 SEP	40.20	22.00	2.00	2.00	62.20	0.00	148.00:
	2	1	1	1	5	0	6:
20 17 SEP	33.80	36.60	3.40	4.00	62.60	12.80	64.00:
	4	2	2	1	4	2	2:
21 24 SEP	4.60	0.00	30.80	2.00	6.80	34.00	6.80:
	1	0	4	1	1	4	1:
22 1 OCT	0.00	0.00	16.00	128.60	0.00	50.30	0.00:
	0	0	1	4	0	5	0:
23 8 OCT	0.00	17.60	0.00	0.00	0.00	0.00	0.00:
	0	2	0	0	0	0	0:
24 15 OCT	0.00	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0	0:
25 22 OCT	0.00	0.00	0.00	0.00	0.00	0.00	123.20:
	0	0	0	0	0	0	3:

(Continued)

Table 5.B1: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 9. ASOLA MENDHA TANK-CHANDRAFUR .
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
30 26 NOV	0.00 0	41.20 3	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0:
31 3 DEC	0.00 0	17.00 1	0.00 0	16.40 2	0.00 0	0.00 0	0.00 0:
34 24 DEC	0.00 0	0.00 0	0.00 0	12.40 1	0.00 0	0.00 0	0.00 0:
36 7 JAN	0.00 0	0.00 0	0.00 0	8.00 3	0.00 0	0.00 0	0.00 0:
37 14 JAN	0.00 0	17.00 2	0.00 0	0.00 0	10.60 2	0.00 0	0.00 0:
38 21 JAN	0.00 0	0.00 0	1.40 1	0.00 0	0.00 0	0.00 0	0.00 0:
39 28 JAN	0.00 0	0.00 0	29.80 1	0.00 0	0.00 0	0.00 0	0.00 0:
40 4 FEB	0.00 0	0.00 0	0.60 1	0.00 0	0.00 0	4.20 1	0.00 0:
41 11 FEB	0.00 0	0.00 0	54.00 1	0.00 0	0.00 0	0.00 0	25.40 1:
42 18 FEB	0.00 0	0.00 0	21.60 2	4.60 1	0.00 0	0.00 0	0.00 0:
43 25 FEB	0.00 0	0.00 0	8.00 1	0.00 0	0.00 0	0.00 0	0.00 0:
47 25 MAR	0.00 0	0.00 0	0.00 0	0.00 0	7.60 2	0.00 0	0.00 0:
49 8 APR	0.00 0	1.20 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0:
51 22 APR	0.00 0	0.00 0	10.40 1	3.00 1	0.00 0	0.00 0	0.00 0:
52 29 APR	0.00 0	16.00 2	0.00 0	0.00 0	6.00 1	0.00 0	0.00 0:
53 30 APR	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	16.00 1:

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.B2:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 9. ASOLA MENDHA TANK-CHANDRAPUR
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	XBAR	S.D.	C.V.	M.D.
1 7 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
6 11 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
7 18 JUN	31.06	31.25	100.62	26.65
	2.14	1.25	58.12	1.06
8 25 JUN	85.89	54.51	63.47	47.07
	4.14	1.12	27.15	0.98
9 2 JUL	74.59	32.19	43.16	28.07
	4.43	1.76	39.77	1.63
10 9 JUL	94.79	43.91	46.33	35.87
	4.57	2.32	50.78	2.04
11 16 JUL	98.24	58.01	59.04	48.68
	5.14	0.64	12.42	0.49
12 23 JUL	69.97	64.36	91.98	51.85
	3.57	2.19	61.45	2.08
13 30 JUL	95.89	46.13	48.11	35.98
	4.43	1.29	29.21	1.10
14 6 AUG	112.47	48.59	43.20	39.03
	5.14	1.25	24.22	1.06
15 13 AUG	69.09	42.81	61.96	34.19
	3.86	1.12	29.16	0.98
16 20 AUG	64.60	50.21	77.73	40.91
	3.86	1.55	40.23	1.31
17 27 AUG	80.74	70.51	87.32	66.16
	3.43	2.44	71.20	2.20
18 3 SEP	67.37	51.92	77.07	48.94
	2.71	1.58	58.13	1.39
19 10 SEP	39.49	49.23	124.68	37.70
	2.29	2.12	92.70	1.84
20 17 SEP	31.03	23.75	76.55	20.82
	2.43	1.05	43.23	0.90
21 24 SEP	12.14	13.04	107.38	11.58
	1.71	1.48	86.60	1.31
22 1 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
23 8 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
24 15 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

Table 5.B3:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 11, SAOLI-CHANDRAPUR
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
RAINFALL	1259.20	1352.86	1531.00	447.50	1724.50	722.29	695.75
DAYS	60	59	66	8	86	34	40
1 7 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
2 14 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
3 21 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
4 28 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
5 4 JUN	0.00 0	0.00 0	14.20 1	0.00 0	7.40 1	0.00 0	0.00 0
6 11 JUN	34.40 3	0.00 0	9.00 1	0.00 0	22.00 2	0.00 0	7.80 2
7 18 JUN	10.40 2	42.20 1	82.30 5	0.00 0	68.80 5	0.00 0	2.30 1
8 25 JUN	48.30 2	18.60 3	122.50 6	247.00 5	59.60 4	0.00 0	110.90 3
9 2 JUL	74.40 4	80.20 6	75.00 3	192.50 2	95.00 6	0.00 0	13.70 2
10 9 JUL	239.90 7	195.60 6	182.80 7	8.00 1	48.50 2	83.30 4	48.40 4
11 16 JUL	304.90 6	47.60 5	241.20 4	0.00 0	103.00 5	76.40 4	115.70 4
12 23 JUL	200.60 7	25.20 2	98.20 5	0.00 0	36.60 2	197.66 5	159.70 5
13 30 JUL	9.60 2	152.40 6	138.80 4	0.00 0	123.80 3	204.74 7	87.16 4
14 6 AUG	92.60 5	88.90 6	13.40 2	0.00 0	182.60 6	14.80 1	58.74 6
15 13 AUG	14.60 3	48.40 5	30.20 3	0.00 0	141.00 7	3.50 1	8.80 2
16 20 AUG	38.40 3	0.00 0	172.60 6	0.00 0	130.70 7	33.00 3	63.50 5
17 27 AUG	20.00 3	488.30 7	236.00 7	0.00 0	49.60 7	0.00 0	15.00 1
18 3 SEP	126.00 7	105.60 5	81.00 4	0.00 0	88.70 7	0.00 0	4.05 1
19 10 SEP	18.30 3	10.40 1	2.40 1	0.00 0	139.20 7	0.00 0	0.00 0
20 17 SEP	26.80 3	34.40 2	0.00 0	0.00 0	205.80 6	19.59 2	0.00 0
21 24 SEP	0.00 0	0.00 0	10.80 3	0.00 0	128.60 4	6.40 1	0.00 0
22 1 OCT	0.00 0	5.00 1	7.40 2	0.00 0	73.00 3	12.90 3	0.00 0
23 8 OCT	0.00 0	10.06 3	0.00 0	0.00 0	0.00 0	70.00 3	0.00 0
24 15 OCT	0.00 0	0.00 0	4.20 1	0.00 0	0.00 0	0.00 0	0.00 0
25 22 OCT	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0

(Continued)

Table 5.B3: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 11.SAOLI-CHANDRAPUR
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
27 5 NOV	0.00	0.00	9.00	0.00	0.00	0.00	0.00
	0	0	1	0	0	0	0
36 7 JAN	0.00	0.00	0.00	0.00	10.80	0.00	0.00
	0	0	0	0	1	0	0
42 18 FEB	0.00	0.00	0.00	0.00	9.80	0.00	0.00
	0	0	0	0	1	0	0
44 4 MAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.B4:

197

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 11. SAOLI-CHANDRAPUR
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	83- 84	84- 85	XBAR	S.D.	C.V.	M.D.
RAINFALL	1378.16	776.36:				
DAYS	77	46:				
1 7 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
5 4 JUN	5.08	0.00:	0.00	0.00	0.00	0.00
	2	0:	0.00	0.00	0.00	0.00
6 11 JUN	9.08	11.40:	10.41	10.78	103.60	8.13
	3	1:	1.33	1.15	86.60	1.04
7 18 JUN	76.20	18.40:	33.40	32.50	97.30	30.20
	2	1:	1.89	1.79	94.85	1.43
8 25 JUN	21.60	0.00:	69.83	75.37	107.92	60.20
	3	0:	2.89	1.91	66.17	1.48
9 2 JUL	234.36	55.00:	91.13	72.32	79.36	55.22
	8	3:	3.78	2.35	62.11	1.98
10 9 JUL	39.80	55.40:	100.19	78.34	78.19	70.61
	3	4:	4.22	1.99	47.08	1.63
11 16 JUL	46.60	18.30:	105.97	97.00	91.54	76.42
	4	2:	3.78	1.69	44.61	1.23
12 23 JUL	97.48	93.20:	100.96	69.03	68.37	56.68
	4	5:	3.89	2.02	52.06	1.70
13 30 JUL	93.80	42.46:	94.75	64.31	67.88	53.50
	6	2:	3.78	2.15	56.88	1.80
14 6 AUG	65.60	204.00:	80.07	68.22	85.20	55.07
	4	4:	3.78	2.15	56.88	1.85
15 13 AUG	123.20	25.60:	43.92	49.34	112.33	40.19
	5	5:	3.44	2.11	61.38	1.83
16 20 AUG	180.16	124.40:	82.53	66.75	80.88	61.72
	7	4:	3.89	2.51	64.65	2.12
17 27 AUG	54.80	5.40:	96.57	155.04	160.55	118.04
	2	1:	3.11	2.88	92.72	2.59
18 3 SEP	74.60	0.00:	53.33	48.81	91.53	46.50
	4	0:	3.11	2.77	88.93	2.54
19 10 SEP	51.60	6.60:	25.39	43.12	169.82	31.12
	6	2:	2.22	2.48	111.80	2.07
20 17 SEP	82.40	22.20:	43.47	62.29	143.30	44.73
	4	3:	2.22	1.93	86.89	1.58
21 24 SEP	67.80	3.60:	24.13	42.25	175.06	32.92
	3	1:	1.33	1.49	111.80	1.33
22 1 OCT	41.60	20.40:	17.81	23.25	130.56	18.13
	6	1:	1.78	1.87	105.33	1.53
23 8 OCT	0.00	3.20:	0.00	0.00	0.00	0.00
	0	1:	0.00	0.00	0.00	0.00
24 15 OCT	0.00	47.80:	0.00	0.00	0.00	0.00
	0	4:	0.00	0.00	0.00	0.00
25 22 OCT	0.00	2.00:	0.00	0.00	0.00	0.00
	0	1:	0.00	0.00	0.00	0.00

Table 5.01:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: S. CHONDHI-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83	83- 84
RAINFALL	442.50	761.00	756.00	891.00	982.00	706.40	1406.00
DAYS	19	54	47	57	69	38	62
1 7 MAY	0.00 0	0.00 0	4.00 1	0.00 0	0.00 0	0.00 0	0.00 0
2 14 MAY	0.00 0	0.00 0	0.00 0	0.00 0	22.00 2	0.00 0	0.00 0
3 21 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
4 28 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	4.00 1	0.00 0
5 4 JUN	0.00 0	10.00 1	0.00 0	21.00 2	14.00 1	0.00 0	53.00 1
6 11 JUN	0.00 0	0.00 0	0.00 0	57.00 4	0.00 0	0.00 0	0.00 0
7 18 JUN	0.00 0	77.00 4	6.00 1	80.00 2	27.00 2	5.00 1	0.00 0
8 25 JUN	0.00 0	85.00 4	77.00 5	14.00 2	46.00 3	72.00 2	19.00 1
9 2 JUL	0.00 0	7.00 3	72.00 3	40.00 2	31.00 3	24.00 1	91.00 5
10 9 JUL	0.00 0	96.00 5	25.00 2	120.00 3	89.00 7	5.40 2	12.00 1
11 16 JUL	0.00 0	53.00 6	69.00 4	11.00 2	31.00 4	59.00 5	128.00 5
12 23 JUL	0.00 0	40.00 3	0.00 0	0.00 0	9.00 3	205.00 4	24.00 2
13 30 JUL	0.00 0	83.00 7	54.00 4	41.00 6	28.00 3	50.00 4	45.00 4
14 6 AUG	0.00 0	17.00 2	133.00 7	114.00 7	94.00 2	10.00 1	121.00 5
15 13 AUG	0.00 0	7.00 2	72.00 3	35.00 4	54.00 3	5.00 1	316.00 6
16 20 AUG	0.00 0	58.00 3	23.00 2	163.00 5	41.00 6	104.00 5	44.00 4
17 27 AUG	0.00 0	60.00 4	0.00 0	59.00 5	8.00 1	44.00 2	30.00 1
18 3 SEP	89.00 6	12.00 2	0.00 0	24.00 3	7.00 1	0.00 0	177.00 3
19 10 SEP	0.00 0	0.00 0	0.00 0	7.00 1	9.00 2	13.00 1	20.00 3
20 17 SEP	20.00 1	0.00 0	115.00 4	12.00 2	87.00 3	78.00 3	39.00 5
21 24 SEP	0.00 0	0.00 0	19.00 2	4.00 1	61.00 6	10.00 2	63.00 4
22 1 OCT	0.00 0	0.00 0	60.00 1	0.00 0	45.00 4	7.00 1	106.00 4
23 8 OCT	89.00 2	50.00 1	0.00 0	0.00 0	21.00 2	0.00 0	65.00 4
24 15 OCT	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	3.00 1
25 22 OCT	0.00 0	13.00 1	3.00 1	0.00 0	0.00 0	0.00 0	0.00 0

(Continued)

Table 5.C1: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:6.CHONDHI-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83	83- 84
26 29 OCT	0.00 0	0.00 0	0.00 0	0.00 0	3.00 1	6.00 1	0.00 0
28 12 NOV	0.00 0	16.00 1	0.00 0	0.00 0	0.00 0	5.00 1	0.00 0
29 19 NOV	0.00 0	0.00 0	1.00 1	0.00 0	0.00 0	0.00 0	0.00 0
30 26 NOV	76.50 2	0.00 0	5.00 1	0.00 0	0.00 0	0.00 0	0.00 0
31 3 DEC	27.00 1	29.00 2	5.00 1	0.00 0	0.00 0	0.00 0	0.00 0
32 10 DEC	0.00 0	29.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
33 17 DEC	0.00 0	0.00 0	5.00 1	0.00 0	24.00 2	0.00 0	0.00 0
34 24 DEC	0.00 0	0.00 0	4.00 1	0.00 0	0.00 0	0.00 0	0.00 0
35 31 DEC	0.00 0	0.00 0	0.00 0	32.00 2	0.00 0	0.00 0	0.00 0
36 7 JAN	5.00 1	0.00 0	2.00 1	0.00 0	0.00 0	0.00 0	25.00 1
37 14 JAN	0.00 0	0.00 0	0.00 0	11.00 1	65.00 2	0.00 0	10.00 1
38 21 JAN	0.00 0	10.00 1	0.00 0	26.00 1	0.00 0	0.00 0	0.00 0
39 28 JAN	49.00 2	9.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
40 4 FEB	0.00 0	0.00 0	0.00 0	0.00 0	55.00 2	0.00 0	0.00 0
41 11 FEB	49.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	15.00 1
43 25 FEB	0.00 0	0.00 0	0.00 0	16.00 1	0.00 0	0.00 0	0.00 0
45 11 MAR	10.00 1	0.00 0	2.00 1	0.00 0	0.00 0	0.00 0	0.00 0
47 25 MAR	0.00 0	0.00 0	0.00 0	4.00 1	91.00 3	0.00 0	0.00 0
50 15 APR	0.00 0	0.00 0	0.00 0	0.00 0	20.00 1	0.00 0	0.00 0
52 29 APR	28.00 2	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.C2:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:6.CHONDHI-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	84- 85	XBAR	S.D.	C.V.	M.D.
RAINFALL DAYS	690.00: 35:				
1 7 MAY	0.00: 0:	0.00	0.00	0.00	0.00
2 14 MAY	0.00: 0:	0.00	0.00	0.00	0.00
3 21 MAY	0.00: 0:	0.00	0.00	0.00	0.00
4 28 MAY	0.00: 0:	0.00	0.00	0.00	0.00
5 4 JUN	0.00: 0:	0.00	0.00	0.00	0.00
6 11 JUN	16.00: 2:	0.00	0.00	0.00	0.00
7 18 JUN	62.00: 2:	32.13	32.99	102.69	30.66
8 25 JUN	0.00: 0:	39.13	33.10	84.60	30.88
9 2 JUL	52.00: 2:	39.63	29.14	73.54	24.13
10 9 JUL	20.00: 4:	45.93	44.53	96.96	41.81
11 16 JUL	58.00: 1:	51.13	37.03	72.43	27.84
12 23 JUL	120.00: 3:	49.75	69.72	140.13	56.38
13 30 JUL	0.00: 0:	37.63	26.15	69.50	21.22
14 6 AUG	65.00: 3:	69.25	50.51	72.94	46.25
15 13 AUG	7.00: 2:	62.00	99.09	159.82	66.00
16 20 AUG	25.00: 4:	57.25	49.12	85.79	38.31
17 27 AUG	5.00: 1:	25.75	24.24	94.14	22.50
18 3 SEP	0.00: 0:	38.63	59.25	153.40	47.19
19 10 SEP	5.00: 1:	6.75	6.70	99.31	5.50
20 17 SEP	29.00: 3:	47.50	38.30	80.63	34.38
21 24 SEP	36.00: 1:	24.13	24.51	101.61	21.91
22 1 OCT	22.00: 2:	30.00	35.70	118.99	30.25
23 8 OCT	38.00: 1:	32.88	31.39	95.50	27.63
24 15 OCT	130.00: 3:	0.00	0.00	0.00	0.00
25 22 OCT	0.00: 0:	0.00	0.00	0.00	0.00

Table 5.C3:

201

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
FOR CENTRE: 7. TULJAPUR-AKOLA
1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	80- 81	81- 82	82- 83	83- 84	84- 85
RAINFALL	943.00	1208.00	827.00	1430.00	665.00:
DAYS	37	48	39	56	35:
1 7 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
2 14 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
3 21 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
4 28 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
5 4 JUN	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
6 11 JUN	0.00 0	0.00 0	0.00 0	0.00 0	6.00: 1:
7 18 JUN	0.00 0	0.00 0	15.00 1	0.00 0	94.00: 4:
8 25 JUN	7.00 1	126.00 4	67.00 4	16.00 1	6.00: 1:
9 2 JUL	101.00 2	49.00 3	20.00 1	71.00 4	15.00: 2:
10 9 JUL	81.00 4	105.00 5	14.00 1	0.00 0	134.00: 4:
11 16 JUL	11.00 1	67.00 5	141.00 5	275.00 4	44.00: 2:
12 23 JUL	0.00 0	8.00 1	192.00 4	59.00 3	36.00: 1:
13 30 JUL	65.00 3	38.00 3	71.00 4	54.00 4	0.00: 0:
14 6 AUG	189.00 7	190.00 3	15.00 2	64.00 5	106.00: 5:
15 13 AUG	95.00 4	102.00 2	0.00 0	311.00 6	30.00: 3:
16 20 AUG	121.00 5	101.00 5	71.00 7	20.00 3	43.00: 4:
17 27 AUG	201.00 5	10.00 1	52.00 2	12.00 1	25.00: 1:
18 3 SEP	33.00 2	37.00 1	0.00 0	53.00 6	0.00: 0:
19 10 SEP	5.00 1	13.00 1	20.00 1	13.00 2	0.00: 0:
20 17 SEP	10.00 1	101.00 2	74.00 2	62.00 5	11.00: 1:
21 24 SEP	0.00 0	56.00 5	17.00 1	67.00 2	25.00: 1:
22 1 OCT	24.00 1	103.00 4	19.00 1	237.00 6	2.00: 1:
23 8 OCT	0.00 0	0.00 0	0.00 0	116.00 4	27.00: 1:
24 15 OCT	0.00 0	0.00 0	0.00 0	0.00 0	61.00: 3:
25 22 OCT	0.00 0	0.00 0	15.00 1	0.00 0	0.00: 0:

(Continued)

Table 5.C3: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:7.TULJAPUR-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	80- 81	81- 82	82- 83	83- 84	84- 85
26 29 OCT	0.00 0	0.00 0	17.00 1	0.00 0	0.00: 0:
28 12 NOV	0.00 0	0.00 0	7.00 1	0.00 0	0.00: 0:
40 4 FEB	0.00 0	102.00 3	0.00 0	0.00 0	0.00: 0:

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.04:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 7. TULJAPUR-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	XBAR	S.D.	C.V.	M.D.
1 7 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
6 11 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
7 18 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
8 25 JUN	44.40	46.58	104.91	41.68
	2.20	1.47	66.80	1.44
9 2 JUL	51.20	32.13	62.75	27.84
	2.40	1.02	42.49	0.88
10 9 JUL	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
11 16 JUL	107.60	93.98	87.34	80.32
	3.40	1.62	47.79	1.52
12 23 JUL	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
13 30 JUL	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
14 6 AUG	112.80	68.93	61.11	61.36
	4.40	1.74	39.63	1.52
15 13 AUG	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
16 20 AUG	71.20	36.84	51.74	31.84
	4.80	1.33	27.64	1.04
17 27 AUG	60.00	72.07	120.12	56.40
	2.00	1.55	77.46	1.20
18 3 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
19 10 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
20 17 SEP	51.60	35.86	69.49	32.88
	2.20	1.47	66.80	1.12
21 24 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
22 1 OCT	77.00	87.26	113.33	74.40
	2.60	2.06	79.20	1.92
23 8 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
24 15 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

Table 5.C5:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
FOR CENTRE: B. MALEGAON-AKOLA
1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
RAINFALL	1147.80	1232.80	937.20	803.00	788.98	840.82	718.40
DAYS	58	81	66	48	57	73	56
1 7 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	6.00 1	0.00 0
2 14 MAY	0.00 0	6.40 1	0.00 0	13.80 1	0.00 0	5.40 1	0.00 0
3 21 MAY	0.00 0	0.00 0	0.00 0	2.00 1	0.00 0	0.00 0	0.60 1
4 28 MAY	0.00 0	11.60 3	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
5 4 JUN	0.00 0	0.00 0	0.00 0	0.00 0	21.00 2	2.00 1	0.00 0
6 11 JUN	14.40 4	0.00 0	13.80 2	0.00 0	35.00 3	4.20 1	0.20 1
7 18 JUN	0.40 1	62.40 1	98.00 4	12.80 1	38.20 2	10.40 1	13.40 2
8 25 JUN	146.00 4	90.40 7	58.60 4	107.20 6	18.40 2	32.00 2	82.00 6
9 2 JUL	16.60 3	107.60 6	10.00 3	52.00 1	48.20 5	79.42 7	0.00 0
10 9 JUL	116.80 5	51.60 6	180.80 5	46.80 1	41.40 4	71.80 6	36.00 3
11 16 JUL	90.40 6	19.20 2	89.40 7	57.80 4	12.00 3	27.20 4	105.40 4
12 23 JUL	133.60 4	38.20 4	58.40 3	0.00 0	0.00 0	3.20 2	170.20 5
13 30 JUL	7.40 2	84.80 5	65.20 4	117.60 5	71.60 7	31.80 3	27.40 7
14 6 AUG	37.80 4	14.00 4	55.40 4	127.00 6	133.00 5	87.20 2	16.60 2
15 13 AUG	7.20 1	153.60 5	27.80 5	52.20 4	19.20 3	56.60 3	17.40 4
16 20 AUG	88.60 4	0.00 0	52.80 2	46.60 3	122.58 4	30.20 4	80.40 6
17 27 AUG	71.80 2	117.80 5	46.80 4	0.00 0	109.20 5	6.80 2	45.00 4
18 3 SEP	251.00 7	93.20 7	14.40 3	0.60 1	20.00 3	0.00 0	0.00 0
19 10 SEP	47.20 5	2.60 1	0.00 0	0.00 0	4.20 1	62.60 4	3.60 1
20 17 SEP	0.40 1	47.00 2	0.00 0	49.60 3	12.80 2	37.40 4	63.00 3
21 24 SEP	4.20 1	0.00 0	0.00 0	46.80 4	47.40 2	112.80 6	20.00 3
22 1 OCT	0.00 0	12.40 2	0.00 0	48.60 2	1.60 1	47.60 3	10.40 2
23 8 OCT	0.00 0	114.20 2	41.80 3	0.00 0	0.00 0	8.00 2	0.00 0
24 15 OCT	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
25 22 OCT	0.00 0	0.00 0	21.40 1	0.00 0	0.00 0	0.00 0	0.00 0

(Continued)

Table 5.C5: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 8. MALEGAON-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
26 29 OCT	0.00	0.00	0.00	0.00	0.00	6.60	0.00
	0	0	0	0	0	2	0
27 5 NOV	0.00	0.00	0.00	0.00	0.00	11.80	0.00
	0	0	0	0	0	1	0
28 12 NOV	16.40	0.00	3.00	0.00	0.00	0.40	14.80
	1	0	1	0	0	1	1
29 19 NOV	0.00	0.00	1.60	0.40	0.00	0.00	0.00
	0	0	1	1	0	0	0
30 26 NOV	93.40	77.80	0.00	0.00	0.00	0.00	0.00
	1	2	0	0	0	0	0
31 3 DEC	0.00	12.80	58.20	17.00	0.00	0.00	0.00
	0	2	2	2	0	0	0
32 10 DEC	0.00	0.00	4.80	0.00	0.00	0.00	0.00
	0	0	1	0	0	0	0
34 24 DEC	0.00	0.00	0.00	0.00	0.00	21.80	0.00
	0	0	0	0	0	3	0
35 31 DEC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
36 7 JAN	0.00	0.00	0.00	0.80	0.00	0.00	0.00
	0	0	0	1	0	0	0
37 14 JAN	0.00	10.60	0.00	0.00	1.00	21.40	0.00
	0	1	0	0	1	3	0
38 21 JAN	0.00	0.00	8.00	0.00	22.00	0.00	0.00
	0	0	2	0	1	0	0
39 28 JAN	0.00	6.00	5.40	0.00	0.00	0.00	12.00
	0	1	2	0	0	0	1
40 4 FEB	0.00	10.00	0.00	0.00	0.00	56.00	0.00
	0	1	0	0	0	3	0
41 11 FEB	0.00	5.20	4.60	0.00	0.00	0.00	0.00
	0	2	1	0	0	0	0
42 18 FEB	0.00	0.00	11.00	0.00	0.00	0.00	0.00
	0	0	1	0	0	0	0
43 25 FEB	0.00	6.80	0.00	0.00	0.00	0.00	0.00
	0	2	0	0	0	0	0
44 4 MAR	4.20	0.00	6.00	0.00	0.00	0.00	0.00
	2	0	1	0	0	0	0
45 11 MAR	0.00	10.20	0.00	0.00	0.00	0.00	0.00
	0	2	0	0	0	0	0
46 18 MAR	0.00	12.80	0.00	0.00	10.20	0.00	0.00
	0	1	0	0	1	0	0
47 25 MAR	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	0	0	0	0	0	1	0
49 8 APR	0.00	3.20	0.00	0.00	0.00	0.00	0.00
	0	1	0	0	0	0	0
50 15 APR	0.00	2.20	0.00	3.40	0.00	0.00	0.00
	0	1	0	1	0	0	0
52 29 APR	0.00	48.20	0.00	0.00	0.00	0.00	0.00
	0	2	0	0	0	0	0

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.06:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 8. MALEGAON-AKOLA
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	83- 84	84- 85	XBAR	S. D.	C. V.	M. D.
RAINFALL	1506.20	519.40:				
DAYS	78	56:				
1 7 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0:	0.00	0.00	0.00	0.00
6 11 JUN	0.00	11.20:	8.76	10.93	124.88	8.75
	0	3:	1.56	1.42	91.47	1.28
7 18 JUN	2.00	102.80:	37.82	38.16	100.89	33.36
	1	6:	2.11	1.66	78.77	1.28
8 25 JUN	32.20	0.40:	63.02	44.46	70.55	38.56
	1	1:	3.67	2.16	58.92	1.93
9 2 JUL	66.00	12.80:	43.62	34.45	78.97	30.02
	6	2:	3.67	2.31	62.98	2.07
10 9 JUL	15.20	22.40:	64.76	49.82	76.94	38.92
	1	2:	3.67	1.89	51.43	1.70
11 16 JUL	120.60	30.00:	61.33	38.67	63.04	35.66
	5	2:	4.11	1.59	38.79	1.26
12 23 JUL	30.00	10.80:	49.38	58.47	118.42	47.57
	4	2:	2.67	1.70	63.74	1.48
13 30 JUL	95.20	5.20:	56.24	37.76	67.14	34.04
	6	1:	4.44	2.01	45.14	1.73
14 6 AUG	98.00	84.20:	72.58	41.74	57.51	37.00
	6	3:	4.00	1.41	35.36	1.11
15 13 AUG	393.80	0.60:	80.93	118.86	146.86	85.67
	7	2:	3.78	1.69	44.61	1.36
16 20 AUG	83.00	16.60:	57.86	36.88	63.74	31.80
	5	3:	3.44	1.64	47.63	1.28
17 27 AUG	7.80	6.40:	45.73	42.81	93.61	36.15
	2	2:	2.89	1.59	55.20	1.43
18 3 SEP	87.40	3.20:	52.20	78.47	150.33	61.11
	5	4:	3.33	2.54	76.16	2.15
19 10 SEP	18.80	2.60:	15.73	21.90	139.19	18.09
	4	1:	1.89	1.79	94.85	1.63
20 17 SEP	95.20	10.80:	35.13	30.32	86.29	25.90
	5	2:	2.44	1.42	58.21	1.16
21 24 SEP	97.40	17.40:	38.44	39.53	102.83	33.47
	5	1:	2.44	2.06	84.31	1.83
22 1 OCT	115.00	27.80:	29.27	35.25	120.43	27.42
	5	3:	2.00	1.49	74.54	1.11
23 8 OCT	58.40	7.40:	25.53	37.19	145.67	30.62
	5	2:	1.56	1.64	105.46	1.38
24 15 OCT	0.00	99.00:	0.00	0.00	0.00	0.00
	0	3:	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.80:	0.00	0.00	0.00	0.00
	0	1:	0.00	0.00	0.00	0.00

Table 5.D1:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
FOR CENTRE: 4. TALODE-JALGAON'

1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	78- 79	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
RAINFALL	465.60	663.90	667.00	364.00	385.20	375.00	675.00:
DAYS	43	44	43	40	35	23	34:
1 7 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
2 14 MAY	0.00 0	0.00 0	0.00 0	10.00 2	0.00 0	0.00 0	0.00: 0:
3 21 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
4 28 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
5 4 JUN	7.00 1	0.00 0	16.00 1	0.00 0	0.00 0	0.00 0	0.00: 0:
6 11 JUN	2.40 1	8.50 1	62.40 5	0.00 0	0.00 0	0.00 0	0.00: 0:
7 18 JUN	51.80 4	3.00 1	19.40 3	0.00 0	28.00 1	14.00 2	7.00: 1:
8 25 JUN	19.20 2	48.00 3	6.20 1	0.00 0	143.00 5	4.60 2	0.00: 0:
9 2 JUL	4.00 1	34.00 1	2.00 1	23.00 3	0.00 0	6.40 1	23.60: 2:
10 9 JUL	54.20 5	34.00 4	5.00 1	36.00 4	6.00 1	0.00 0	91.00: 5:
11 16 JUL	29.00 3	42.00 1	0.00 0	7.60 3	32.20 5	220.00 7	57.00: 4:
12 23 JUL	23.00 1	1.40 1	0.00 0	15.80 3	1.00 1	51.00 3	16.00: 1:
13 30 JUL	0.00 0	104.00 5	2.00 1	11.60 2	6.80 2	16.00 2	0.00: 0:
14 6 AUG	2.40 1	58.00 6	38.00 5	39.00 2	0.00 0	12.20 3	51.00: 1:
15 13 AUG	0.00 0	69.00 2	10.00 4	40.00 3	1.20 2	50.80 3	36.00: 4:
16 20 AUG	13.00 2	0.00 0	278.00 6	39.00 3	9.60 3	0.00 0	26.40: 3:
17 27 AUG	50.00 2	2.00 1	16.60 3	0.00 0	4.40 2	0.00 0	9.00: 1:
18 3 SEP	66.00 4	45.00 3	44.00 2	4.00 1	54.00 3	0.00 0	0.00: 0:
19 10 SEP	46.00 3	0.00 0	61.00 2	17.00 2	31.00 2	0.00 0	10.00: :
20 17 SEP	0.00 0	67.00 4	20.60 1	58.00 5	12.00 2	0.00 0	127.00: 2:
21 24 SEP	0.00 0	74.60 6	18.80 2	39.00 3	22.00 2	0.00 0	20.00: 1:
22 1 OCT	4.00 1	21.40 3	0.00 0	15.00 2	5.00 1	0.00 0	23.00: 4:
23 8 OCT	17.20 1	0.00 0	0.00 0	5.00 1	0.00 0	0.00 0	111.00: 2:
24 15 OCT	0.00 0	10.00 1	0.00 0	0.00 0	0.00 0	0.00 0	67.00: 2:
25 22 OCT	0.00 0	42.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:

(Continued)

Table 5.D1: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:4.TALQDE-JALGAON
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	78- 79	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
27 5 NOV	0.00 0	0.00 0	0.00 0	4.00 1	3.00 1	0.00 0	0.00: 0:
28 12 NOV	15.00 2	0.00 0	0.00 0	0.00 0	26.00 2	0.00 0	0.00: 0:
30 26 NOV	1.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
31 3 DEC	19.00 2	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
34 24 DEC	0.00 0	0.00 0	12.00 1	0.00 0	0.00 0	0.00 0	0.00: 0:
35 31 DEC	0.00 0	0.00 0	24.00 2	0.00 0	0.00 0	0.00 0	0.00: 0:
36 7 JAN	2.60 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
38 21 JAN	5.40 1	0.00 0	15.00 1	0.00 0	0.00 0	0.00 0	0.00: 0:
39 28 JAN	24.20 3	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
44 4 MAR	8.40 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
47 25 MAR	0.00 0	0.00 0	16.00 1	0.00 0	0.00 0	0.00 0	0.00: 0:

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.D2:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:4.TALODE-JALGAON
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	XBAR	S.D.	C.V.	M.D.
1 7 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
6 11 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
7 18 JUN	17.60	16.60	94.33	13.26
	1.71	1.28	74.54	1.10
8 25 JUN	31.57	48.11	152.39	36.53
	1.86	1.64	88.38	1.31
9 2 JUL	13.29	12.35	92.94	11.64
	1.29	0.88	68.49	0.69
10 9 JUL	32.31	30.29	93.73	24.56
	2.86	1.96	68.56	1.88
11 16 JUL	55.40	69.55	125.55	47.49
	3.29	2.19	66.51	1.76
12 23 JUL	15.46	16.76	108.42	12.56
	1.43	1.05	73.48	0.90
13 30 JUL	20.06	34.72	173.13	23.98
	1.71	1.58	92.04	1.18
14 6 AUG	28.66	21.83	76.18	20.39
	2.57	2.06	80.12	1.80
15 13 AUG	29.57	24.55	83.01	22.15
	2.57	1.29	50.31	1.06
16 20 AUG	52.29	93.06	177.99	64.49
	2.43	1.92	78.92	1.51
17 27 AUG	11.71	16.56	141.36	12.33
	1.29	1.03	80.12	0.90
18 3 SEP	30.43	26.10	85.77	24.94
	1.86	1.46	78.45	1.31
19 10 SEP	23.57	21.70	92.08	19.22
	1.43	1.05	73.48	0.94
20 17 SEP	40.66	43.06	105.91	37.15
	2.00	1.77	88.64	1.43
21 24 SEP	24.91	23.84	95.69	18.22
	2.00	1.93	96.36	1.43
22 1 OCT	9.89	9.07	91.75	8.50
	1.57	1.40	89.07	1.22
23 8 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
24 15 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

Table 5.D3:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: S.MANYAD DAM-JALGAON
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
RAINFALL	448.40	265.00	210.60	679.80	195.00	259.20	224.00
DAYS	33	21	13	40	8	28	21
1 7 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
2 14 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
3 21 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
4 28 MAY	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
5 4 JUN	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
6 11 JUN	127.00	4.00	0.00	18.00	39.00	0.00	0.00
	3	1	0	3	1	0	0
7 18 JUN	0.00	29.00	0.00	0.00	26.00	0.00	0.00
	0	1	0	0	2	0	0
8 25 JUN	28.00	98.00	6.00	38.00	0.00	0.00	67.00
	1	6	1	2	0	0	2
9 2 JUL	24.50	19.00	0.00	0.00	0.00	0.00	0.00
	2	2	0	0	0	0	0
10 9 JUL	18.20	0.00	28.00	15.00	0.00	20.00	2.00
	3	0	2	2	0	3	1
11 16 JUL	6.40	0.00	17.00	37.00	0.00	0.00	23.00
	3	0	1	1	0	0	5
12 23 JUL	17.20	42.00	0.00	0.00	0.00	0.00	0.00
	2	4	0	0	0	0	0
13 30 JUL	8.00	40.00	23.60	55.00	0.00	3.00	6.00
	1	3	2	3	0	1	1
14 6 AUG	55.20	0.00	0.00	46.00	0.00	48.50	0.00
	6	0	0	5	0	3	0
15 13 AUG	0.00	14.00	9.00	66.00	0.00	28.00	0.00
	0	2	1	3	0	2	0
16 20 AUG	0.00	0.00	11.00	0.00	42.00	25.00	30.00
	0	0	1	0	1	2	1
17 27 AUG	34.00	0.00	0.00	0.00	58.00	6.00	0.00
	2	0	0	0	2	1	0
18 3 SEP	78.80	0.00	25.00	26.00	0.00	1.70	26.00
	5	0	1	3	0	2	1
19 10 SEP	0.00	0.00	26.00	0.00	0.00	14.00	33.00
	0	0	1	0	0	2	3
20 17 SEP	15.00	19.00	0.00	172.80	0.00	62.00	17.00
	2	2	0	5	0	4	1
21 24 SEP	36.10	0.00	0.00	49.00	30.00	15.00	6.00
	3	0	0	3	2	4	1
22 1 OCT	0.00	0.00	0.00	65.00	0.00	14.00	3.00
	0	0	0	2	0	1	1
23 8 OCT	0.00	0.00	30.00	0.00	0.00	5.00	0.00
	0	0	1	0	0	1	0
24 15 OCT	0.00	0.00	0.00	16.00	0.00	0.00	0.00
	0	0	0	1	0	0	0
25 22 OCT	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0

(Continued)

Table 5.D3: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: S.MANYAD DAM-JALGAON
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
26 29 OCT	0.00 0	0.00 0	0.00 0	40.00 1	0.00 0	0.00 0	3.00 1
27 5 NOV	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	17.00 2	3.00 1
28 12 NOV	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	5.00 2
29 19 NOV	0.00 0	0.00 0	0.00 0	6.00 1	0.00 0	0.00 0	0.00 0
30 26 NOV	0.00 0	0.00 0	0.00 0	6.00 2	0.00 0	0.00 0	0.00 0
31 3 DEC	0.00 0	0.00 0	0.00 0	24.00 3	0.00 0	0.00 0	0.00 0
39 28 JAN	0.00 0	0.00 0	-20.00 1	0.00 0	0.00 0	0.00 0	0.00 0
47 25 MAR	0.00 0	0.00 0	15.00 1	0.00 0	0.00 0	0.00 0	0.00 0

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.D4:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: S.MANYAD DAM-JALGAON
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	83- 84	84- 85	XBAR	S.D.	C.V.	M.D.
RAINFALL DAYS	807.00 43	440.00: 23:				
1 7 MAY	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
2 14 MAY	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
3 21 MAY	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
4 28 MAY	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
5 4 JUN	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
6 11 JUN	0.00 0	24.00: 2:	23.56 1.11	38.83 1.20	164.86 107.70	26.52 1.04
7 18 JUN	14.00 1	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
8 25 JUN	0.00 0	0.00: 0:	26.33 1.33	33.53 1.83	127.31 136.93	27.93 1.33
9 2 JUL	0.00 0	85.70: 2:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
10 9 JUL	0.00 0	48.40: 3:	14.62 1.56	15.50 1.26	106.01 80.81	12.55 1.16
11 16 JUL	252.00 7	32.40: 3:	40.87 2.22	75.83 2.35	185.55 105.59	46.92 2.02
12 23 JUL	46.00 4	19.00: 2:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
13 30 JUL	0.00 0	0.00: 0:	15.07 1.22	19.00 1.13	126.09 92.71	16.31 0.96
14 6 AUG	3.00 1	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
15 13 AUG	36.00 3	13.50: 1:	18.50 1.33	20.59 1.15	111.29 86.60	16.56 1.04
16 20 AUG	63.00 4	14.00: 1:	20.56 1.11	20.47 1.20	99.60 107.70	17.28 0.84
17 27 AUG	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
18 3 SEP	44.00 3	0.00: 0:	22.39 1.67	24.98 1.63	111.55 97.98	19.52 1.41
19 10 SEP	21.00 3	16.00: 1:	12.22 1.11	12.08 1.20	98.84 107.70	10.86 1.04
20 17 SEP	109.00 5	52.00: 1:	49.64 2.22	54.75 1.87	110.29 84.26	43.83 1.63
21 24 SEP	77.00 3	14.00: 1:	25.23 1.89	24.17 1.37	95.80 72.52	20.26 1.23
22 1 OCT	58.00 4	34.00: 2:	19.33 1.11	24.91 1.29	128.86 115.76	22.00 1.04
23 8 OCT	32.00 3	74.00: 2:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
24 15 OCT	52.00 2	13.00: 2:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
25 22 OCT	0.00 0	0.00: 0:	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

Table 5.51:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 2. NAZARE-PUNE
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
RAINFALL	594.50	455.00	325.00	754.00	578.00	637.00	415.00
DAYS	39	47	35	54	42	28	32
1 7 MAY	0.00 0	0.00 0	0.00 0	0.00 0	38.00 1	0.00 0	7.00 1
2 14 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
3 21 MAY	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	47.00 2
4 28 MAY	0.00 0	5.00 1	61.00 4	0.00 0	0.00 0	0.00 0	7.00 1
5 4 JUN	0.00 0	0.00 0	15.00 1	0.00 0	19.00 1	0.00 0	28.00 1
6 11 JUN	193.00 3	8.00 1	0.00 0	15.00 1	117.00 4	24.00 1	6.00 1
7 18 JUN	0.00 0	56.00 3	18.00 4	10.00 1	25.00 3	59.00 2	0.00 0
8 25 JUN	14.00 1	48.00 2	21.00 4	0.00 0	14.00 2	26.00 1	4.00 1
9 2 JUL	50.00 2	42.00 6	3.00 1	29.00 2	27.00 2	0.00 0	0.00 0
10 9 JUL	0.00 0	25.00 3	5.00 1	0.00 0	45.00 7	65.00 3	4.00 1
11 16 JUL	36.20 4	6.00 2	3.00 2	0.00 0	1.00 1	13.00 1	0.00 0
12 23 JUL	24.30 7	20.00 1	2.00 1	0.00 0	4.00 3	0.00 0	20.00 1
13 30 JUL	20.00 2	24.00 4	4.00 2	83.00 5	1.00 1	0.00 0	2.00 1
14 6 AUG	99.00 6	10.00 4	7.00 3	26.00 3	52.00 2	23.00 2	3.00 1
15 13 AUG	0.00 0	32.00 1	8.00 2	23.00 7	11.00 3	5.00 1	12.00 4
16 20 AUG	0.00 0	0.00 0	0.00 0	2.00 2	15.00 1	0.00 0	13.00 3
17 27 AUG	0.00 0	2.00 1	15.00 2	0.00 0	114.00 2	0.00 0	8.00 1
18 3 SEP	15.00 3	22.00 3	0.00 0	68.00 3	7.00 2	0.00 0	0.00 0
19 10 SEP	9.00 2	0.00 0	0.00 0	11.00 2	0.00 0	105.00 5	0.00 0
20 17 SEP	0.00 0	0.00 0	0.00 0	118.00 6	0.00 0	80.00 3	0.00 0
21 24 SEP	65.00 3	5.00 1	56.00 2	156.00 6	38.00 3	122.00 4	71.00 4
22 1 OCT	6.00 1	23.00 1	25.00 2	54.00 3	31.00 3	0.00 0	111.00 4
23 8 OCT	10.00 1	40.00 5	0.00 0	0.00 0	19.00 1	0.00 0	0.00 0
24 15 OCT	0.00 0	15.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0
25 22 OCT	0.00 0	0.00 0	17.00 2	15.00 2	0.00 0	0.00 0	45.00 1

Table 5.52:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 2. NAZARE-PUNE
 1ST FIG RAINFALL (IN MM) 2ND FIG NO OF RAINY DAYS

WEEK ENDING	83- 84	84- 85	85- 86	XBAR	S.D.	C.V.	M.D.
RAINFALL DAYS	522.00 43	489.00 40	277.00: 28:				
1 7 MAY	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	4.00:	0.00	0.00	0.00	0.00
	0	0	1:	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
5 4 JUN	8.00	13.00	0.00:	8.30	9.56	115.19	8.36
	1	1	0:	0.50	0.50	100.00	0.50
6 11 JUN	0.00	25.00	26.00:	41.40	60.00	144.93	45.44
	0	3	2:	1.60	1.28	80.04	1.12
7 18 JUN	39.00	57.00	12.00:	27.60	22.28	80.71	20.12
	3	4	1:	2.10	1.45	68.84	1.30
8 25 JUN	9.00	0.00	16.00:	15.20	13.62	89.62	10.04
	5	0	2:	1.80	1.54	85.35	1.20
9 2 JUL	3.00	17.00	6.00:	17.70	17.45	98.57	15.44
	2	2	1:	1.80	1.60	88.89	1.04
10 9 JUL	0.00	27.00	2.00:	17.30	21.58	124.73	18.56
	0	2	1:	1.80	2.04	113.31	1.56
11 16 JUL	18.00	30.00	17.00:	12.42	12.23	98.48	10.42
	2	2	1:	1.50	1.12	74.54	0.90
12 23 JUL	7.00	11.00	55.00:	14.33	15.97	111.48	12.40
	2	2	4:	2.10	2.02	96.30	1.54
13 30 JUL	4.00	3.00	0.00:	14.10	24.34	172.60	16.94
	1	1	0:	1.70	1.55	91.32	1.24
14 6 AUG	5.00	2.00	29.00:	25.60	28.61	111.75	20.72
	2	1	4:	2.80	1.47	52.49	1.20
15 13 AUG	44.00	9.00	8.00:	15.20	12.95	85.21	10.68
	3	3	2:	2.60	1.85	71.34	1.40
16 20 AUG	53.00	1.00	0.00:	8.40	15.82	188.32	11.16
	4	1	0:	1.10	1.37	124.98	1.14
17 27 AUG	3.00	1.00	0.00:	14.30	33.55	234.60	20.08
	1	1	0:	0.80	0.75	93.54	0.64
18 3 SEP	3.00	0.00	6.00:	12.10	19.91	164.52	13.74
	1	0	1:	1.30	1.27	97.60	1.16
19 10 SEP	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
20 17 SEP	73.00	33.00	0.00:	0.00	0.00	0.00	0.00
	4	2	0:	0.00	0.00	0.00	0.00
21 24 SEP	99.00	48.00	0.00:	66.00	46.51	70.48	36.80
	4	2	0:	2.90	1.64	5.56	1.32
22 1 OCT	62.00	66.00	13.00:	39.10	32.36	82.75	27.32
	3	3	3:	2.30	1.19	51.63	1.04
23 8 OCT	2.00	57.00	76.00:	20.40	26.32	129.03	22.36
	1	3	4:	1.50	1.75	116.43	1.50
24 7 OCT	0.00	12.00	0.00:	0.00	0.00	0.00	0.00
	0	2	0:	0.00	0.00	0.00	0.00
25 22 OCT	30.00	14.00	0.00:	12.10	14.73	121.77	12.10
	1	1	0:	0.70	0.78	111.58	0.70

Table 5.E3:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 2.NAZARE-FUNE
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82	82- 83
26 29 OCT	0.00	0.00	0.00	0.00	0.00	59.00	0.00
	0	0	0	0	0	2	0
27 5 NOV	0.00	8.00	0.00	0.00	0.00	28.00	0.00
	0	1	0	0	0	1	0
28 12 NOV	28.00	0.00	37.00	48.00	0.00	11.00	25.00
	2	0	1	1	0	1	3
29 19 NOV	0.00	6.00	0.00	60.00	0.00	0.00	0.00
	0	1	0	5	0	0	0
30 26 NOV	25.00	2.00	0.00	6.00	0.00	0.00	0.00
	2	1	0	1	0	0	0
31 3 DEC	0.00	56.00	28.00	7.00	0.00	0.00	0.00
	0	4	1	3	0	0	0
39 28 JAN	0.00	0.00	0.00	0.00	0.00	0.00	2.00
	0	0	0	0	0	0	1
48 1 APR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
49 8 APR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
50 15 APR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0	0	0	0	0	0	0
51 22 APR	0.00	0.00	0.00	0.00	0.00	17.00	0.00
	0	0	0	0	0	1	0
53 30 APR	0.00	0.00	0.00	23.00	0.00	0.00	0.00
	0	0	0	1	0	0	0

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.34:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 2. NAZARE-PUNE
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	83- 84	84- 85	85- 86	XBAR	S.D.	C.V.	M.D.
26 29 OCT	0.00	4.00	0.00:	0.00	0.00	0.00	0.00
	0	1	0:	0.00	0.00	0.00	0.00
27 5 NOV	0.00	30.00	0.00:	0.00	0.00	0.00	0.00
	0	1	0:	0.00	0.00	0.00	0.00
28 12 NOV	0.00	0.00	7.00:	15.60	16.79	107.62	15.12
	0	0	1:	0.90	0.94	104.82	0.72
29 19 NOV	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
30 26 NOV	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
31 3 DEC	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
39 28 JAN	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00
48 1 APR	27.00	24.00	0.00:	0.00	0.00	0.00	0.00
	1	1	0:	0.00	0.00	0.00	0.00
49 8 APR	0.00	5.00	0.00:	0.00	0.00	0.00	0.00
	0	1	0:	0.00	0.00	0.00	0.00
50 15 APR	2.00	0.00	0.00:	0.00	0.00	0.00	0.00
	1	0	0:	0.00	0.00	0.00	0.00
51 22 APR	31.00	0.00	0.00:	0.00	0.00	0.00	0.00
	1	0	0:	0.00	0.00	0.00	0.00
53 30 APR	0.00	0.00	0.00:	0.00	0.00	0.00	0.00
	0	0	0:	0.00	0.00	0.00	0.00

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.35:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
FOR CENTRE: 3. SASWAD-PUNE
1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	80- 81	81- 82	82- 83	83- 84	84- 85	85- 86
RAINFALL	582.20	1081.10	609.50	617.62	688.30	392.76:
DAYS	53	62	56	58	55	47:
1 7 MAY	0.00	0.00	12.00	0.00	0.00	0.00:
	0	0	2	0	0	0:
2 14 MAY	0.00	14.00	0.00	0.00	0.00	9.00:
	0	1	0	0	0	1:
3 21 MAY	0.00	0.00	10.00	0.00	0.00	19.20:
	0	0	1	0	0	1:
4 28 MAY	0.00	0.00	0.00	0.00	0.00	0.00:
	0	0	0	0	0	0:
5 4 JUN	15.00	63.00	47.00	0.00	0.00	0.00:
	1	1	1	0	0	0:
6 11 JUN	57.30	45.00	0.00	0.00	10.20	27.60:
	4	1	0	0	1	2:
7 18 JUN	23.00	85.00	22.00	12.00	54.40	16.00:
	2	4	1	1	5	1:
8 25 JUN	26.00	8.00	14.00	31.20	0.00	33.60:
	5	1	2	5	0	1:
9 2 JUL	35.00	75.00	0.00	0.80	31.80	23.00:
	6	4	0	1	2	3:
10 9 JUL	55.00	147.00	0.00	6.20	62.70	5.60:
	4	5	0	4	5	1:
11 16 JUL	2.50	52.00	8.60	10.40	67.10	0.00:
	2	5	2	2	4	0:
12 23 JUL	0.00	3.00	27.50	25.80	25.40	61.80:
	0	3	6	4	5	4:
13 30 JUL	4.00	21.50	8.00	3.80	3.60	7.40:
	1	3	5	3	1	4:
14 6 AUG	63.00	29.50	12.50	23.20	28.00	49.44:
	7	4	3	7	4	7:
15 13 AUG	8.50	51.50	5.60	51.20	30.60	18.38:
	3	5	2	4	4	4:
16 20 AUG	18.20	4.00	38.40	97.00	0.60	3.00:
	3	2	6	5	1	2:
17 27 AUG	100.00	13.50	18.00	0.00	4.90	2.04:
	4	4	6	0	2	2:
18 3 SEP	0.00	0.00	0.00	3.20	4.60	0.00:
	0	0	0	1	3	0:
19 10 SEP	0.00	88.00	0.00	0.00	0.00	7.60:
	0	4	0	0	0	2:
20 17 SEP	0.00	150.40	8.00	52.60	133.40	0.00:
	0	5	1	5	3	0:
21 24 SEP	42.00	140.40	145.40	82.02	27.80	4.00:
	2	5	5	6	2	1:
22 1 OCT	77.00	0.00	84.00	94.00	112.60	20.80:
	4	0	4	4	3	3:
23 8 OCT	0.00	0.00	0.00	31.00	46.80	66.60:
	0	0	0	3	3	6:
24 15 OCT	0.00	12.00	0.00	0.00	18.00	3.50:
	0	1	0	0	3	1:
25 22 OCT	0.00	0.00	47.20	18.20	3.00	0.00:
	0	0	3	1	1	0:

(Continued)

Table 5.35: (Continued)

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE:3.SASWAD-PUNE
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	80- 81	81- 82	82- 83	83- 84	84- 85	85- 86
26 29 OCT	0.00 0	49.00 1	77.10 3	0.00 0	20.60 2	0.00: 0:
27 5 NOV	0.00 0	24.30 2	0.00 0	0.00 0	2.20 1	0.00: 0:
28 12 NOV	0.00 0	0.00 0	24.20 3	0.00 0	0.00 0	14.20: 1:
29 19 NOV	22.70 3	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
34 24 DEC	29.00. 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
46 18 MAR	4.00 1	0.00 0	0.00 0	0.00 0	0.00 0	0.00: 0:
48 1 APR	0.00 0	0.00 0	0.00 0	37.00 1	0.00 0	0.00: 0:
49 8 APR	0.00 0	0.00 0	0.00 0	38.00 1	0.00 0	0.00: 0:
52 29 APR	0.00 0	5.00 1	0.00 0	0.00 0	0.00 0	0.00: 0:

ONLY FOR THE WEEKS REPORTING RAINFALL
 WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

Table 5.E6:

WEEKLY TOTAL RAINFALL & NO OF RAINY DAYS & VARIATION
 FOR CENTRE: 3. SASWAD-PUNE
 1ST LINE RAINFALL (IN MM) 2ND LINE NO OF RAINY DAYS

WEEK ENDING	XBAR	S.D.	C.V.	M.D.
1 7 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
2 14 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
3 21 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
4 28 MAY	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
5 4 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
6 11 JUN	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
7 18 JUN	35.40	26.07	73.65	22.87
	2.33	1.60	68.51	1.44
8 25 JUN	18.80	12.37	65.79	11.47
	2.33	1.97	84.52	1.78
9 2 JUL	27.60	25.23	91.43	19.67
	2.67	1.97	73.95	1.67
10 9 JUL	46.08	51.47	111.68	42.15
	3.17	1.95	61.60	1.78
11 16 JUL	23.43	26.14	111.55	24.08
	2.50	1.61	64.29	1.33
12 23 JUL	23.92	20.26	84.72	14.94
	3.67	1.89	51.43	1.44
13 30 JUL	8.05	6.27	77.84	4.48
	2.83	1.46	51.62	1.22
14 6 AUG	34.27	16.90	49.32	14.63
	5.33	1.70	31.87	1.67
15 13 AUG	27.63	18.58	67.24	16.80
	3.67	0.94	25.71	0.78
16 20 AUG	26.87	33.93	126.31	27.22
	3.17	1.77	55.95	1.56
17 27 AUG	23.07	34.98	151.59	25.64
	3.00	1.91	63.83	1.67
18 3 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
19 10 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
20 17 SEP	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
21 24 SEP	73.60	54.20	73.64	49.00
	3.50	1.89	54.08	1.83
22 1 OCT	64.73	40.39	62.40	36.22
	3.00	1.41	47.14	1.00
23 8 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
24 15 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00
25 22 OCT	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

CHAPTER VI

SUMMARY AND CONCLUDING REMARKS

1. The study mainly deals with the subjective and objective evaluations of utilisation of kharif irrigation potential in order to identify the main factors responsible for particularly low utilisation of kharif irrigation potential in respect of schemes from different agro-climatic and rainfall zones in Maharashtra. Five such agro-climatic zones are identified in consultation with the Department of Irrigation, Government of Maharashtra, for this purpose, and one scheme each from the five said zones is selected for detailed study. The purpose of enlisting irrigation schemes from different agro-climatic zones of the State is to ensure the inclusion of different rainfall patterns which are likely to have impact on utilisation of kharif irrigation potential differently in different zones. In other words, it is expected that each scheme so selected from a zone is representative of the schemes in that zone.

2. Before we go into the main findings of the study it would be instructive to make a few observations about the representative nature of the schemes mentioned earlier. It may not be necessarily correct to say that each of the five schemes selected for study is representative of the schemes in a given agro-climatic zone. This may be particularly true of the scheme selected from very heavy rainfall zone of Raigad

district. The scheme selected from this zone is a minor irrigation scheme and is located around the ghat section connecting Pune with Bombay. The agro-climatic conditions in respect of this scheme cannot be said to be similar to those prevailing in the coastal area of Konkan region, although the rainfall is very heavy like in the entire Konkan region. Similarly, to a lesser extent, the schemes selected from other agro-climatic zones may not in every respect be representative schemes of the respective zones and to that extent there is limitation in generalising the findings of the study.

3. As mentioned earlier, the study pertains to the evaluation of the factors responsible for particularly low utilisation of kharif irrigation potential, but, in order to do that it is necessary to examine the extent of utilisation in rabi and hot weather seasons also. The necessity for doing so arises not only because a comparative picture of the extent of utilisation in each season is to be presented with a view to see if the same is particularly low in kharif season, but also because release of water for kharif irrigation is very much conditional to the stipulated requirements of water storage for rabi and hot-weather irrigation.

4. The extent of utilisation has been measured in two ways, one by comparing the area actually irrigated with area proposed to be irrigated and the other by water actually released with the water proposed to be released. Our estimates by both the methods show that the extent of utilisation is

particularly low in kharif season in all the agro-climatic zones except in the high rainfall zone represented by a medium irrigation scheme in Chandrapur district.

5. The extent of utilisation in this zone of high rainfall is around 95 per cent in kharif. Paddy is the only crop grown in kharif and the irrigators get full protective irrigation for this crop during two and half months from the middle of August to the end of October under a long term agreement. The subjective evaluation and the objective evaluation clearly show that the demand for water by the irrigators and its periodicity and the supply of water through the distribution system and its periodicity match very well. The irrigators depend on rainfall for the sowing and transplantation of paddy and also for initial growth of crop upto mid-August or so and thereafter demand water when the rain begins to recede and dry spells begin to appear. This observation based on the opinion survey of the irrigators is also borne out by the objective evaluation of rainfall data and the dates of release of water for kharif irrigation. The objective of providing protective irrigation to monsoon crop, mainly paddy, is largely fulfilled.

6. The main crop grown in this zone is paddy, even the second crop grown in fair weather (rabi + hot weather) is paddy. Over the last 50 years or so the irrigation development has taken place in such a way that only paddy is suitable in this zone; soil is also not suitable for growing any other crop. Balance of water, if available, is used for providing irriga-

tion to summer paddy and a part of it is also carried forward for providing irrigation for the sowing and transplanted of paddy in the next monsoon season in case the monsoon is delayed.

7. In the heavy rainfall zone represented by a minor irrigation scheme in Raigad district there is absolutely no utilisation of water for kharif irrigation. There is no demand for water from the irrigators during the monsoon season and as such there is no supply either from the distribution system. The issue of not utilising irrigation water for kharif crop seems to mainly arise from the demand factors.

8. The subjective evaluation based on the opinion survey of the irrigators indicate that there is no demand for irrigation during kharif season because of adequate and well distributed rainfall. The objective evaluation of the rainfall data from the command area of the scheme also shows that the rainfall is heavy and fairly well distributed every year. Although in some years short dry spells appear in between the season, the irrigators manage to take care of those short dry spells by providing accumulated water from Nalas to the low lying paddy fields.

9. The irrigators tend to concentrate their attention to the irrigated paddy cultivation in the non-monsoon season called Konkan-Hangam extending from November to April. The canal authorities also accordingly concentrate their distribution programme during this period to meet the irrigators' demand. It is reported that yield of paddy grown in Konkan

Hangam with irrigation is 50 to 60 per cent higher than grown in monsoon season, hence the irrigators concentrate their resources and attention to growing paddy in this season.

10. Balance of live storage at the end of the irrigation every year indicates the possibility of providing water for early sowing of kharif paddy so that the irrigators do not have to depend upon the monsoon for sowing but, the objective evaluation suggests that this would be possible only if the irrigators agree to raise paddy seedlings in the contiguous blocks mainly in the upper reaches of the distribution system. Early beginning of kharif season would also ensure timely sowing of crops in the following seasons.

11. As the situation exists paddy seems to be the only crop suitable in this zone. The irrigation provided is field to field irrigation during the non-monsoon season. During monsoon season there is likely to be demand for water during the dry spells in the first fortnight of June and in the month of October. It is possible to supply water during these periods of dry spells by proper water planning as the balance of live storage is seen to be remaining unused. This would certainly improve the productivity of kharif paddy. What is needed is to convince the irrigators of the utility of such irrigation along with an assurance that their demand for water in Konkan Hangam would not be affected because of this.

12. The present system of field to field irrigation leads to considerable loss in transmission and distribution.

Irrigation through well laid out field channels is not possible because of heavy downpour which destroys the field channels during the monsoon season. A change in the crop mix to growing long duration perennial cash crops like coconut, arecanut, etc., in addition to the staple crop of paddy to give boost to the agricultural economy of the command area requires a change in the design of the entire distribution system. Controlled water distribution required for this change would involve laying down water pipes lines for irrigation.

13. In respect of the assured rainfall zone represented by a medium irrigation scheme in Akola district, less assured rainfall zone represented by a medium irrigation scheme in Jalgaon district and scarcity zone represented by a medium irrigation scheme in Pune district the extent of utilisation is particularly low in kharif season.

14. As is evident from the subjective evaluation based on the opinion survey of the irrigators, there is hardly any demand for water from the irrigators for irrigating kharif crops. The main reason assigned for such a state of affair is the uncertain unpredictable and inadequate supply of canal water from the distribution system. It is not as if the irrigators do not need irrigation water during the kharif season. The irrigators are quite aware of the adverse impact of the long and short dry spells on the standing kharif crops.

But they are of the opinion that even if they resort to kharif irrigation (i.e. demand irrigation water for kharif crops) the supply from the distribution system is so uncertain and unpredictable, particularly during the dry spells, that crop output gets affected adversely anyway. Further, they opine that with such an uncertain supply if they have to pay irrigation charges for the entire season and sometimes for two seasons, if the watering for kharif crops extends over to rabi season, they would rather not demand water for kharif irrigation.

15. Most of the irrigators mention that increasing number of irrigators would resort to kharif irrigation if irrigation water is provided for early sowing of kharif crops and also if the timely supply of adequate quantity of water during dry spells is fully ensured. However, at the same time they also mention that they would not like the supply of canal water to get adversely affected in rabi season because of this change. This is particularly the opinion of the irrigators in the scarcity zone of the state where traditionally rabi crops enjoy more importance.

16. There is a clear correspondence between the main reason given by the irrigators and the reason arising out of the analysis of secondary data collected from the official records. Analysis of the rainfall data show that there are considerable variations in the amount of precipitation and in number of rainy days in a month and that there are periods of long and

short dry spells during the kharif season when the standing kharif crops need watering. Analysis of the data on water content in the reservoir indicates that the possibility of supply of water for early sowing in kharif (premonsoon) and during the long and short dry spells is remote particularly after meeting the full water requirements of rabi and hot-weather seasons. This would naturally lead to uncertain and inadequate supply of water during kharif season from the distribution system.

17. In respect of assured rainfall zone, the monsoon generally sets in by the 3rd week of June, it is concentrated in the months of July and first 2 to 3 weeks of August and starts receding from the end of August. There are very few short dry spells during this period. Rainfall during the months of September and the first 2 weeks of October seems to be erratic, irregular and insufficient. Standing kharif crops, mainly hybrid jowar and cotton, would need irrigation in these months during the dry spells (at least 3 waterings). Water planning and distribution mechanism should be such that it should be possible to supply required quantity of water during these periods as part of protective irrigation. The storage requirement for kharif is estimated to be only 2.30 Mm^3 in respect of the particular scheme under study (Chapter II, page 24) when the total water requirement for kharif crops is estimated to be 11.53 Mm^3 (Chapter III, page 51). Actual release of water varies between 0.22 Mm^3 and 2.83 Mm^3 during

different years (Chapter III, page 52). This seems to be on the lower side if the entire kharif potential created is to be given protective irrigation.

18. The balance of storage available at the end of irrigation season in most of the years is hardly more than the dead storage required to be maintained in the reservoir, hence there is remote possibility of providing water to the irrigators for early sowing of kharif crops under the existing set up. There seems to be a trade off between making irrigation water available for early kharif sowing along with protective irrigation during dry spells and allowing for full irrigation provision for rabi and hot weather season crops.

19. Similarly, in the scarcity zone of the Western Maharashtra, the monsoon generally sets in by the middle of June and is spread over three and half months upto end of September. A few showers also occur during October and even in early November. Long and short dry spells occur almost every year during the months of July and August. Standing kharif crops, mainly bajra, groundnut, cotton and vegetables would require irrigation (around 3 waterings) during these periods of dry spell. Water planning and distribution should be so organised as to meet the requirement of water during these periods as part of protective irrigation. The storage requirement for kharif is estimated to be only 1.46 Mm^3 of water when the total water requirement for kharif season is estimated to be 7.30 Mm^3 in respect of the particular scheme

under study in this zone (Chapter II, page 30). Actual release during different years is even lower than that, around 1 Mm³ (Chapter III, page 81). This seems to be very much on the lower side considering the amount of precipitation and its distribution, if the entire kharif potential created is to be given protective irrigation.

20. Balance of storage available at the end of irrigation year in 4 out of 9 years is adequate only to meet the dead storage required to be maintained in the reservoir; in other years the live storage remaining unused varies between 2 Mm³ and 5 Mm³. Therefore there does not seem to be any assurance of supply of water to the irrigators for early sowing of kharif crops and also to meet the full water requirement for protective irrigation during dry spells in kharif season.

21. It may also be noted that although no provision was made for hot-weather irrigation in the project water planning, in actual practice water is being released for hot-weather crops perhaps at the cost of irrigation in kharif season. This policy is contrary to the objective of providing protective irrigation particularly in scarcity zone.

22. In respect of less assured rainfall zone, the monsoon normally appears to break in the 2nd or 3rd week of June every year and continues up the middle of October. But, there occurs a number of dry spells, short and long, during almost every month. Standing kharif crops mainly hybrid jowar and bajra, would need irrigation during these dry

spells (at least 3 waterings). Water planning and distribution should be geared towards meeting the water requirement during the dry spells in kharif season. For illustration purposes it may be noted that in respect of the scheme under study from this zone the storage requirement for kharif season irrigation is estimated to be 3.30 Mm^3 when the total water requirement for kharif season crops is estimated to be 16.17 Mm^3 (Chapter II, page 27). Actual release during different years varies between 3.39 Mm^3 and 0.82 Mm^3 except the first two years (Chapter III, page 56). This seems to be very much on the lower side to provide protective irrigation to the entire kharif potential created, particularly considering the amount of precipitation and its distribution during the rainy season every year.

23. Balance of storage available at the end of irrigation every year is 5 Mm^3 to 13 Mm^3 more than the dead storage required to be maintained in the reservoir. This unused surplus live storage can conveniently be used for providing irrigation to early sown kharif crops along with providing protective irrigation during the dry spells. This should be possible even after meeting the full water requirement of rabi season and hot-weather season, although hot-weather season irrigation was not provided for in the project cropping pattern.

24. The above observations clearly indicate that particularly low utilisation of irrigation potential in kharif

season in the assured rainfall zone, less assured rainfall zone and scarcity zone of the State mainly arises out of supply constraint. Lack of demand for irrigation water by the irrigators in these zones are rooted into the uncertain and inadequate supply of water from the distribution system during dry spells and also into the general practice of not supplying water for early sowing (pre-monsoon) of kharif crops.

25. Under the existing set up the main concern of the irrigation system in these zones seems to be assuring water supply during fair weather, particularly during rabi season. As a matter of fact, over the years the practice of releasing water for hot weather cash crops, mainly groundnut, is gaining importance, presumably as a result of pressure from the relatively better off farmers from the head reaches and middle reaches of the distribution system. This practice is most likely to restrict the possibility of providing irrigation water for early kharif sowing.

26. It seems there is a trade off between growing early sown kharif crops with protective irrigation and growing hot weather crops. It may be instructive to note that the main crops grown in these zones in kharif are foodgrain crops, like hybrid jowar, bajra, etc., and cotton in some areas, where as the main crop grown in hot weather under irrigation is a very important cash crop like groundnut. Hot weather groundnut is reported to be very high yielding crop and is also reported to be highly profitable. Available water released

for hot weather irrigation is enough only to meet the requirement of a small proportion of the entire irrigable command area, that too in the upper reaches of the main distribution system, presumably dominated by the better off farmers having considerable say in actual water distribution.

27. In the heavy rainfall zone of the State on the other hand, virtual absence of kharif season irrigation mainly arises out of the demand factors. The available evidence suggests no supply constraint even for early kharif sowing. Under the existing set up and the type of irrigation development that has taken place over the year paddy is the most suitable crop to be grown year round. The irrigators are quite convinced that there is no need for irrigation in kharif because of adequate and well distributed rainfall. Entire demand for water is concentrated in fair weather.

28. The practice of irrigation over the years has inadvertently developed in tune with this demand pattern and the whole effort in water distribution is concentrated during fair weather. Farmers need to be convinced of the utility of irrigating standing paddy crop during dry spells which do occur every year during the monsoon season.

29. Under the existing situation the practice followed is field to field irrigation which naturally leads to considerable loss in distribution and transmission. Possibility of creating demand for kharif irrigation and also of improving the over all irrigation efficiency may be explored by attempting on an

experimental basis the introduction of long duration perennial cash crops like cocoanut, arecanut, etc., in addition to the staple foodgrain crop like paddy. This would require considerable change in the design and in the organisation of the distribution net work.

30. The irrigation systems created and designed to provide protective irrigation, particularly in assured rainfall zone less assured rainfall zone and scarcity zone are also being required to fulfil the requirement of high intensity productive irrigation. A conflict in objectives under such a situation naturally arises. These ought to be examined in proper perspective in order to achieve a higher level of irrigation efficiency along with the equitable distribution of water from the irrigation systems.

APPENDIX:1

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:1, RAIGAD

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
*TOT-DSCHRG	3.36204	3.53637	2.48955	1.00776	3.19620	3.25959 :
TOT-OVRFLW	3.44468	3.59212	5.72283	4.55460	7.75081	6.67484 :
1 7 MAY	0.89000 0.12311 0.00000	0.22100 0.28187 0.00000	0.24100 0.00000 0.00000	0.54300 0.00000 0.00000	0.87500 0.00000 0.00000	0.47300 0.07415 0.00000 :
2 14 MAY	0.73000 0.06198 0.00000	0.15800 0.24621 0.00000	0.19600 0.03990 0.00000	0.47300 0.00000 0.00000	0.84800 0.00000 0.00000	0.43700 0.00000 0.00000 :
3 21 MAY	0.70000 0.00000 0.00000	0.15400 0.00000 0.00000	0.18700 0.00000 0.00000	0.42500 0.00000 0.00000	0.82900 0.00000 0.00000	0.41300 0.00000 0.00000 :
4 28 MAY	0.65000 0.00000 0.00000	0.15400 0.00000 0.00000	0.18100 0.00000 0.00000	0.36900 0.00000 0.00000	0.78600 0.00000 0.00000	0.40100 0.00000 0.00000 :
5 4 JUN	0.55000 0.05490 0.00000	0.15400 0.00000 0.00000	0.17800 0.00000 0.00000	0.25300 0.00000 0.00000	0.76900 0.00000 0.00000	0.37900 0.00000 0.00000 :
6 11 JUN	0.50000 0.02689 0.00000	0.44300 0.00000 0.00000	0.15400 0.02406 0.00000	0.20800 0.00000 0.00000	0.70300 0.00000 0.00000	0.17200 0.13244 0.00000 :
7 18 JUN	0.42000 0.07669 0.00000	0.72000 0.00000 0.00000	0.15400 0.00000 0.00000	0.21300 0.00000 0.00000	0.69500 0.00000 0.00000	0.48500 0.00000 0.00000 :
8 25 JUN	0.47000 0.00000 0.00000	1.90000 0.00000 0.00000	0.27700 0.00000 0.00000	1.03000 0.00000 0.00000	1.29000 0.00000 0.00000	0.59800 0.00000 0.00000 :
9 2 JUL	1.09000 0.00000 0.00000	3.47000 0.00000 0.00000	1.86000 0.00000 0.00000	1.10000 0.00000 0.00000	1.74000 0.00000 0.00000	1.28000 0.00000 0.00000 :
10 9 JUL	1.74000 0.00000 0.00000	4.37000 0.00000 0.61949	4.34000 0.00000 0.00000	1.31000 0.00000 0.00000	2.01000 0.00000 0.00000	4.37000 0.00000 0.39846 :
11 16 JUL	2.09000 0.00000 0.00000	4.34000 0.00000 0.11999	4.41000 0.00000 0.48959	1.52000 0.00000 0.00000	2.75000 0.00000 0.00000	4.54000 0.00000 0.35913 :
12 23 JUL	2.56000 0.00000 0.00000	4.37000 0.00000 0.08999	4.44000 0.00000 0.55949	3.47000 0.00000 0.00000	4.44000 0.00000 0.32970	4.37000 0.00000 0.94211 :
13 30 JUL	4.41000 0.00000 0.06990	4.41000 0.00000 0.39960	4.37000 0.00000 0.62939	4.22000 0.00000 0.00000	4.41000 0.00000 0.57647	4.41000 0.00000 0.49836 :
14 6 AUG	4.44000 0.00000 1.16879	4.44000 0.00000 0.75929	4.41000 0.00000 0.65939	4.37000 0.00000 0.21989	4.47000 0.00000 0.60704	4.47000 0.00000 0.34922 :
15 13 AUG	4.41000 0.00000 0.51931	4.37000 0.00000 0.27989	4.37000 0.00000 0.37979	4.51000 0.00000 0.43780	4.77000 0.00000 1.37878	4.47000 0.00000 0.42790 :
16 20 AUG	4.34000 0.00000 0.22980	4.35000 0.00000 0.18961	4.41000 0.00000 0.41969	4.44000 0.00000 1.03889	4.37000 0.00000 1.52735	4.41000 0.00000 0.36733 :
17 27 AUG	4.28000 0.00000 0.00000	4.37000 0.00000 0.24932	4.37000 0.00000 0.34979	4.41000 0.00000 0.76806	4.41000 0.00000 0.28866	4.41000 0.00000 0.63760 :
18 3 SEP	4.28000 0.00000 0.00000	4.37000 0.00000 0.22893	4.34000 0.00000 0.29941	4.37000 0.00000 0.36733	4.37000 0.00000 0.39790	4.41000 0.00000 0.32800 :

APPENDIX: 1

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

235

FOR SCHEME: 1. RAIGAD

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
19 10 SEP	4.28000	4.35000	4.34000	4.41000	4.37000	4.41000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.00000	0.15905	0.00000	0.46780	0.28866	0.43724 :
20 17 SEP	4.57000	4.35000	4.41000	4.34000	4.41000	4.41000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.24989	0.13867	0.26970	0.29800	0.24932	0.73750 :
21 24 SEP	4.44000	4.34000	4.44000	4.37000	4.41000	4.34000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.71741	0.07924	0.65939	0.43837	0.36733	0.33734 :
22 1 OCT	4.37000	4.35000	4.37000	4.41000	4.41000	4.41000 :
	0.00000	0.00000	0.00000	0.06934	0.00000	0.00000 :
	0.42959	0.17942	0.37979	0.45846	0.89202	0.30734 :
23 8 OCT	4.31000	4.34000	4.35000	4.34000	4.47000	4.37000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.06000	0.09962	0.14886	0.06000	0.38856	0.28866 :
24 15 OCT	4.28000	4.31000	4.35000	4.25000	4.27000	4.34000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.39931	0.00000	0.45903	0.25866 :
25 22 OCT	4.34000	4.28000	4.34000	4.28000	4.34000	4.31000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.07924	0.00000	0.00000	0.00000 :
26 29 OCT	4.28000	4.25000	4.28000	4.25000	4.31000	4.25000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000 :

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE & OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW
FOR SCHEME:2.PUNE-NAZARE1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW
ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
*TOT-DSCHRG	8.29920	9.02777	7.93973	6.54423	6.86722	6.54139
TOT-OVRFLW	111.89300	6.81747	0.00000	8.45527	1.00450	0.10003
1 7 MAY	12.11240 0.15840 0.00000	8.26360 0.59321 0.00000	7.95230 0.33600 0.00000	8.20700 0.07934 0.00000	11.60300 0.00000 0.00000	9.43635 0.34003 0.00000
2 14 MAY	11.77280 0.14400 0.00000	8.02305 0.22442 0.00000	7.89570 0.16800 0.00000	7.92400 0.10814 0.00000	11.40490 0.27482 0.00000	9.01185 0.29923 0.00000
3 21 MAY	11.30590 0.29040 0.00000	7.78250 0.14962 0.00000	7.83910 0.16800 0.00000	7.88155 0.00000 0.00000	11.26340 0.03696 0.00000	8.48887 0.44256 0.00000
4 28 MAY	10.83890 0.40800 0.00000	7.11745 0.51252 0.00000	9.31070 0.07200 0.00000	7.81080 0.00000 0.00000	10.95210 0.10836 0.00000	8.00777 0.19430 0.00000
5 4 JUN	10.35780 0.45840 0.00000	6.89105 0.04800 0.00000	10.27290 0.09600 0.00000	7.27310 0.09072 0.00000	10.61250 0.20587 0.00000	7.68062 0.04858 0.00000
6 11 JUN	16.23400 0.00000 15.13610	6.74955 0.12000 0.00000	9.96160 0.16800 0.00000	7.07500 0.01296 0.00000	10.86720 0.00000 0.00000	7.21876 0.36502 0.00000
7 18 JUN	16.15930 0.12240 0.51120	7.58440 0.21120 0.00000	9.84840 0.04800 0.00000	7.01840 0.00000 0.00000	10.78230 0.00000 0.00000	7.69987 0.05690 0.00000
8 25 JUN	16.45790 0.20640 0.54415	13.51330 0.00000 0.00000	9.93330 0.00000 0.00000	6.70710 0.06730 0.00000	10.64080 0.00000 0.00000	8.41416 0.04858 0.00000
9 2 JUL	16.45790 0.00000 7.66716	14.23490 0.00000 0.00000	9.84840 0.28800 0.00000	6.22600 0.07200 0.00000	10.58420 0.00000 0.00185	7.50742 0.24288 0.00490
10 9 JUL	16.23400 0.12240 2.10682	16.45790 0.00000 0.00000	9.25410 0.67920 0.00000	5.71660 0.00000 0.00000	16.15930 0.04039 0.00000	9.89708 0.00000 0.00000
11 16 JUL	16.45790 0.09600 10.16570	16.23400 0.17280 0.00000	8.97110 0.16080 0.00000	5.66198 0.00000 0.00000	16.15930 0.04039 0.00598	16.15930 0.06732 0.00000
12 23 JUL	16.46070 0.09600 6.48091	16.15930 0.23040 0.00000	8.85790 0.02400 0.00000	5.63312 0.00000 0.00000	16.15930 0.00000 0.01754	16.15930 0.09425 0.01831
13 30 JUL	16.45790 0.14400 2.25494	16.15930 0.00000 0.00000	8.20700 0.43200 0.00000	5.80292 0.00000 0.00000	16.04610 0.00000 0.00000	16.15930 0.08078 0.00835
14 6 AUG	17.01740 0.00000 43.82880	16.30840 0.00000 0.87038	7.82495 0.10800 0.00000	6.19770 0.00000 0.00000	16.15930 0.38645 0.00000	16.15930 0.00000 0.00000
15 13 AUG	16.45790 0.00000 7.42541	16.30840 0.11520 0.87161	7.81080 0.00000 0.00000	12.84820 0.00000 0.00000	16.15930 0.09425 0.01344	16.15930 0.05386 0.00598
16 20 AUG	16.30840 0.14400 2.87654	16.15930 0.00000 0.80746	7.83910 0.00000 0.00000	15.42350 0.00000 0.00000	16.15930 0.09425 0.00000	16.15930 0.00000 0.01870
17 27 AUG	16.23400 0.18240 1.33704	16.15930 0.00000 0.00000	8.65980 0.19200 0.00000	15.70790 0.00000 0.00883	16.15930 0.79414 0.00000	16.15930 0.00000 0.00000
18 3 SEP	16.45790 0.00000 1.66241	16.23400 0.10800 0.08520	12.31030 0.04800 0.00000	16.15930 0.03118 0.00576	16.15930 0.14364 0.00000	16.15930 0.02486 0.01253

APPENDIX:2

237

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:2.PUNE-NAZARE

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
19 10 SEP	16.30840	16.23400	13.86700	16.15930	16.15930	16.15930
	0.24000	0.07200	0.00000	0.00000	0.06732	0.05386
	2.56577	0.89146	0.00000	0.00000	0.00149	0.01572
20 17 SEP	16.30840	16.15930	12.80580	16.15930	16.15930	16.15930
	0.00000	0.07200	0.25440	0.58224	0.00000	0.17578
	1.63330	0.00000	0.00000	0.00000	0.01435	0.00000
21 24 SEP	16.45790	15.73480	14.23490	16.15930	16.15930	16.15930
	0.19200	0.30240	0.11040	0.47441	0.07632	0.81734
	1.33704	0.00000	0.00000	0.00000	0.00000	0.00000
22 1 OCT	16.30840	15.59330	14.65940	16.15930	16.15930	16.15930
	0.14400	0.00000	0.00000	1.91232	0.71057	0.20047
	1.94412	0.00000	0.00000	0.00000	0.00000	0.00000
23 8 OCT	16.23400	16.23400	14.91410	16.15930	16.15930	16.15930
	0.00000	0.00000	0.00000	0.16843	0.24569	0.01346
	1.33704	0.08520	0.00000	0.00000	0.00000	0.01555
24 15 OCT	16.15930	16.15930	14.88580	16.15930	16.15930	16.15930
	0.14400	0.00000	0.00000	0.08093	0.08078	0.00000
	0.08520	1.03308	0.00000	0.15600	0.16985	0.00000
25 22 OCT	15.76310	15.93290	14.80090	16.15930	16.15930	16.15930
	0.34800	0.36000	0.21600	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	1.09200	0.15600	0.00000
26 29 OCT	15.21120	15.67820	14.91410	16.15930	16.10270	16.15930
	0.42000	0.07200	0.14400	0.05690	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE & OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

APPENDIX:2

238

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW
FOR SCHEME:2.PUNE-NAZARE1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW
ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	82- 83	83- 84	84- 85
*TOT-DSCHRG	7.28993	6.90415	7.28021 :
TOT-OVRFLW	1.77281	0.23760	4.62487 :
1 7 MAY	8.98695 0.37015 0.00000	7.58440 0.17071 0.00000	7.08575 : 0.00000 : 0.00000 :
2 14 MAY	8.81262 0.00000 0.00000	7.31498 0.17071 0.00000	6.69974 : 0.24288 : 0.00000 :
3 21 MAY	8.48887 0.19430 0.00000	7.06821 0.00000 0.00000	6.52428 : 0.00000 : 0.00000 :
4 28 MAY	7.98852 0.24288 0.00000	6.82256 0.17071 0.00000	6.32845 : 0.00000 : 0.00000 :
5 4 JUN	8.83752 0.00000 0.00000	6.50674 0.16843 0.00000	6.10657 : 0.10925 : 0.00000 :
6 11 JUN	8.28964 0.24288 0.00000	6.38306 0.00000 0.00000	5.91866 : 0.06360 : 0.01440 :
7 18 JUN	7.83457 0.19430 0.00000	6.27864 0.00000 0.00000	6.00385 : 0.00000 : 0.00000 :
8 25 JUN	7.75760 0.00000 0.00000	6.20874 0.00000 0.00000	5.88470 : 0.00000 : 0.00000 :
9 2 JUL	7.48818 0.09715 0.00835	6.08931 0.00000 0.00000	5.69679 : 0.00000 : 0.00000 :
10 9 JUL	8.29020 0.00000 0.02506	5.90168 0.00000 0.00000	6.68220 : 0.00000 : 0.00000 :
11 16 JUL	6.69974 0.00000 0.01056	5.85046 0.00000 0.00000	7.83457 : 0.00000 : 0.02765 :
12 23 JUL	6.43655 0.00000 0.01284	5.76528 0.00000 0.00000	10.49550 : 0.00000 : 0.00461 :
13 30 JUL	6.31373 0.00000 0.00000	5.69679 0.00000 0.00000	11.55320 : 0.00000 : 0.00000 :
14 6 AUG	6.22600 0.00000 0.00000	0.00000 0.00000 0.00000	12.44970 : 0.00000 : 0.03446 :
15 13 AUG	6.15751 0.00000 0.00000	6.20874 0.00000 0.00000	13.94170 : 0.00000 : 0.03583 :
16 20 AUG	6.08931 0.00000 0.00000	8.09946 0.00000 0.00000	15.99540 : 0.00000 : 0.00000 :
17 27 AUG	6.10657 0.00000 0.00000	8.83866 0.00000 0.00000	16.15930 : 0.00000 : 0.00000 :
18 3 SEP	6.07233 0.00000 0.00000	8.88847 0.00000 0.00000	16.07720 : 0.00000 : 0.02232 :

APPENDIX:2

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW
FOR SCHEME:2.PUNE-NAZARE

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW
ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	82- 83	83- 84	84- 85
19 10 SEP	5.95291	8.68923	15.96930 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
20 17 SEP	5.71405	9.39560	16.15930 :
	0.00000	0.00000	0.50064 :
	0.00000	0.13440	0.00000 :
21 24 SEP	14.58360	10.49930	16.15930 :
	0.00000	0.44902	0.17875 :
	0.00000	0.00000	0.00000 :
22 1 OCT	14.62910	10.49930	16.15930 :
	0.75890	0.34826	0.67654 :
	0.00000	0.00000	0.00000 :
23 8 OCT	14.62910	10.49930	16.15930 :
	0.15108	0.09425	0.29407 :
	0.00000	0.00000	0.00000 :
24 15 OCT	16.15930	16.15930	16.15930 :
	0.01344	0.04039	0.17957 :
	0.00000	0.00000	0.15600 :
25 22 OCT	16.15930	16.15930	16.15930 :
	0.04858	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
26 29 OCT	16.15930	16.15930	16.15930 :
	0.00000	0.23477	0.00000 :
	0.93600	0.00000	1.63680 :

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE AND OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:3.JALGAON-MANYAD DAM

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
*TOT-DSCHRG	74.23210	36.84240	30.51650	49.31380	68.34120	57.88210
TOT-OVRFLW	0.00000	0.00000	0.00000	4.78265	19.00090	0.00000
1 7 MAY	27.27330	18.28180	18.32280	14.26320	26.80010	26.48880
	1.97858	1.15522	0.15403	0.25200	1.35840	3.15926
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2 14 MAY	26.85900	16.83850	17.60680	13.89530	24.93230	25.07380
	0.48955	2.20068	0.90554	0.16800	3.33852	1.85976
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3 21 MAY	25.54610	15.62160	16.61210	13.49910	23.43240	23.57390
	1.59007	0.81583	0.86678	0.00000	2.95932	3.16834
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4 28 MAY	24.13680	14.91410	15.96120	12.87650	21.87590	22.15890
	2.13281	1.91594	0.36504	0.33600	2.33388	2.01108
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5 4 JUN	23.00480	14.05100	15.48010	12.50860	20.71560	21.11180
	1.63140	1.00673	0.83311	0.08400	1.15200	2.64014
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6 11 JUN	23.65430	13.52740	15.28200	12.42370	21.22500	19.32890
	0.58426	0.98050	0.00000	0.33600	0.26640	2.23771
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7 18 JUN	23.24650	13.01800	24.90630	12.22560	21.62120	17.48940
	1.05845	0.88337	0.00000	0.00000	0.00000	1.92072
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8 25 JUN	27.68730	18.73460	26.88500	13.38590	22.64000	17.26300
	2.16334	0.00000	0.00000	0.16800	0.00000	1.38785
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9 2 JUL	32.14310	19.27230	26.48880	13.72550	22.64000	17.23470
	0.00000	0.00000	0.40745	0.00000	0.00000	0.12480
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10 9 JUL	33.59210	19.27230	26.80860	13.72550	22.64000	17.23470
	1.56761	0.00000	0.00000	0.00000	0.32640	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11 16 JUL	33.85100	18.96100	27.02650	15.33860	22.49850	17.20640
	0.33869	0.24067	0.00000	0.00000	0.32640	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12 23 JUL	33.84850	21.67780	26.60200	15.33860	21.62120	17.14980
	0.42878	0.15422	0.80105	0.00000	2.11298	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13 30 JUL	34.24020	22.07400	26.31900	27.02650	20.03640	17.43280
	1.06135	0.00000	0.75667	0.00000	2.23826	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14 6 AUG	37.07810	21.67780	24.90400	32.79970	19.47040	17.54600
	0.37666	0.81026	1.85482	0.00000	1.18080	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15 13 AUG	39.21280	20.97740	23.63050	43.07260	19.47040	17.94220
	1.11216	1.50346	1.70880	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16 20 AUG	38.86580	20.62820	22.64000	47.37420	39.50680	18.19690
	1.05931	0.97858	1.56480	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17 27 AUG	42.85780	20.03640	21.67780	48.25150	54.59070	18.22520
	0.91349	1.56451	0.72960	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	1.12565	0.00000
18 3 SEP	48.18240	21.93250	23.54560	51.30790	54.53410	18.36670
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	3.26165	0.00000

APPENDIX:3

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW
 FOR SCHEME:3.JALGADN-MANYAD DAM
 1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW
 ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
19 10 SEP	49.99620	22.84060	24.30970	51.64750	54.47750	18.87610
	1.19880	0.00000	0.00000	0.08400	0.67200	0.25440
	0.00000	0.00000	0.00000	0.00000	4.32240	0.00000
20 17 SEP	50.36860	22.01230	24.45120	54.74970	54.36430	24.76250
	0.19152	1.30198	0.67169	0.36480	1.71360	1.59996
	0.00000	0.00000	0.00000	3.06984	2.15520	0.00000
21 24 SEP	49.99620	20.64630	23.71540	57.10940	54.59070	34.78070
	1.19640	1.02326	2.76499	0.00000	0.65280	0.00000
	0.00000	0.00000	0.00000	1.71281	1.91040	0.00000
22 1 OCT	49.22930	21.24370	23.26260	54.64730	54.47750	37.38430
	0.52541	1.16539	0.99667	0.00000	1.58400	0.19282
	0.00000	0.00000	0.00000	0.00000	2.99040	0.00000
23 8 OCT	48.99580	21.46700	24.05500	54.59070	54.10960	38.31820
	0.34570	0.00000	0.40214	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	2.35680	0.00000
24 15 OCT	48.46290	21.18090	23.20600	54.59070	53.91150	38.12010
	0.46267	0.33619	1.54294	0.34080	0.46080	0.89165
	0.00000	0.00000	0.00000	0.00000	0.87840	0.00000
25 22 OCT	48.23900	21.10810	23.20600	54.59070	53.82660	38.20500
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
26 29 OCT	48.23760	20.99920	23.20600	54.59070	53.71340	38.20500
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE & OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

WEEK ENDING WATER CONTENT; WEEKLY DISCHARGE & OVERFLOW
 FOR SCHEME:3, JALGAON-MANYAD DAM
 1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW
 ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	B2- B3	B3- B4	B4- B5
*TOT-DSCHRG	27.30340	54.71650	73.31170 :
TOT-OVRFLW	0.00000	152.87200	7.38979 :
1 7 MAY	21.08350	22.07400	35.60140 :
	0.23345	1.09567	2.71956 :
	0.00000	0.00000	0.00000 :
2 14 MAY	19.95150	21.67780	34.63920 :
	1.09699	0.46850	1.27764 :
	0.00000	0.00000	0.00000 :
3 21 MAY	19.86660	20.97030	33.70530 :
	0.00000	0.60703	3.00794 :
	0.00000	0.00000	0.00000 :
4 28 MAY	19.13080	20.65900	32.74310 :
	1.37412	0.00000	3.29633 :
	0.00000	0.00000	0.00000 :
5 4 JUN	18.62140	19.95150	31.35640 :
	0.00000	1.16724	2.75251 :
	0.00000	0.00000	0.00000 :
6 11 JUN	17.99880	19.89490	29.68670 :
	1.07258	0.00000	1.58342 :
	0.00000	0.00000	0.00000 :
7 18 JUN	17.68750	19.27230	29.29050 :
	0.56640	0.90269	0.00000 :
	0.00000	0.00000	0.00000 :
8 25 JUN	26.43220	19.24400	28.21510 :
	0.00000	0.00000	1.78584 :
	0.00000	0.00000	0.00000 :
9 2 JUL	27.33780	19.81000	42.45000 :
	0.00000	0.00000	1.27560 :
	0.00000	0.00000	0.00000 :
10 9 JUL	27.62080	20.65900	45.59130 :
	0.00000	0.60703	0.00000 :
	0.00000	0.00000	0.00000 :
11 16 JUL	28.44150	37.10130	48.67600 :
	0.00000	0.20234	0.00000 :
	0.00000	0.00000	0.00000 :
12 23 JUL	28.44150	40.32750	50.09100 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
13 30 JUL	28.44150	40.41240	50.79850 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
14 6 AUG	28.41320	41.06330	50.88340 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
15 13 AUG	27.33780	53.91150	51.87390 :
	2.57057	0.00000	0.00000 :
	0.00000	1.94352	0.00000 :
16 20 AUG	26.29070	53.91150	52.55310 :
	2.71553	0.00000	0.00000 :
	0.00000	5.06784	0.00000 :
17 27 AUG	24.93230	53.91150	52.58140 :
	1.97652	0.00000	0.00000 :
	0.00000	2.32896	0.00000 :
18 3 SEP	24.28140	53.91150	52.58140 :
	1.78080	0.00000	0.00000 :
	0.00000	3.17035	0.00000 :

APPENDIX:3

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:3, JALGAON-MANYAD DAM

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	82- 83	83- 84	84- 85
19 10 SEP	24.76250	53.91150	52.55310 :
	1.27200	0.00000	0.00000 :
	0.00000	5.46984	0.00000 :
20 17 SEP	26.34730	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	20.60160	0.00000 :
21 24 SEP	31.13000	53.91150	53.85490 :
	0.00000	0.00000	0.00000 :
	0.00000	19.92140	0.00000 :
22 1 OCT	32.26200	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	62.66760	0.34327 :
23 8 OCT	32.26200	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	11.44250	2.86366 :
24 15 OCT	32.17710	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	7.88928	3.23551 :
25 22 OCT	32.17710	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	5.74224	0.00000 :
26 29 OCT	32.68650	53.91150	53.91150 :
	0.00000	0.00000	0.00000 :
	0.00000	2.81160	0.00000 :

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE AND OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:4, AKOLA-CHONDHI

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
*TOT-DSCHRG	24.04080	574.55300	16.58410	22.79110	32.31910	74002.54000 :
TOT-OVRFLW	9.23319	15.79850	2.66520	2.85590	162.70200	2.62300 :
1 7 MAY	4.81700 0.25562 0.00000	6.63700 0.45051 0.06562	5.23700 0.22910 0.03660	6.70700 0.65947 0.03660	5.97200 0.32018 0.03660	6.97250 : 0.77938 : 0.02440 :
2 14 MAY	4.39700 0.19211 0.00000	6.11200 1.09103 0.03660	4.95700 0.16540 0.03660	6.35700 0.36104 0.03660	5.55200 0.31139 0.03660	5.93700 : 1.10728 : 0.01220 :
3 21 MAY	4.75200 0.39884 0.00000	5.65200 0.31443 0.02440	4.60700 0.22668 0.02440	5.83200 0.35607 0.03660	5.16700 0.29105 0.02440	4.98700 : 0.88428 : 0.01220 :
4 28 MAY	3.78000 0.18826 0.00000	5.30700 137.66800 0.04880	4.15200 0.18419 0.03660	5.41200 0.32243 0.03660	4.85200 0.24096 0.02440	4.71200 : 0.00000 : 0.00000 :
5 4 JUN	3.45000 0.10743 0.00000	5.09700 410.09400 0.03660	3.94500 0.22217 0.02440	4.99200 0.25580 0.03660	4.64200 0.22967 0.04880	3.94500 : 0.00000 : 0.04880 :
6 11 JUN	3.31450 0.09754 0.00000	5.09700 0.00000 0.08540	3.61500 0.19644 0.03660	4.36200 0.15102 0.03660	4.36200 0.25566 0.03660	3.83500 : 0.00000 : 0.08540 :
7 18 JUN	3.19250 0.07872 0.00000	5.30700 0.02570 0.07320	3.50500 0.19565 0.02440	3.83500 0.17370 0.03660	4.18700 0.25820 0.03660	5.41200 : 0.00000 : 0.08540 :
8 25 JUN	3.24130 0.02591 0.00000	5.27200 0.01623 0.06100	3.45000 0.15548 0.03660	4.08600 0.01499 0.07320	4.34700 0.00000 0.08540	5.41200 : 0.00000 : 0.08540 :
9 2 JUL	3.56000 0.00000 0.00000	5.27200 0.00000 0.07320	3.45000 0.00000 0.08540	4.18700 0.24794 0.03660	5.65700 0.00000 0.06340	5.41200 : 2.54700 : 0.04880 :
10 9 JUL	3.56000 0.00000 0.00000	5.41200 0.19842 0.06100	3.58750 0.00000 0.08540	4.18700 0.00000 0.08540	5.72700 0.00000 0.00840	5.65700 : 0.00000 : 0.08540 :
11 16 JUL	5.13200 0.00000 0.00000	5.41200 0.00000 0.08540	4.22200 0.00000 0.08540	4.60700 0.00000 0.08540	7.49300 0.00000 0.00840	5.86700 : 0.00000 : 0.08540 :
12 23 JUL	5.20200 0.00000 0.00000	5.34200 0.10934 0.03660	4.32700 0.00000 0.08540	17.24100 0.00000 0.08540	8.57900 0.00000 0.00840	7.96500 : 0.00000 : 0.08540 :
13 30 JUL	8.05900 0.00000 0.00000	5.27200 0.00970 0.07320	4.39200 0.16395 0.02440	17.78100 0.00000 0.08540	11.82950 0.00000 0.00840	8.01200 : 0.00000 : 0.08540 :
14 6 AUG	16.82100 0.00000 0.07320	9.71150 0.00000 0.08540	5.65700 0.03333 0.07320	18.18100 0.00000 0.08720	21.61700 0.00000 0.07440	9.28700 : 0.00000 : 0.08540 :
15 13 AUG	24.67750 0.00000 0.08600	13.45550 0.00000 0.08540	8.57900 0.00000 0.08540	18.18100 0.00000 0.08750	33.09040 0.37578 0.96574	9.58650 : 0.00000 : 0.08540 :
16 20 AUG	27.95900 0.00000 0.08750	26.79750 0.00000 0.09030	10.83500 0.00000 0.08540	19.27100 0.00000 0.08750	32.40400 2.63939 18.04190	9.75900 : 0.00000 : 0.08540 :
17 27 AUG	28.28820 0.00000 0.08750	32.63300 0.00000 10.68350	11.54700 0.00000 0.08540	21.53600 0.00000 0.08750	32.40430 0.92186 3.52611	9.85400 : 0.00000 : 0.08540 :
18 3 SEP	29.23600 0.00000 0.05585	32.40430 0.00000 1.72907	11.71450 0.06518 0.06100	21.69800 0.00000 0.08750	33.20480 0.00000 26.45530	9.90100 : 0.00000 : 0.08540 :

APPENDIX:4

245

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:4.AKOLA-CHONDHI

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	79- 80	80- 81	81- 82	82- 83	83- 84	84- 85
19 10 SEP	29.33900	32.29000	11.48650	21.21200	32.51870	9.94800 :
	0.03473	0.00000	0.44102	0.91255	0.00000	0.00000 :
	0.01365	1.14384	0.00000	0.01250	18.09720	0.08540 :
20 17 SEP	32.29000	32.29000	12.93900	22.38300	32.51870	9.94800 :
	0.07137	0.08688	0.00000	0.01717	0.00000	0.00000 :
	0.01365	0.03660	0.08540	0.07500	11.78730	0.08540 :
21 24 SEP	32.63300	32.29000	16.54100	24.30750	32.74740	9.00400 :
	0.00000	0.00000	0.00000	0.00000	0.59791	1.15957 :
	2.58780	0.08540	0.08540	0.08750	24.61900	0.00000 :
22 1 OCT	32.40430	32.18200	20.01100	25.04000	32.51870	8.51500 :
	0.00000	0.17343	0.00000	0.00000	0.71824	0.20971 :
	5.25461	0.01220	0.08540	0.08750	33.22930	0.07320 :
23 8 OCT	32.29000	30.06000	21.21200	24.58500	32.63300	9.28700 :
	0.00120	1.91435	0.00000	0.63917	0.51493	1.21398 :
	0.27625	0.00000	0.08540	0.02500	18.87990	0.01220 :
24 15 OCT	32.18200	29.85400	21.53600	23.47500	32.40430	11.23750 :
	0.10948	0.32462	0.20445	1.24990	0.79107	0.00000 :
	0.02511	0.06100	0.03660	0.01250	3.94709	0.08540 :
25 22 OCT	32.07400	29.64800	21.77900	23.47500	32.29000	11.30300 :
	0.31087	0.21360	0.00000	0.00000	0.53679	0.00000 :
	0.04895	0.03660	0.08540	0.08750	1.73761	0.08540 :
26 29 OCT	32.07400	28.82400	21.86000	23.47500	32.29000	11.36850 :
	0.01510	0.17651	0.01333	0.00000	0.35499	0.00000 :
	0.06110	0.04880	0.08540	0.08750	0.08050	0.08540 :

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE & OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME: S. CHANDRAPUR-ASOLA MENDHA

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
*TOT-DSCHRG	60.67520	50.46010	60.75850	57.68900	37.91770	65.06610
TOT-OVRFLW	0.00000	16.88190	127.91200	3.89134	3.96285	20.71390
1 7 MAY	40.24260 1.84439 0.00000	27.79060 0.00000 0.00000	21.60080 0.60138 0.00000	18.72750 0.58148 0.00000	14.79580 0.00000 0.00000	22.78460 0.61060 0.00000
2 14 MAY	37.83710 1.48900 0.00000	27.28120 0.00000 0.00000	20.68310 0.41499 0.00000	18.09390 0.51164 0.00000	13.87690 0.00000 0.00000	22.06270 0.37413 0.00000
3 21 MAY	36.08250 0.78213 0.00000	26.77180 0.00000 0.00000	19.99450 0.28037 0.00000	17.88280 0.12328 0.00000	13.34630 0.00000 0.00000	21.14180 0.32409 0.00000
4 28 MAY	34.72410 0.39846 0.00000	26.48880 0.00000 0.00000	19.36100 0.10064 0.00000	17.68520 0.00000 0.00000	12.28500 0.00000 0.00000	20.45350 0.32409 0.00000
5 4 JUN	34.04490 0.33960 0.00000	15.35220 0.00000 0.00000	18.93860 0.00000 0.00000	17.29050 0.00000 0.00000	11.79010 0.00000 0.00000	19.78310 0.22702 0.00000
6 11 JUN	34.04490 0.00000 0.00000	14.98120 0.00000 0.00000	18.51610 0.05057 0.00000	17.09290 0.00000 0.00000	11.62510 0.00000 0.00000	19.14980 0.17122 0.00000
7 18 JUN	33.70530 0.33960 0.00000	14.62030 0.00000 0.00000	17.88280 0.66109 0.00000	16.69810 0.00000 0.00000	12.12000 0.00000 0.00000	18.93860 0.00000 0.00000
8 25 JUN	33.36570 0.67920 0.00000	14.42470 0.00000 0.00000	19.78310 0.27556 0.00000	17.39370 0.00000 0.00000	12.28500 0.00000 0.00000	19.99450 0.00000 0.00000
9 2 JUL	33.70530 0.00000 0.00000	15.72290 0.00000 0.00000	20.22400 0.00000 0.00000	39.51670 0.00000 0.00000	16.30330 0.00000 0.00000	22.05990 0.00000 0.00000
10 9 JUL	36.08250 0.00000 0.00000	17.68530 0.00000 0.00000	28.83430 0.00000 0.00000	42.75560 0.00000 0.00000	19.36090 0.00000 0.00000	31.75170 0.00000 0.00000
11 16 JUL	48.76090 0.00000 0.00000	18.09390 0.00000 0.00000	41.66810 0.00000 0.00000	44.25330 0.00000 0.00000	20.45350 0.00000 0.00000	37.14540 0.00000 0.00000
12 23 JUL	62.28830 0.00000 0.00000	20.22400 0.00000 0.00000	45.79850 0.00000 0.00000	45.79850 0.00000 0.00000	20.45350 0.00000 0.00000	38.16170 0.00000 0.00000
13 30 JUL	64.21270 0.00000 0.00000	21.37140 0.00000 0.00000	53.53850 0.00000 0.00000	46.95730 0.00000 0.00000	23.52750 0.00000 0.00000	51.84280 0.00000 0.00000
14 6 AUG	72.33480 0.90433 0.00000	24.74840 0.00000 0.00000	53.11460 1.30350 0.00000	58.30540 0.00000 0.00000	38.50050 0.00000 0.00000	65.12450 0.00000 0.00000
15 13 AUG	73.29700 2.81670 0.00000	30.24480 0.00000 0.00000	51.01130 3.18884 0.00000	68.49430 0.00000 1.06864	47.75120 0.00000 0.00000	71.46800 0.00000 9.45786
16 20 AUG	70.38210 3.47184 0.00000	29.39860 1.63710 0.00000	64.19370 0.42733 0.00000	67.01550 1.56468 2.82270	50.60380 0.00000 0.00000	70.47410 0.00000 7.14350
17 27 AUG	68.03320 4.07011 0.00000	60.98650 0.92510 0.00000	77.03150 0.51161 32.75670	63.73560 3.85559 0.00000	59.18780 0.00000 0.00000	68.00150 8.90261 4.11256
18 3 SEP	77.31560 1.58650 0.00000	70.47410 0.00000 1.98128	70.47410 0.90945 75.19990	58.74660 5.67189 0.00000	60.52830 0.00000 0.00000	65.12450 4.32707 0.00000

APPENDIX:5

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME: S. CHANDRAPUR-ASOLA MENDHA

1ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	76- 77	77- 78	78- 79	79- 80	80- 81	81- 82
19 10 SEP	83.48500	68.49450	67.50850	53.96240	64.65190	60.98650
	0.00000	0.00000	2.07807	5.78848	0.00000	5.58246
	0.00000	6.49570	19.95550	0.00000	0.00000	0.00000
20 17 SEP	85.57920	68.81770	62.81920	48.97370	66.54260	57.86470
	1.89777	0.30513	5.38804	5.45737	0.00000	5.82244
	0.00000	3.68630	0.00000	0.00000	0.00000	0.00000
21 24 SEP	80.88140	65.59740	59.62900	45.02590	68.00150	55.23420
	4.82136	4.28241	5.65660	4.77874	1.13981	5.32917
	0.00000	1.70550	0.00000	0.00000	3.80635	0.00000
22 1 OCT	74.76860	60.52830	55.40400	45.02590	64.65190	59.62900
	5.49883	5.93536	5.56887	4.18274	4.00884	3.66117
	0.00000	0.00000	0.00000	0.00000	0.15650	0.00000
23 8 OCT	68.51430	55.40400	49.78880	40.94300	58.74660	57.42300
	5.81820	6.00045	5.78848	4.22576	6.00045	3.36940
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24 15 OCT	61.77890	50.19630	44.25330	35.18430	52.69060	52.69060
	5.81820	5.93989	5.80942	5.59689	6.00045	5.52671
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
25 22 OCT	54.10960	44.63960	39.17800	29.39830	46.57100	47.34360
	5.81820	5.66057	5.86178	5.71519	5.87197	5.86178
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
26 29 OCT	47.09120	39.85550	34.22150	24.51800	42.39310	41.66810
	5.81820	5.10334	5.70160	5.35436	5.05466	5.86178
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE & OVERFLOW REFER TO WHOLE YEAR

WEEKS COVERED REFER TO RAINY SEASON ONLY

APPENDIX:5

248

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME:5.CHANDRAPUR-ASOLA MENDHA

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	82- 83	83- 84	84- 85
*TOT-DSCHRG	25.12680	48.77230	68.58460 :
TOT-OVRFLW	0.00000	4.01342	4.56545 :
1 7 MAY	25.29740	18.51610	32.35450 :
	0.41375	0.00000	0.65192 :
	0.00000	0.00000	0.00000 :
2 14 MAY	24.76560	18.09390	30.84760 :
	0.19380	0.00000	0.56113 :
	0.00000	0.00000	0.00000 :
3 21 MAY	24.27040	17.09290	29.96260 :
	0.13590	0.00000	0.62022 :
	0.00000	0.00000	0.00000 :
4 28 MAY	23.52750	16.30330	28.83430 :
	0.00000	0.00000	0.56241 :
	0.00000	0.00000	0.00000 :
5 4 JUN	23.03220	16.10580	28.27030 :
	0.05422	0.00000	0.24103 :
	0.00000	0.00000	0.00000 :
6 11 JUN	22.78460	15.72290	27.42380 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
7 18 JUN	22.53700	18.51610	27.70800 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
8 25 JUN	22.53700	18.72720	27.42380 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
9 2 JUL	23.52750	21.83030	27.98810 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
10 9 JUL	22.28940	21.83030	28.55220 :
	0.41850	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
11 16 JUL	23.27990	22.05990	29.39860 :
	0.13360	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
12 23 JUL	24.51800	27.42380	29.96260 :
	0.00000	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
13 30 JUL	25.29740	29.68050	31.45040 :
	0.02516	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
14 6 AUG	25.82880	33.57960	66.54320 :
	0.49381	0.00000	0.00000 :
	0.00000	0.00000	0.00000 :
15 13 AUG	22.73310	51.41880	65.12450 :
	1.78050	0.00000	2.72246 :
	0.00000	0.00000	0.00000 :
16 20 AUG	23.77510	58.74660	69.97710 :
	2.89866	0.00000	2.10128 :
	0.00000	0.00000	2.21199 :
17 27 AUG	23.03220	60.07010	66.54320 :
	0.81286	0.00000	3.09744 :
	0.00000	0.00000	2.35346 :
18 3 SEP	23.27990	58.74660	61.44470 :
	0.60443	3.39798	5.73471 :
	0.00000	0.00000	0.00000 :

APPENDIX:5

WEEK ENDING WATER CONTENT, WEEKLY DISCHARGE & OVERFLOW

FOR SCHEME: S. CHANDRAPUR-ASOLA MENDHA

1 ST LINE WATER CONTENT, 2ND LINE DISCHARGE, 3RD LINE OVERFLOW

ALL FIGURES ARE IN MILLION CUBIC METER

WEEK ENDING	82- 83	83- 84	84- 85
19 10 SEP	29.68050	67.01550	56.09940 :
	0.58360	1.69376	6.57494 :
	0.00000	0.00000	0.00000 :
20 17 SEP	34.22150	69.48020	51.84280 :
	0.00000	2.90935	5.79980 :
	0.00000	0.66182	0.00000 :
21 24 SEP	32.95730	68.00150	46.18480 :
	1.32203	3.32477	6.32194 :
	0.00000	1.27370	0.00000 :
22 1 OCT	29.11650	68.49450	40.92600 :
	4.83565	3.39345	6.44221 :
	0.00000	2.07790	0.00000 :
23 8 OCT	23.52750	67.01550	34.86420 :
	5.00372	3.39345	6.50334 :
	0.00000	0.00000	0.00000 :
24 15 OCT	20.22370	64.65190	32.65590 :
	3.11187	3.61051	5.56293 :
	0.00000	0.00000	0.00000 :
25 22 OCT	23.77510	60.07010	26.62530 :
	1.99572	5.21824	6.08931 :
	0.00000	0.00000	0.00000 :
26 29 OCT	24.51800	55.65820	22.53700 :
	0.00000	5.58699	4.56819 :
	0.00000	0.00000	0.00000 :

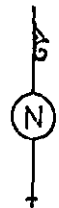
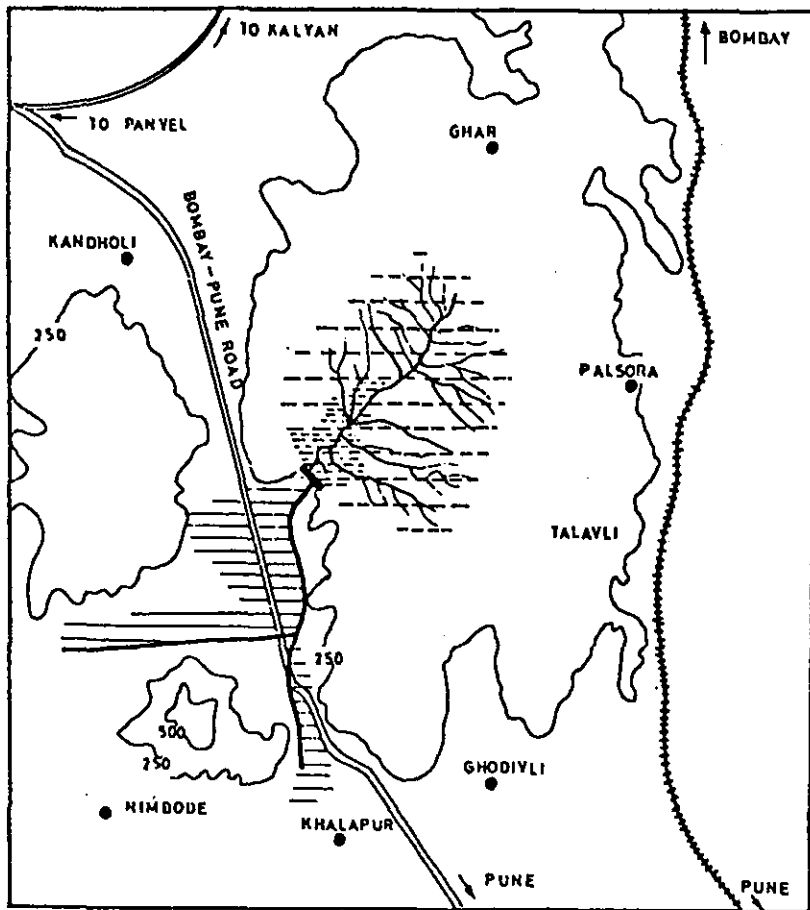
WEEK ENDING DATES ADJUSTED FOR LEAP YEAR

* TOTAL DISCHARGE AND OVERFLOW REFER TO WHOLE YEAR


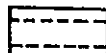


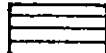
WEEKS COVERED REFER TO RAINY SEASON ONLY

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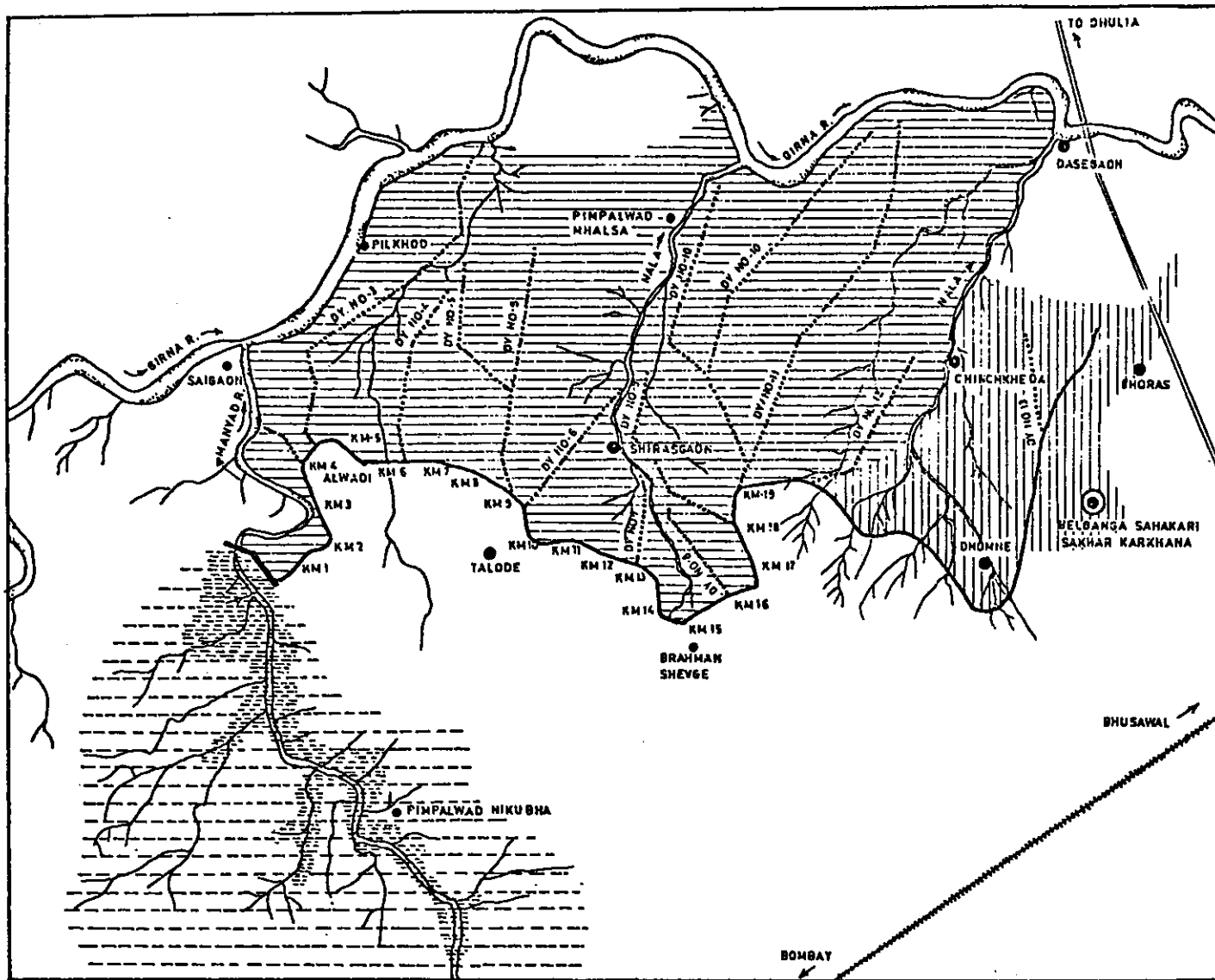
REFERENCE

-  DAM
-  CATCHMENT AREA
-  SUBMERGENCE AREA
-  CANAL
-  COMMAND AREA








INDEX PLAN SHOWING COMMAND AREA
OF KALOTE MOKASHI PROJECT
TAL: KHALAPUR DIST: RAIGAD

SCALE 0 1 MILE



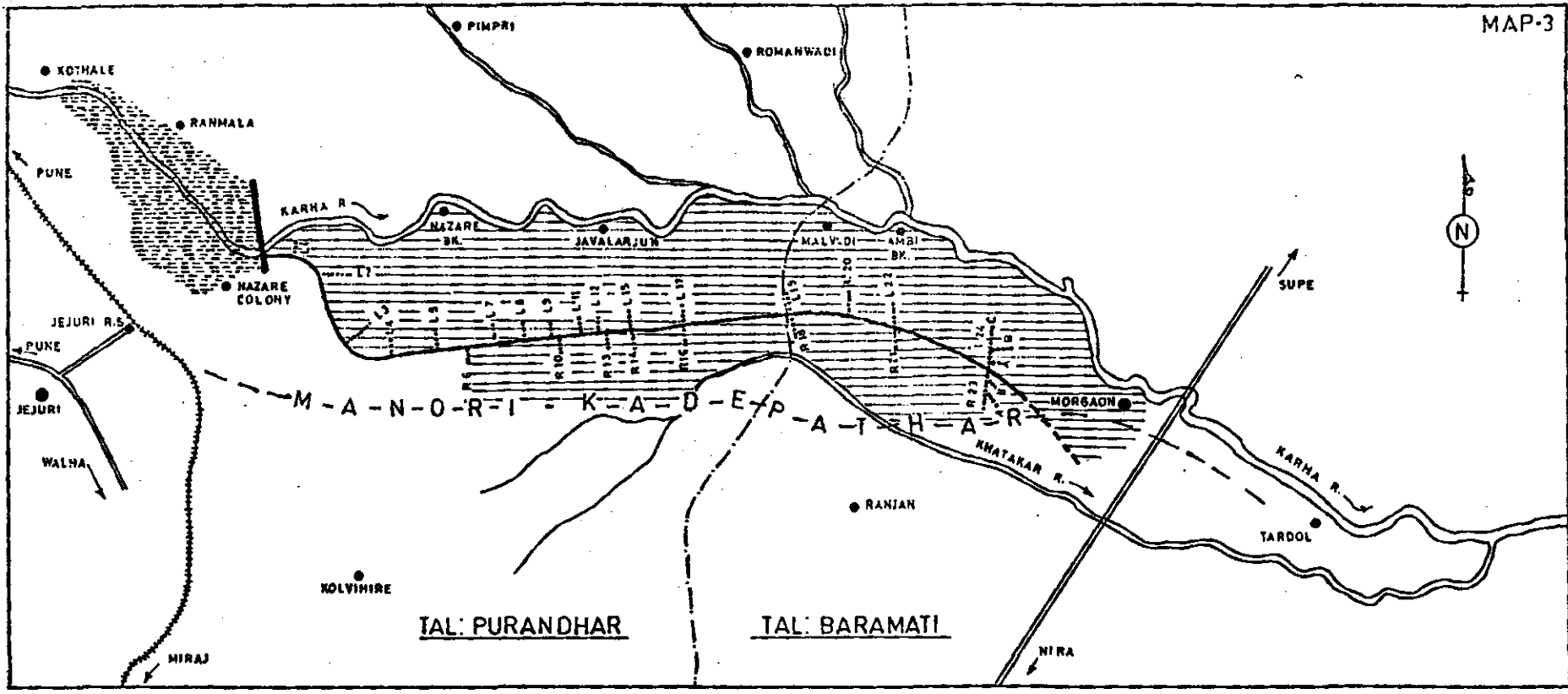


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
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-  CATCHMENT AREA
-  SUBMERGENCE AREA
-  CANAL
-  DISTRIBUTARY
-  COMMAND AREA
-  COMMAND AREA (EXTR. BY NO 13)


**INDEX PLAN SHOWING COMMAND AREA
OF MANYAD PROJECT
TAL : CHALISGAON DIST : JALGAON**

SCALE  1 MILE



REFERENCE

-  DAM
-  SUBMERGENCE AREA
-  CANAL
-  DISTRIBUTARY
-  COMMAND AREA

INDEX PLAN SHOWING COMMAND AREA OF NAZARE PROJECT
TAL: PURANDHAR DIST: PUNE
 SCALE  1 MILE