

**REPORT
OF
THE WESTERN GHATS WATER RESOURCES
STUDY COMMITTEE**



**GOVERNMENT OF INDIA
PLANNING COMMISSION
NEW DELHI
MARCH 1981**



सदस्य

योजना आयोग, योजना भवन
नई दिल्ली ११० ००१

MEMBER

Planning Commission
Yojana Bhavan
New Delhi 110 001
March 25, 1981

FOREWORD

The Sixth Five-Year Plan has outlined a detailed strategy for the conservation of mountain eco-systems and for promotion of water conservation and management in hilly terrain. The Himalayan and Western Ghats regions have been chosen for integrated attention, since both these regions are the centres of origin of many of our major river systems as well as of several important economic plants and farm animals. The conservation of the natural assets of these regions is also vital for the prosperity of the plains. Unfortunately, considerable damage has taken place both to the Himalayan and Western Ghats ranges due to lack of attention to the principles of eco-development and due to extensive denudation of forests. In order to arrest further damage to fragile mountain eco-systems and to promote development without destruction, special groups have been set up separately for the Himalayan and Western Ghats regions.

2. The Western Ghats Region, which extends from Maharashtra to Kerala, has rich forest and hydel resources. The region also receives heavy rainfall during the south-west monsoon period. In spite of these endowments, the people in the area have remained poor due to inadequate scientific resource conservation and utilisation strategies. On a suggestion from the Chief Minister of Maharashtra, a beginning has been made to undertake an interdisciplinary analysis of rainwater conservation and natural resources utilisation in the Konkan region. The Konkan region along the western foothills of Sahyadri receives from 2,000 mm to 5,000 mm of rainfall during June-September. Leaving aside small strips of coastal plains, nearly the entire terrain is rugged and dissected by high hills with steep slopes. There is also considerable variability in the rainfall characteristics of the watershed along the western and eastern sides of the Sahyadri range. For example, the precipitation on the eastern slopes diminishes very fast to less than 800 mm within a short distance of 50 km. from the ridge line. Since the precipitation in Konkan is limited to a period of less than 120 days and the soil moisture holding capacity is poor, the rivers in Konkan dry up very fast. Hence there is scarcity of water in the non-rainy season. The coastal belt along the Konkan

has also special features including a large reclaimable *khar* land area and mangroves. An urgent need of the region, therefore, is the conservation of the rainwater which is lost through surface run off within a short period of time. Water conservation measures should be accompanied by appropriate land use plans based on considerations of ecology, economics, energy needs and employment generation. Thus, land and water conservation and use will hold the key to optimising the benefits of the natural endowments of the area for the present and future population of the region. The economic development of this region will also make it unnecessary for the rural poor to migrate to Bombay City seeking for wage employment. Proper surface and ground water utilisation is also necessary for meeting the needs of the human and animal population for drinking water.

3. In order to look at the problems and potential of the Konkan region, in an integrated manner, a Western Ghats Water Resources Study Committee was set up by the Planning Commission. The present report represents the first in a series of studies undertaken and is confined to the Konkan region of Maharashtra. The Government of Maharashtra provided the necessary technical and administrative support for ensuring the completion of the study within a short span of 3 months. It is proposed to initiate a similar study in the Goa region with the help of the Government of Goa. Our sincere thanks are due to Shri A. R. Antulay, Chief Minister of Maharashtra, who was instrumental in getting the present study initiated. The Committee is also indebted to Shri Narayan Datt Tiwari, Minister for Planning and Deputy Chairman, Planning Commission, for having entrusted to it this important and challenging task.

4. I would like to acknowledge with gratitude the wholehearted co-operation received from all members of the Committee. Particular thanks are due to the Convenors of the three Task Forces set up by the Committee at its first meeting, viz., (1) Shri M. G. Padhye, Member, Central Water Commission, Delhi, (2) Shri G. S. Ghanekar, Chief Engineer, Konkan Region, Bombay, and (3) Dr. R. S. Murthy, Director, National Bureau of Soil Survey and Land Use Planning, Nagpur. A very large number of individuals and institutions have given the Committee their valued guidance and suggestions. But for such an enthusiastic response from technical, administrative and voluntary organisations, it would not have been possible to gather so much valuable data and offer a plan of action. It is obvious that such a study would not have been easy but for the Committee having had the services of an able and dedicated Member-Secretary. I would like to record on behalf of my colleagues and myself in the Committee our sincere thanks to Shri M. A. Chitale, Chief Engineer (IWD) and Joint Secretary, Irrigation Department, Government of Maharashtra, for the extraordinarily competent manner in which he organised the work of the Task Forces and of the Committee.

5. I hope that this analysis of problems and of opportunities for development would lead to prompt action. Action should start from the coming south-west monsoon period. It was with this motivation that the Committee decided to complete its work as speedily as possible. The recent census has shown that the population of our country is gaining numerically by over 17 million individuals every year. Therefore, both the short and long-term implications of losing time in the area of scientific eco-development are obvious.

M. S. Swaminathan

(Dr. M. S. SWAMINATHAN)
Member, Planning Commission

New Delhi, March 25, 1981

ABBREVIATIONS

BHA	..	..	Bombay Hydrometric Area.
BMC	..	..	Bombay Municipal Corporation.
BMRDA	..	..	Bombay Metropolitan Region Development Authority.
CADA	..	..	Command Area Development Authority.
CEA	..	..	Central Electricity Authority.
CIFE	..	..	Central Institute of Fisheries Education.
C.P.E.	..	..	Cumulative Pan Evaporation.
C.S.R.	..	..	Commencement of Sowing Rains.
CWC	..	..	Central Water Commission.
CWPRS	..	..	Central Water Power Research Station.
DCKL	..	..	Development Corporation of Konkan Limited.
D.P.A.P.	..	..	Drought Prone Area Programme
E.G.S.	..	..	Employment Guarantee Scheme
F.Y.P.	..	..	Five-Year Plan
GSDA	..	..	Ground Water Survey and Development Agency.
GSI	..	..	Geological Survey of India.
H.Y.V.	..	..	High Yielding Variety.
IARI	..	..	Indian Agricultural Research Institute.
ICAR	..	..	Indian Council for Agricultural Research.
IDCOM	..	..	Irrigation Development Corporation of Maharashtra.
I.R.D.P.	..	..	Integrated Rural Development Programme.
IWD	..	..	Inter-State Water Development.
KKV	..	..	Konkan Krishi Vidyapeeth (Dapoli).
L.B.C.	..	..	Left Bank Canal.
L.F.	..	..	Load factor.
LT	..	..	Low tension.
MERI	..	..	Maharashtra Engineering Research Institute (Nasik).
M.I.	..	..	Minor Irrigation.
MIDC	..	..	Maharashtra Industrial Development Corporation.
N.R.E.P.	..	..	National Rural Employment Programme.
PAD	..	..	Peoples' Action for Development.
P.S.S.	..	..	Pump Storage Schemes.
R.B.C.	..	..	Right Bank Canal.
REC	..	..	Rural Electrification Corporation.
R.L.	..	..	Reduced Level.
SICOM	..	..	State Industrial Investment Corporation of Maharashtra.
T. ha. m.	..	..	Thousand hectare metre
TMC	..	..	Thousand Million Cubic feet.
TRYSEM	..	..	Training of rural youth for self-employment.
UNDP	..	..	United Nations Development Programme.
UNIDO	..	..	United Nations Industrial Development Organisation.
W.G.D.	..	..	Western Ghats Development.
ZP	..	..	Zilla Parishad.

CONTENTS

	PAGE
CHAPTER I—Introduction	1
CHAPTER II—LAND AND WATER RESOURCES—	
2.1. Konkan Region	3
2.2. Population	3
2.3. Climate and Rainfall	4
2.4. Geological Setting	5
2.5. Land Forms	7
2.6. Land Use	8
2.7. Soils	9
2.8. Surface Water Resources	10
2.9. Ground Water Resources	11
2.10. Agriculture	12
2.11. Forests	13
2.12. Horticulture	14
2.13. Fisheries	14
2.14. Khar Land Development	15
2.15. Irrigation Development	15
2.16. Hydro-Electric Development	16
2.17. Domestic and Industrial Water Supply	16
2.18. Rural Electrification	18
2.19. Techno-Economic Survey	19
2.20. Institutional Infrastructure	19
CHAPTER III—RAIN WATER CONSERVATION AND UTILISATION—	25
3.1. The Need for Rain Water Conservation	25
3.2. Developments in Retrospect	25
3.3. Master Plan Work	26
3.4. High Cost of Storage	27
3.5. Relaxation in Feasibility Criteria	28
3.6. Training for Rehabilitation	28
3.7. Mechanised Earth Work	29
3.8. Incentives for staff	29
3.9. Irrigation Schemes	29
3.10. Command Area Development	31
3.11. Hydro-Power	34
3.12. Use of Average Flows	39
3.13. Tidal Power	40
3.14. Sweet Water Lakes across the Creeks	40
3.15. Water Supply Schemes	41
3.16. Ground Water Development	41
3.17. Use of Koyna Tail Waters	42
3.18. Tourist Resorts	42
3.19. Cost Sharing through Multipurpose Uses	43

CONTENTS

	PAGE
CHAPTER IV—LAND AND WATER USE PLAN- NING—	45
4.1. Need for a Change	45
4.2. Eco-Regions in Relation to Land Use Planning.	45
4.3. Deficiencies in the Present Land Use ..	46
4.4. Eco-units for Development	47
4.5. Integrated Planning of Eco-units ..	47
4.6. Conservation Approach	48
4.7. The Strategy for Development ..	49
4.8. Recommended Land Use Activities ..	50
4.9. Schemes for Adoption	55
4.10. Water Shed Development Schemes ..	55
4.11. Environmental Protection	56
4.12. Training Programmes	57
4.13. Financial Requirements	60
4.14. Role of Voluntary Organisations ..	61
4.15. Land and Water Use Committee ..	62
4.16. Public Policies	63
CHAPTER V—SUMMARY OF RECOMMENDATIONS	65
ANNEXURES	77
MAPS	141

CHAPTER I

INTRODUCTION

1. Western Ghat Region is an ecologically rich but economically poor area. In the absence of the scientific development of the natural endowments of this region, its economic potential has largely remained untapped. Western Ghats nurse some of the major river systems in peninsular India. Some of the last remaining tropical rain forests of the world occur in the Western Ghats region. Crop plants like pigeon pea (arhar) have their nature home in the Western Ghats region extending from Maharashtra to Kerala. To provide for the special developmental requirements of this area a separate Western Ghat Development Programme has been initiated from 1974. The main thrust of this programme is towards the preservation of its ecology and the development of its natural resources for the economic uplift of the inhabitants.

2. The most important physical resource of the Western Ghat Region is the plentiful supply of water received particularly during the south-west monsoon period. The unflinching rainfall coming in abundance had given rise to luxuriant vegetation on the hill slopes. But by indiscriminate cutting of trees the natural cover of the hills slopes is getting lost progressively resulting into severe erosion of the soil mantle. Good cultivable land is relatively less in this hilly area. There is considerable pressure of population on this scarce land resource because of dwindling returns from the degraded forest areas. For the development of this region, therefore, emphasis has been laid on the conservation and restoration of ecology by undertaking integrated programme on watershed basis.

3. At the personal request of Shri A. R. Antulay, Chief Minister of Maharashtra, the Planning Commission decided to examine in the first instance, as a part of this development strategy, the problems relating to the conservation of rain water received during the south-west monsoon period in Konkan region. Accordingly the Planning Commission in consultation with the Government of Maharashtra constituted a Committee called the "Western Ghat Water Resources Study Committee" under the Chairmanship of Dr. M. S. Swaminathan, Member, Planning Commission. The composition of the Committee and its terms of reference are spelt out in the Planning Commission's Office Memorandum No. PC(P) 19/1/WG/WRSC/81-MLP, dated 14th January 1981 (Annexure 1.1).

4. At present only 14 of the 42 Talukas in Konkan have been included in the Western Ghat area (Ref : Annexure 1.2). In view of the hilly nature of the entire Konkan belt, low percentage of cultivable land, and almost similar pattern of climate all over and the inter-dependence of the lands in the valleys from the coast to the crest of Sahyadri in respect of ecological integrity, the Committee has considered the problems of the entire Konkan Region together.

5. The Committee held in all three meetings. After the deliberations in the first meeting, three Task Forces for detailed consideration of specific subject areas were set up. The composition of the Task Forces and the terms of reference were as outlined in the Planning Commission's Memoranda enclosed as Annexures 1.3 to 1.5 of this report. The reports of the Task Forces were discussed in a joint meeting of the Members of the Task Forces and the Members of the Committee on 20th February, 1981. As a sequel to these discussions, a drafting committee of the following Members of the Committee was set up for preparing the report of the Committee:—

- (1) Shri M. G. Padhye, Convenor, Task Force No. I.
- (2) Shri G. S. Ghanekar, Convenor, Task Force No. II.

- (3) Dr. R. S. Murthy, Convenor, Task Force No. III.
- (4) Shri K. S. S. Murthy, Adviser (I & CAD), Planning Commission.
- (5) Shri M. A. Chitale, Member Secretary of the Committee.

The draft report thus compiled was discussed by the entire Committee at Bombay, on March 9, 1981.

6. Experts from the various fields and the institutions which were approached for supplying information and for suggestions on the issues dealt with by the Committee gave willing co-operation and helped the Committee in its work. But for the enthusiastic response from the institutions and the individuals who were approached for assistance by the Committee, it would not have been possible for the Committee to complete its work within the short time assigned to it. The names of the institutions and individuals who helped the Committee with detailed notes on their fields of activities are listed in Annexure 1.6 and the names of the special invitees who participated in the deliberations of the Committee are mentioned at Annexure 1.7 to this report. Their whole-hearted participation in the work of this Committee even at short notice and their valuable contribution to the analysis of the different issues is gratefully acknowledged.

7. The Government of Maharashtra has appointed a High Power Committee under the Chairmanship of Shri B. J. Khatal, Hon'ble Minister for Irrigation, in October 1980 for finalising the Master Plans for irrigation development in Konkan. This Committee consisted of the peoples' representatives from Konkan and Heads of the Departments of Irrigation and Agriculture in Maharashtra. The Government Resolution defining the composition and terms of reference of that Committee are appended as Annexure 1.8 to this report. Master Plans for utilising the water resources of all the river basins in Konkan were finalised by the High Power Committee and presented to the Hon'ble Chief Minister of Maharashtra on 8th March 1981. The information collected and analysed by the High Power Committee for its work on the Master Plans was very useful for the work of the Western Ghats Water Resources Study Committee also.

8. Even though steps were taken to cover as many concerned fields of activities as possible while considering the problems related with the conservation of rain water and its utilisation in Konkan, the Committee is fully aware that some vital sectors of planning and development like man-power planning for technical personnel and the new fields of tidal and wind power could be dealt with only in preliminary manner. It is hoped that more detailed considerations of these sectors will be pursued by the concerned departments of the Government of Maharashtra. Moreover, even in the sectors dealt with by the Committee, appropriate follow up work will be required for preparing detailed action programmes with reference to the suggestions offered by our Committee in this report. It is hoped that such follow-up action will be taken up by the concerned departments and the institutions in right earnest so that some programmes for rain water conservation can be introduced during the south-west monsoon period 1981.

9. The Committee would like to record its gratitude to the Planning Commission and the Government of Maharashtra for extending to the Committee's Members an opportunity to study and understand the developmental needs of Konkan which receives plentiful supplies of water but which has remained economically backward. This opportunity has revealed to us the immense potential for development that remains to be harnessed in Konkan. We are particularly grateful to Shri A. R. Antulay, Chief Minister of Maharashtra, at whose personal interest, initiative and lead has helped this study being completed so speedily. We hope that the Western Ghat Development Programme will meet some of the long standing needs of this area.

CHAPTER II

LAND AND WATER RESOURCES

2.1. Konkan Region

2.1.1. Konkan region of Maharashtra is a narrow terrain between western coast and the crest of Sahyadri. It is about 60 km. in width and about 500 km. in length and is located between 72°—45' E and 74°—5' E longitudes and 15°—30' N to 20°—15' N latitudes. It has a total geographical area of 30,090 sq. km. The western precipice of Sahyadri marks its eastern boundary and the Arabian Sea constitutes its western boundary; with the State of Gujarat in the north and the Union Territory of Goa in the south. The region has four districts. The Thane, Raigad and Ratnagiri are the three rural districts and the fourth one is the urban area of the Greater Bombay District. A proposal to bifurcate the district of Ratnagiri into two districts is under consideration of the Government of Maharashtra.

2.1.2. In order to deal with all the problems associated with the Metropolitan Development around Greater Bombay, Government of Maharashtra have constituted the Bombay Metropolitan Region Development Authority (BMRDA) in 1975 by an act of the State Legislature. The Bombay Metropolitan region has an area of 4,165.02 sq. km. and covers the islands of Bombay (437.71 sq. km.) and part of Thane and Raigad Districts 2,152.72 sq. km. + 1,574.59 sq. km. respectively. In the context of water resources development, the Bombay Metropolitan Region is expected to generate a relatively large demand for use of surface water resources for domestic and industrial water supplies, more so, in view of the Petro-Chemical Complexes that would come up in and around this area in the near future. The water requirements of this area may have, therefore, to be dealt with on a different footing separately from those of the other areas in Konkan.

2.2. Population

2.2.1. The population of the Konkan Region as per 1971 census is as below:—

(1) Greater Bombay	..	..	..	..	59,70,575
(2) Thane District	..	..	..	..	22,81,664
(3) Raigad District	..	..	..	..	12,63,003
(4) Ratnagiri District	..	..	..	..	19,00,583
				Total	1,15,05,825

2.2.2. Because of inadequate developmental activities in Thane, Raigad and Ratnagiri Districts and because of greater scope for employment in the industrialised town of Bombay, now a Metropolitan area, a trend towards shifting of population to Greater Bombay is easily discernible. As a matter of fact, a large percentage of the population which originally belonged to the three districts of Konkan is now located in Bombay. It mainly belongs to the workers' class and the lower middle class. This trend is much more pronounced for the Ratnagiri District and the southern parts of Raigad District.

2.2.3. As a result of such migration to Bombay for employment, the percentage of male population of the Ratnagiri District is much less than that in other districts of Maharashtra (Annexure 2.1). In fact shortage of labour is experienced for the works now being undertaken in Ratnagiri District. The speedy development of Konkan area is a must, if the unplanned migration of rural poor is to be stopped.

2.3. Climate and Rainfall

2.3.1. The Konkan Region being a coastal belt experiences hot and humid climate with plentiful rainfall during the south-west monsoon. It can be broadly classified as a tropical wet and dry or as a tropical monsoon type of climate. The region in general enjoys equitable climate with warm temperatures throughout the year. The mean annual temperature ranges from 22° C to 30° C. The range is low because of its proximity to sea and wind barrier from western cliffs of Sahyadri. The mean maximum temperature generally ranges between 25° C to 35° C and the mean minimum temperature between 17° C to 27° C although absolute maximum of 40° C to 43° C and absolute minimum of 7° C to 12° C are known to have been recorded. April and May are the hottest months of the year. High humidity and pleasant on-shore breezes are characteristic of the coastal low lands. The mean relative humidity at 0830 hrs. IST and 1730 hrs. IST over the region is generally found to be 80 per cent.

2.3.2. *Rainfall.*—The Western Ghats provides a principal geographic barrier in the path of the Arabian Sea branch of the south-west monsoon and are principally responsible for the very heavy rainfall over the western coastal belt. The southwest monsoon season (June to September) is the principle rainy season for the region. As much as 94 per cent of the annual rainfall is realised in this period (Annexure 2.2). The annual rainfall over the region is about 2,500 mm. with an average number of rainy days exceeding 50 days (a rainy day being the one with + 2.5 mm. rainfall). Quite a substantial area from this region receives rainfall in excess of 2,500 mm. In view of the relief effect certain areas nearer to or on the Ghats record very heavy rainfall e.g. Matheran 5,167 mm., Amboli 7,477 mm. July is the rainiest month of the year with about 39 per cent of the seasonal rainfall. The region also experiences a feeble secondary spell of rainfall of 80 to 200 mm (with 5 to 10 rainy days) during the October and November, mostly in association with movement of depressions and storms.

2.3.3. The coefficient of variation for the south-west monsoon season (June-September) is rather low and varies between 20-30 per cent. Even the monthwise coefficient of variation for the months of June, July and August during the monsoon period varies only between 30-40 per cent. During the month of September, however, it exceeds 50 per cent. The region is on the whole assured of annual and seasonal total rainfall. But the variations in the monthly and weekly precipitations are important from the point of rice yields in kharif season. Protection against dry spells in September can go a long way in stabilising the kharif rice yields. This requirement is therefore to be considered while planning the utilisation of surface waters in Konkan.

2.3.4. Depressions and storms do effect the region only during pre (May-June) and post (September-November) monsoon months. During the 80 years period 1891-1970 about 20 depressions and storms affected the region. On the other hand, the region had experienced seven years of hydrological drought with monsoon rainfall deficit varying between 21-49 per cent during 1876-1975. No severe drought conditions, however, were experienced.

2.3.5. *Onset and Withdrawal of Monsoon.*—The normal date of onset of monsoon over the southern end of Konkan takes place on 5th June and by 10th June the entire Konkan is covered by monsoon. However, during 9 years out of the last 16 years (1965-1980) the monsoon had set

in late by a week to ten days. The normal date of commencement of the withdrawal of monsoon is 29th September and by 6th October monsoon withdraws from the entire Konkan. During 2 years out of the last 16 years the monsoon had withdrawn 5 to 10 days earlier.

2.3.6. From the year to year values of seventy monsoon seasons (1901-1970) it is seen that the mean dates of commencement of sowing rains (CSR) are the earliest over extreme south Konkan (South Ratnagiri District). Commencement of sowing rains progress gradually northwards along the coast reaching Raigad District by 8th June and the northern extremity of Thane District by 14th June. The variation across the coastal strip upto the ridge of Sahyadri is small. The average inter-spell duration between the first date of commencement of sowing rains and the next crop life saving rain is hardly a week to ten days. The study of dry spells related to agricultural drought shows that the probability of occurrence of dry sequences of 5 days with less than 6.3 mm./day precipitation is as much as 21 to 30 per cent in Konkan (Annexure 2.3). This is quite significant in the context of the water requirements of paddy crop on the Konkan soils.

2.3.7. *Evaporation and Evapotranspiration.*—The evaporation observations are recorded with standard Class A evaporimeter pan covered with wire mesh both at the Indian Meteorological and the Agro-meteorological observatories. The mean evaporation over the region attains a peak value of about 8 mm/day during April-May. Subsequently it decreases to about 4 mm/day during monsoon and post monsoon seasons. During February-March the evaporation is of the order of 6 mm/day (Annexure 2.4). The mean monthly potential evapotranspiration values over the region based on Penmann's formula range between 100-180 mm per day. Monthly and annual potential evapotranspiration values according to Penmann's formula for six stations in Konkan (including Goa) Dahanu, Santacruz, Bombay, Harnai, Devgarh, Marmugao have been computed and published in India Meteorological Department's Report No. 136.

2.3.8. A Lysimeter (volumetric) station is located at the rice research station at Karjat. In and around Konkan evaporation measurements are being made at Bombay (Observatory station), Karjat, Surat and Panji (Agro-meteorological observatory stations). There is also a proposal under consideration to have Evapotranspiration station at Konkan Krishi Vidyapeeth, Dapoli. Installation of a few more agro-meteorological stations is being contemplated by the Konkan Krishi Vidyapeeth. Since Irrigation Department will construct a few major irrigation projects in Konkan, agro-meteorological stations can also be installed in some of these project areas.

2.3.9. *Net work of rain-gauge stations and data availability.*—In addition to 50 raingauge stations in the region for which rainfall data are available with the India Meteorological Department for a period of over 75 years, 144 raingauge stations are maintained by the Irrigation Department. In addition, Irrigation Department also maintains 36 River gauging stations in Konkan. Locations of all raingauge and rivergauge stations are shown on Plate 3. A list of all the raingauge and rivergauge stations is also appended as Annexure 2.5. These are considered adequate for the initial planning purposes.

2.4. Geological Setting

2.4.1. The geological formations found in Konkan include those of pre-Cambrian, Mesozoic, Tertiary and Quaternary ages. The district-wise geological setting is as under:—

(i) *Thane District.*—A major part of the district is covered by basaltic flows, which are commonly referred to as Deccan Traps. These flows are intruded by a large number of dykes. They vary in thickness from a metre to as much as 30 m and extend over long distances upto 18 km. Majority of the dykes in the district trend between NNE-NNW to SSW-SSE

At places, laterite occurs on top of the high hills. Along the coastal part of the district there are deposits of coastal alluvium and shaly limestones.

(ii) *Raigad District*.—The entire district is covered with basaltic lava flows. These are intruded by number of dykes. In western parts of the district, the basalt flows are extensively altered to laterites. Recent deposits, comprising of beach sands and alluvium are found along the coast and near the river mouth.

(iii) *Ratnagiri District*.—Between the border with Goa, and the Phonda Ghat, ferruginous phyllites and pink banded ferruginous quartzites, micaceous quartzite and mica schist of Archaean Dharwar group are found. The regional strike of the formation is NNW-SSE with steep easterly dips. In Phonda Ghat-Malvan area, a large thickness of quartzites with minor conglomerates, shales and limestones belonging to Kaladgi group are exposed below traps. These are westerly extensions of the Kaladgi group found in Karnataka and southern parts of Kolhapur district. The strike varies from NNE-SSW to NW-SE with dips upto 25 ml. The area from the lower middle part of the district to northern border of the district is covered by basaltic lava flows.

2.4.2. Laterites derived by the leaching process acting on the traps and pre-Cambrian rocks occur over large areas on the high plateau of Sahyadri ranges at different levels. They are products of alteration of the basalts. The alteration process has also given rise to bauxitic deposits in a linear belt along the coast within a narrow width of about 5-6 km. from the sea coast between latitudes of 17°-42' N to 18°-42' N. (Plate 6). These bauxitic deposits are of varying qualities. The total available resource of bauxite of Thane, Raigad and Ratnagiri Districts may be of the order of little over 17 million tonnes.

2.4.3. In the context of water resources developments in Konkan, the engineering properties of laterite and lateritic soils are of considerable importance. These have been exclusively studied by the Maharashtra Engineering Research Institute (Ref.: MERI's Technical report SM/204-II March 80). This study will be extremely useful for planning and designing of dams, especially earthen dams in Konkan region. For construction of masonry or concrete dams, non-availability of sand of required quality and inadequate quantities within economical leads may have to be given due consideration.

2.4.4. Tectonically, Konkan region as a whole is disturbed and active. Some have suggested existence of a zone of fault located immediately west of the western cliff of Sahyadri and running approximately parallel to the west coast between latitude 17°N and 19°-36' N. i.e. from Ratnagiri to north of Thane and seismicity is attributed to release of the strains accumulated in the zone of faults. The post Koyna earthquake studies have indicated the existence of a major fault beneath the traps. The recent studies on seismicity have indicated that the narrow coastal belt of Konkan is likely to be susceptible to seismic activity due to artificial external loading.

2.4.5. *Thermal Springs*.—About 60 surface manifestations of warm and hot-springs (above 30° C) are known in 18 localities in Konkan along a 350 km. long belt trending roughly parallel to the coast line. The temperatures of these springs vary from 30° C to 70° C and the discharge from 630 to 8,415 litre per hour. Considering the geo-thermal gradients, the origin of these thermal springs may vary from 800 to 2,300 m. below the ground. From chemical analysis they can be termed as sodium chloride type.

2.4.6. The Geological Survey of India commenced their multidisciplinary exploration activities for geo-thermal energy resources in the west coast area of Maharashtra in the year 1975. During 1976-77, at the instance of UNDP the priority of work was shifted to southern group of springs covering Unhavre (Khed), Unhavre (Tamhanea), Aravli, Turat, Rajwadi, Sangameshwar, Rajapur and Math hot-springs. Under this UNDP Programme geological,

geo-hydrological, geo-chemical and geo-physical studies were carried out under the guidance of UNDP experts. Their findings, mainly based on the geo-chemical work, indicated the west coast area to be a low temperature field. However, the collection and interpretation of other data viz. thermal gradient, heat flow, geo-hydrological and geo-physical studies were still in progress. To verify the above findings from the geo-chemical studies, the investigation work has been continued by the Geological Survey of India.

2.4.7. It is seen that all the hot-springs have almost similar geological and geo-hydrological set-up. Barring Ganeshpuri and Akloli hot-springs which are associated with dykes, all other springs are generally associated with fracture and shear zones trending N 20° W—S 20° E. It is also observed that the trap flows which are nearly horizontal, show gentle dips west of the spring line, suggestive of effect of some deep seated structural feature and associated tectonic movements. Geo-hydrological studies reveal that occurrence and movement of thermal waters at depth is likely to be controlled by the pre-trappean topography especially in the southern parts of thermal spring belt covering the areas of Tural-Rajwadi, Unhavr (Khed) and Rajapur hot-springs. Trap-flow-Kaladgi contacts in favourable palaeotopographic dispositions at depth could be the likely areas for occurrence of deeper thermal reservoir. Keeping this in view, geo-physical surveys to bring out pretrappean topography underlying the west coast thermal spring belt were proposed by the Geological Survey of India and the results are said to be encouraging. Similarly, the lineament studies in selected areas also corroborate the findings from geo-physical surveys. Hence it is necessary that these studies are pursued in further details. Whether the hot waters of these springs can be used with advantage as a source of thermal energy needs to be fully investigated early.

2.5. Land Forms

2.5.1. The entire region is covered by dissected hills. The eastern side is demarcated by the crest zone and escarpment of Sahyadri ranging in altitude from 600 to 900m. and 150 to 600 m. above the mean sea level respectively. From the crest zone or the escarpment, the protruding ridges run in the western direction varying in height from 100 to 450 m. At places they are dissected into low hills breaking the continuity of the ridge lines. Low dissected plateau surfaces, rocky and rugged in nature, form the major portion of western parts of Thane District and the southern part of Ratnagiri District. The sharp but sinuous strip of escarpment exhibits a gravitational fault. From the crest zone the tiny streams run very swiftly towards the Arabian Sea dissecting the escarpment and the ridges developing narrow valleys in the rocky terrain. In the western part they exhibit meandering courses because of loss of gradient and have developed tiny flood plains along their banks. The ridge line and stream courses run parallel to each other especially in southern part of the region developing narrow valley bottoms. (Plate 1).

2.5.2. From the above, the region can be divided into the following landform units (i) crest zone at an elevation of 600-900m., (ii) steep escarpments with elevations of 150-600m., (iii) high hills and ridges 100-450m., (iv) low hills 100-150m., (v) valley bottoms 100-600m., (vi) low dissected rocky plateaus 150-300m. and (vii) coastal plain below 25m. Along the coast, the marine landforms like lagoons, estuaries, mud flats, marshy land and sand beaches are common.

2.5.3. *Rivers.*—Rivers in the Konkan region emanate from the western ghats at elevations ranging from 436 m. to 1,585 m. above the sea level, generally run west-ward and meet the sea after a short run varying from 50 km. to 270 km. It is, thus, natural, that the rivers are very steep in the earlier reaches and fairly steep in the middle reaches. It is only near the sea that they have relatively flat gradients and some sort of a flood plain. In the relatively flat reaches, almost all the rivers are subjected to tidal influence. There are as many as 20 river basins in Konkan (Plate 2).

2.5.4. Because of the steep slopes and the shallow cover of soils, almost all the rivers flow in monsoon and go almost dry during the late fair weather season. The rivers have developed tiny alluvial flood plains along their banks where their slopes flatten. At the mouths of the river, the tidal effect is seen to reach even upto 40 km. in the interior, for the rivers like Vaitarna and Amba.

2.5.5. Toposheets of the Survey of India are always a great asset in the field investigations for irrigation, hydropower, or forest development projects. But it is noticed that three Toposheet Nos. 47-G-6, 48-E-9 and 48-E-15 do not yet show the contours. Preparation of contoured survey sheets for the areas covered by these 3 Toposheets will have to be given priority, so that the investigational programmes in these areas do not suffer for want of adequate ground data.

2.6. Land-use

2.6.1. The geographical area, culturable area and the areas under forest of the three districts of Konkan are as below:—

District	Geographical area (ha.)	Culturable area (ha.)	Forest area (ha.)
1. Thane ..	9,55,300 (100%)	3,39,000 (35%)	4,62,100 (48%)
2. Raigad ..	7,19,800 (100%)	3,28,000 (46%)	2,22,600 (31%)
3. Ratnagiri ..	1,30,400 (100%)	8,61,000 (66%)	80,800 (6%)
Total ..	29,79,500 (100%)	15,28,000 (51%)	7,65,500 (26%)

2.6.2. On the basis of the land use statistics, the present land use pattern is as below (Source : All India Land Use Statistics) :—

Land use	Area (1000 ha)
1. Forest	563.8
2. Barren and uncultivable land	569.0
3. Land under non-agricultural use	136.9
4. Cultivable waste	371.1
5. Permanent pasture	139.0
6. Land under miscellaneous tree crop	76.7
7. Fallow land	280.7
8. Net area sown	810.2
9. Unclassified (by difference)	71.6
	3,009.0

It may be seen from this, that net area sown is very small proportion of the geographical area. Moreover good culturable area has been largely fragmented. Size of most of the holdings is very small (Annexure 2.6).

2.6.3. District-wise land use statistics of the area is appended at Annexure 2.7. The geographical area of the district of Greater Bombay is 60,300 ha. Since the area is expected to be highly urbanised, the statistics of the land use pattern for this district is not indicated.

2.6.4. It is seen that the figures of cultivable area and the areas under forests do not tally. One of the reasons for this could be the methodology of assessment of the land use classification by the different agencies. It is also learnt that in addition to the reserved and protected forests, there are some private forests in the Konkan area which may have been classified differently by different agencies. This would point out to the need for updating the land use classification in a realistic manner. In spite of the above data gap, the overall picture indicated by the above data is reasonably adequate for the purposes of developmental planning.

2.6.5. The area under private forests is estimated to be about 1,810 sq. km. out of which, 1,249.4 sq. km. was actually taken over by Government under Private Forest Acquisition Act, 1975. As a result of subsequent amendment to the act in 1978, individual holdings which were less than 12 ha. in extent were restored back to the original owners. The extent of old private forests left in the possession of the forest department has been only 865 sq. km. by March 1980.

2.7. Soils

2.7.1. The soils of Konkan may be classified as follows:—

1. Laterite soils.
2. Alluvial soils.
3. Coastal saline soils.
4. Paddy soils in the valley.
5. Forest soils.

2.7.2. Under the heavy monsoon rainfall the rocks have undergone intensive weathering, and are considerably leached. The weathered products are carried away by the rapid runoff from the steeply sloping lands. The residual soils left behind are usually reddish-grey to reddish-yellow in colour, shallow in depth, and coarse (sandy loam to silty loam) in texture. They are acid-neutral in reaction and highly friable non-calcareous. Internally, they are rapidly drained. In plains and along nallah-banks the soils have dark grey colour, are moderately deep and slightly finer in texture with acid to neutral pH. The coastal saline soils called the 'Khar-Lands' have increased content of soluble salts and present special management problems.

2.7.3. Paddy soils are generally reddish yellow to greyish in colour and have soil depth varying from 600 to 1200 mm and are usually terraced for rainfed paddy cultivation. The garden soils and the alluvial soils can possibly be grouped in a single broad group which can support garden crops and of other high value plantation. The forest soils are shallow and coarse textured,—especially on the hill-slopes.

2.7.4. The alluvial soils occur along the flood plains of the major rivers and to some extent along the coast in a narrow belt somewhat away from the sea. The saline soils occur in a narrow belt along the sea coast and to some extent along creeks and are subjected to tidal influence and as such may not be suitable for agricultural operations unless salt water ingress is prevented and the land reclaimed. The coastal saline soils called the khar lands show an increased content of soluble salts and present special management problems.

2.7.5. The fertility of the highly leached Konkan soils is usually low even with a fair amount of organic matter. The acidic reaction and the rapid internal drainage of these soils puts some limitation on their response to the easily soluble chemical fertilisers which may get either leached or become fixed in an unavailable form (P). The low fertility and the acidic reaction of these soils would require special attention in the choice and use of fertilisers and the time and methods of their application. Use of organic mixtures and slow-release fertilisers are likely to be more suitable; use of local source like fish-meal may have to be encouraged.

2.7.6. Systematic and extensive investigation of entire soils of Konkan is yet to be undertaken. Based on a few sample surveys, it may be stated that the soils are slightly acidic (Ratnagiri) to neutral in reaction (Raigad, Thane and ranging from sandy to loamy in texture. The colloidal complex is low in bases and divalent cations accounting for more than 90 per cent of the total exchangeable bases. They are fairly well supplied with nitrogen but are poor in available phosphate and potash. The district-wise distribution of soils is broadly assessed and shown on Plate 4. Results of typical soil analysis are appended at Annexure 2.8.

2.7.7. *Irrigability of Konkan Soils.*—From the foregoing data it would appear that the major constraints for irrigation of these soils would arise from:

- (1) their limited water holding capacity,
- (2) their rapid drainage, and
- (3) their situation on steeply sloping lands.

These factors are unfavourable for open, unlined gravity canals which would probably lead to excessive seepage. They also indicate the need for a short rotation period of 5-7 days in the Rabi and Hot-weather seasons. Considerable land shaping and levelling work would also be involved in cutting slopes exceeding 5 per cent. Detailed investigations on the hydrological and drainage characteristics of these soils are necessary for the determination of soil moisture curves.

2.7.8. A large portion of these soils, especially in Ratnagiri District are of lateritic origin. In view of this, they may pose some problems for their use as engineering material for the dams. Due to their pervious nature they may also cause relatively large seepage losses from the canals. Provision for lining of the canals in such areas will have therefore, to be carefully detailed out.

2.8. Surface Water Resources

2.8.1. On the basis of empirical formulae for rain-fall and run-off, the total surface water potential of the Konkan region right upto the mouths of crooks has been roughly estimated as 5,273 T. ha. m. at 75 per cent reliability. This includes 326 T. ha. m. of permissible diversion from east to west from the Koyna Project and from the Tata's hydro electric projects. Basin wise 75 per cent dependable yields as assessed from the empirical formulae is shown at Annexure 3.1.

2.8.2. Good record of rainfall and gauged run off has been maintained at Bhatsa Dam site at Sajivali, in Thane District. Rain fall run-off relationship established from the hydrological analysis of the Bhatsa catchment shows that run-offs are likely to be 16 per cent less than those indicated by the Inglis's formula traditionally used in assessing the basinwise yields. Similar analysis is also done for the river Kalu. Such relationships are not yet established for the other valleys and especially for valleys in Raigad and Ratnagiri Districts. When the actual availability is assessed basinwise on the basis of relationship in the observed rainfall and rain off actual availability may reduce to some extent. But since the total available supply is substantially more than the needs of the area except in the Bombay Metropolitan Region in the north, this may not be of consequence immediately. This, however, points to the need for establishing rainfall and gauge discharge sites on the important rivers of the region.

2.8.3. Central Water and Power Research Station, Khadakwasla has established an experimental station for the hydrological measurements on a watershed near Khopoli in Raigad District. In view of the importance of the small watersheds as discussed in the subsequent chapters—in the land and water based development programmes in Konkan, it is necessary to establish immediately at least three more stations on similar lines for watersheds of less than 10 sq. km.—one in southern part of Raigad District and two in Ratnagiri District.

2.8.4. In view of the rapid urbanisation and industrialisation around Bombay, the water resources of the Ulhas and Patalganga basin in the northern part of Konkan have been and may have to be further developed mainly for urban and industrial uses in the vicinity of Bombay. It is, therefore, appropriate that watershed areas that drain through the Bombay Metropolitan Region are considered as a separate unit for purposes of water planning. This has already been considered by the Bombay Metropolitan Region Development Authority in their planning

activity, and an area of about 11,950 sq. km. has been identified as Bombay Hydro metric Area and water resources of the area have been assessed from the point of view of use for BMRDA's activities. The geographical extent of Bombay Metropolitan Region and the Bombay Hydro-metric area is shown on Plate 2. In the Bombay Hydro-metric Area, about (495.7 T. ha. m.) of waters are available at 95 per cent dependability from the identified storage sites on the rivers which flow into the sea through the Bombay Metropolitan Region.

2.9. Ground Water Resources

2.9.1. Ground water recharge in the area of the three districts of Konkan has been assessed in 1979 by the Ground Water Survey and Development Agency (GSDA) of Maharashtra State from water balance studies as (330 T. ha. m.) and exploitable ground water resource assessed as about 165 T. ha. m. on the basis of some assumptions. The valleywise tentative assessment of ground water done by GSDA is at Annexure 2.9.

2.9.2. The lateritic soils and lateritic formations in the region have very high permeabilities and hence do not 'hold' large quantities of water. The fresh basalts are also not known to be very promising as water bearing strata. Water in basalts is generally held in the weathered rock mantle (which is rather thin in Konkan) or in the joints which in Konkan are not open for great depths or in thin inter trapean beds. But in view of the nature of geological formations which is seen to be criss-crossed by a large number of lineaments as assessed from the satellite and aerial photography it appears that the ground water in Konkan may exist along such lineaments. The alluvium which is seen along the coast and along the relatively plain river valleys in narrow widths is also expected to hold some ground water under water table conditions. Its proximity to sea will place some limits on its exploitation.

2.9.3. At present ground water extraction is mostly through about 57,000 dug wells of which about 9,000 are fitted with mechanical pump sets. The rest of the wells use rather primitive lifting devices such as mots and lats. They can provide irrigation facility for about 15,000 ha. On the whole, use of ground water is rather limited.

2.9.4. GSDA undertakes drilling programme in difficult villages which are located in unfavourable hydrogeological setting. Upto the end of December 1980, in all 2,018 borewells have been drilled in the districts of Thane (906 borewells), Raigad (679 borewells) and Ratnagiri (433 borewells). The majority of the borewells have been drilled in the Deccan trap. Out of the total borewells drilled, 1,282 borewells have been reported as successful by GSDA. District-wise and geological formation wise rate of success has been given in Annexure 2.10.

2.9.5. It is necessary that the ground water potential in the three districts of Konkan is assessed on a more firm basis by detailed investigations in a time bound manner. It also appears, the storage and transmissibility potential of the Konkan rocks needs to be assessed with extensive field experimentation so that more reliable estimate about the availability of ground water can be had. This would require augmentation of the field units of the GSDA. GSDA has under taken such a study and one sub-division is working in the area. However, to complete the study in a period of three years it is necessary to strengthen the GSDA. organisation by adding at least two more sub-divisions.

2.9.6. Extensive research on the behaviour of "ground water" in lateritic areas is also called for immediately. The storage works tried in this area have not been successful because of heavy percolation losses from the reservoir basins. It will have to be checked up how far it would be feasible to use the porosity of the lateritic mass for undertaking the projects for ground water recharge. Sophisticated isotop tracer studies for such a field work may be undertaken through an organisation, like Central Water and Power Research Station and BARC.

2.10. Agriculture

2.10.1. Agricultural productivity in Konkan continues to be dependent upon the monsoon rainfall. Most of the instability in foodgrain production in India is due to the variability in the production of rice and wheat which are grown in the 'so-called' assured rainfall areas. Nearly the entire unirrigated rice is grown in high rainfall area (areas of more than 1,100 mm. rainfall). Similarly unirrigated wheat is grown in areas of medium rainfall, 750-1,100 mm. In the drought year of 1979, 65 per cent of the fall in production of cereals was accounted for by rice, and 23 per cent by wheat.

2.10.2. No other factor is as critical to rice production as the moisture stress at the reproductive stage of the crop. Yield reduction from lack of water during reproductive stage can lead to serious loss in rice productivity. For a crop of 110 days' duration, this stage is 70-85 days after sowing. Thus, the moisture stress for the crop sown in the first week of July, will be in the second half of September. For longer duration crop, as is the case in many rice growing areas, this critical period will be in October. Rainfall in this period (September and October) is both, inadequate and uncertain.

2.10.3. The predominant crop in Konkan is Paddy which is largely rainfed. Low quality cereals such as Jowar, hill millet and other local grains are also grown. Pulses are essentially grown on the residual moisture after the monsoon months. During the rainy season, there are at times very long dry spells, causing severe strain especially for the paddy crops.

2.10.4. The cropping pattern and the Agricultural production realised in Konkan for the year 1978-79 is given in Annexure 2.11. Total area under cultivation, total foodgrain production and the average districtwise yield was as follows:—

District	Area '00 ha.	Total foodgrain produced '00 tons	Area yield kg/ha.
Thane	1937	2979	1538
Raigad	1863	2971	1595
Ratnagiri	2388	3081	1294
Total	6188	90741	1461

2.10.5. The prevailing high yield rice varieties, generally being used are given below. The yield shown against each is under ideal conditions.

	Tons/ha.
(i) Karjat 184	3 to 8.5
(ii) Ratna	4 to 4.5
(iii) Taichung	4 to 5.0
(iv) Jaya	5 to 6.0
(v) I.R.S.	5 to 5.50
(vi) Ratnagiri 68	5 to 5.50
(vii) Karjat	4 to 4.50
(viii) Ratnagiri 24	3.50 to 4.0

2.10.6. Figures of area under paddy and area under H.Y.V. for the year 1977-78 were as below:—

Sr. No.	District	Total area under paddy (000 ha.)	Area under H.Y.V. (000 ha.)	Average H.Y.V. (Kg./ha.)	Yield local (Kg./ha.)
1.	Thane	150	71.0	2,029	1,544
2.	Raigad	141	96.6	1,971	1,500
3.	Ratnagiri	141	65.7	2,004	1,362
For Konkan Region		432	233.3	2,001	1,469

2.10.7. Compared to the total availability of surface water resources, the use of the water resources by rainfed agriculture and the flora of the region is estimated to be very small. On the basis of evapotranspiration requirement of the entire area over the period of four months in kharif season, it is estimated that out of a total precipitation only about 1495 T. ha. m. would be consumed leaving a large quantum of surface water resource for further exploitation.

2.11. Forests

2.11.1. Though about 26 per cent area of the three districts in Konkan is classified as forest area, its distribution in three districts is not uniform. It is 48 per cent in Thane District, 31 per cent in Raigad and only 6 per cent in Ratnagiri. The area under actual tree cover is even less than this. It is only 14 per cent of the Konkan's geographical area (Annexure 2.12) The coastal strip in Thane district has comparatively thick forest and it gets thinner towards east. Dahanu, Palghar and Vasai have comparatively more area under forest as compared to the hilly talukas. More than 90 per cent of the forest is Tropical moist (mixed) deciduous forest. There are mainly two types of forest namely (1) Reserve and (2) Protected forest covering respectively 74 and 26 per cent of the total area under forest. The major produces are Teak, Ain, Bibla, Khair, Dhavda, Hed, Kalamb, Charcoal, Kadhipatta, Babul, Mahuaflowers, Hirda, Karvi, Vavding.

2.11.2. The southern part of Raigad district comprising of Mangaon, Mahad, Poladpur, Mhasala and Shriwardhan talukas has a low percentage of forest area, compared to other talukas. Mostly the forest is situated on the higher slopes and spurs of the hills, running along the western side of the district. The forest in Raighad is mainly of mixed types with Teak, Ain Bibla, Khair, Nava, Shisam, Savar, Jambul, Hirda and Bheda as main deciduous species. The minor species are Apta, Shikakai, Tad, Palas and Chillari.

2.11.3. Unlike Thane and Raighad District, Ratnagiri has very low percentage of forest. The southern part of the district consisting of Kankavali, Kudal and Sawantwadi talukas have slightly higher percentage of forest area (about 8-10 per cent), but in all other talukas it is less than 1 per cent. The main species are the same as in the Raigad District. The major forest produce is either consumed locally or sent to Kolhapur, Belgaum and Nipani. The minor forest produces like Shikekai, Savar, Tamalpatra, Kokam, Wavding are sent to Bombay.

2.11.4. Teak is generally used in buildings or for furniture and industrial purposes. The wood of Ain is durable and hard and is therefore used for buildings. It's bark is used for tanning and it's sap yields a gum which is largely eaten. Khair is used for 'Kat' as well as fuel. Apta leaves are valuable in cigarette-making. Heda is a pretty looking tree used for beautifying the area. Its logs are used for fish stakes. Karvi Stakes are used for hut and cottage buildings. Dhavada is a firewood and its gum is generally eaten. It is also used for making cart axles, poles and for cloth printing. Its leaves yield a black dye and is used in tanning.

2.11.5. Although as per land use statistics, maintained by the Forest Department of Maharashtra, 26 per cent of the area in the three districts is categorised as forest area, due to destruction of forest and other causes the actual area under forests is reported to be much less. It is also possible that some of the area which is under private forest lands may have been classified elsewhere as culturable wastes. Therefore, it is necessary to up-date the statistics pertaining to the area under forests.

2.12. Horticulture

2.12.1. The region offers good scope for horticultural development, as all the factors like soil, climate rainfall and temperature are favourable. Local people are also becoming increasingly aware of the market prices of the fruit crops. The climate of Konkan is particularly favourable for many exotic varieties of fruit trees like Alphonso Mango. Many plantations of this variety exist in the southern portion of Konkan especially in Ratnagiri District. There is considerable scope for increasing the area under mangoes and other fruit crops.

2.12.2. The important fruit crops are Bananas, Mango, Guava, Pineapple, Jackfruit, Chikoo, Cashewnut and Kokam. Besides this vegetables like Sweet Potato, Onion, Cabbage Brinjal, Tomato, Lady's Finger, Cauliflower are also grown. The vegetable growing activity is especially seen in Thane District due to the nearness of vast market of Bombay City. Vegetable production in Raigad District mostly goes to satisfy the local demands. However, Ratnagiri District is far below the desired level, with the result that vegetables are brought from Kolhapur even to satisfy the local demand. Existing horticulture in Konkan is as per Annexure 2.13.

2.13. Fisheries

2.13.1. At present, there are in all 2,376 water sheets in Konkan Region comprising of reservoirs (200 hectares and above), medium tanks (21-200 hectares) and ponds (1-20 hectares). There are 2 reservoirs with water spread area of 3,015 hectares, 25 medium tanks with a hectareage of 1,433 and 2,349 ponds covering an area of 2,286 hectares. The total waterspread area is 6,698 hectares.

2.13.2. These watersheet areas are being stocked with 84.43 lakhs of fish seed as against the optimum capacity of 170 lakhs. The present fish production from these watersheets is 1,597 M. Tonnes valued at Rs. 83,82,000 as against the optimum capacity of 1,870 tonnes valued at Rs. 112.2 lakhs. 2,349 ponds are under the control of local bodies and Zilla Parishad. Fishing rights of only 27 tanks are under the control of the Department of Fisheries. Five co-operative societies, 280 local bodies and 64 individuals avail of the benefit of purchase of seed. Fish seed is supplied at subsidised rates to fisheries co-operatives and local bodies. The rate of subsidy is 31½ per cent. Total amount of subsidy granted to the local bodies and fisheries co-operative societies in 1980 was Rs. 76,469.

2.13.3. Development of fisheries in 27 irrigation tanks is undertaken, exclusively by the Department of Fisheries. They are being stocked regularly. 22,67,000 fry was stocked in these water sheets during 1980-81. To cite an instance Dapcheri tank (540 hectares) in Thane District was stocked with 10.60 lakhs seed and leased to a tribal co-operative society, having a membership of 851. Total fish netted from this reservoir in two years is 24.7 tonnes which was valued at Rs. 1,00,340. It is thus evident that there is considerable scope for sweet water fisheries development in Konkan as the development of surface water resources progresses. The fisheries organisation would need to be strengthened to take all this anticipated increase in their activities.

2.13.4. *Brackish Water Fish Farming.*—There is a total area of 80,000 hectares of brackish waters in the four districts of this region. Out of the 71 creeks, 38 creeks and the brackish water areas around these are surveyed, under a special project. 6,400 hectares out of 16,622 hectares

so far surveyed have been found to be suitable for fisheries development during the initial survey. There may be some scope for development of prawn in the Brackish water fish farms. Though the survey for natural seed source is going on, areas which could offer sizeable quantities of economic varieties of prawn seed have not yet been indentified. Some concerted effort in this direction is called for.

2.13.5. Alongwith development of fisheries the development of commercial and marketing infrastructure for preservation of the catch, transportation to the various centres and selling at the demand centres may have to be thought of and provided for.

2.14. Khar Land Development

2.14.1. Some of the lands in Konkan which are near the coasts or which are along the creeks, are subjected to effects of tides and are effected by ingress of periodical sub mergence due to the saline waters of the sea or the creek. Those lands are termed as Khar Lands. A typical scheme for reclaiming these lands consists of providing low height earthen bunds around these lands with suitable self closing outlets. During the past 30 years, 252 khar land development schemes reclaiming an area of about 33,572 ha. at a cost of Rs.145.65 lakhs have been completed. In addition to this, there are about 150 private khar land developments covering an area of about 4,000 hactares completed by the individuals. Based on toposhoet studies, district-wise outline plans for areas yet to be reclaimed have also been prepared by the Department of Irrigation. According to these plans , 433 new khar land development schemes have been identified in the 3 districts. These will cover an area of about 26,869 hectares and reclamation of these areas is estimated to cost about Rs. 32 crores. From these new schemes 23 have been taken up for construction. 17 more have been surveyed and their project reports, formulated. Detailed surveys for the remaining 393 schemes are yet to be taken up (Annexure 2.14).

2.14.2. For deciding the economic yardstick for reclaiming these khar lands, Government of Maharashtra have fixed up a financial yardstick. The economic yardstick for reclaiming these khar lands are available in Government of Maharashtra, ID'S Resolution No.KLD-1078/(600/73)/MIN-I, dated 30th September 1978. They are, (i) Rs. 5,000 per hectares for schemes requiring protection for the bund from one side, (ii) Rs. 6000 per hectares for area reclaimed for schemes requiring protection from both the sides and (iii)for difficult sites, this yardstick is increased by 25 per cent.

2.14.3. Whether all the identified schemes will fit in this yard stick, is not yet clear, as detailed investigations are yet to be done. Earlier, these schemes were being treated as district level schemes. Government of Maharashtra have now decided to treat those schemes as State Level Schemes. For construction of these schemes, additional establishment will also be required to be provided. It is learnt that the Government of Maharashtra have, in principle, accepted the need for creating one division with 6 sub-divisions for each of the three districts of Konkan to take up the work of investigations and of construction of khar land development schemes. At present there is only one sub-division for each of the three districts.

2.15. Irrigation Development

2.15.1. Irrigation development in Konkan is expected to take place mainly through medium and minor irrigation projects . There will be only a few major irrigation projects. The minor irrigation projects benefitting an area of over 100 hectares are being financed and implemented by the State Sector and the projects benefitting 100 hectares and, less by the Zilla Parishads in the local sector. As at present, one major irrigation project, namely Kal irrigation project utilising the waters of tail race of Bhira power house, 69 minor irrigation projects in the State-Sector and 1,147 minor irrigation projects under Local Sector—all categories together covering

a service area of 35,159 hectares, have been completed. Less than 3 per cent of the culturable area in Konkan can receive irrigation service from these completed irrigation schemes. The districtwise details of this development can be seen at Annexure 3.2. Water use of 54.54 T. ha. m. is envisaged from these projects.

2.15.2. In addition to the above, the construction work on 9 major and medium projects is in progress. Fifty four minor irrigation schemes in the State Sector and 313 minor irrigation schemes in the Local Sector are also in progress. On completion of all the projects under construction, an additional area of 85,878 ha. involving a surface water use of about 210 T.ha.m. is expected to be brought under irrigation service. The districtwise details in respect of these projects are indicated in Annexure 3.3.

2.15.3. Thus, the surface water use contemplated from the completed projects and from the project under construction is expected to be about 364.54 T.ha.m. only. With a service potential of 1.2 lakh hectares considering that additional area of about 15,000 ha. is being served by the ground water development, (which may utilise about 10 T.ha.m. of ground water) the area under irrigation from all these schemes together would be about 9 per cent of the culturable area in Konkan. But compared to the total availability of surface waters in Konkan, only a small quantity will be harnessed by these schemes for irrigation service in Konkan. As will be seen from the discussions in the following chapter 3, there is considerable scope for irrigation works in Konkan. Much greater attention to this activity will be required in the years to come to utilise the available potential.

2.16. Hydro-Electric Development

2.16.1. As at present, the Koyna Hydro-electric project with an installed capacity of 840 MW and the Tata Hydro-electric systems Khopoli power house (6×12 MW), Bhira Power house (3×22 and 3×25 MW) and the Bhivpuri power house (6—12 MW) are the four hydro-electric stations situated in Konkan. Together they divert about 326.9 T.ha.m. of waters of the east flowing rivers to the west. A project to use the tail race waters of Bhira power house by installing an additional capacity of 80 MW is already under construction and is scheduled for completion by 1984-85.

2.16.2. On the west flowing waters of Vaitarna, 60 MW station in Nashik District has already gone into operation. Another hydro-electric project for utilising the west flowing waters of Tillari is under construction in Kolhapur and Ratnagiri Districts for an installation of 60 MW. It is scheduled for completion in 1983-84. The tail race waters of Bhira power house are already being used for irrigation through the Kal project, the waters of Bhivpuri tail race, on the Rajanalla system and the waters of Khopoli power house on canals from Patalganga. Much of the tail race waters from Bhivpuri and Khopoli is however being used for industrial water supplies. The waters of Koyna tail race however do not appear to have been much used except from a few local lifts. By themselves, the hydro-electric systems do not envisage an appreciable consumptive use of surface water. Water from hydro electric projects is available for reuse in irrigation or domestic and industrial water supplies. Hence hydro power projects will not constitute much of a net charge on the water account of the west flowing rivers.

2.17. Domestic and Industrial Water Supply

2.17.1. Of the Domestic and Industrial demands, the demand from the Bombay Metropolitan Region needs special consideration. This demand will be concentrated in the northern portion

of the Konkan region where sizeable demand for irrigation is also anticipated. As per BMRDA's estimates, water demands of the Bombay Metropolitan Region may be as below :—

Existing (1971)	Population (lakhs) (1971)	Water demand (in T. ha. m.)		
		Domestic	Industrial	Total
Bombay	59.70	23.60	47.30	70.90
Thane (Part)	13.43	4.60	9.20	13.80
Kolaba (Part)	4.78	3.50	17.10	20.60
	Total	31.70	73.60	105.30
Total Projected—				
1981	107.98	91.60	44.30	135.90
1991	142.51	105.51	53.09	158.60
2001	173.82	151.20	59.10	210.30

2.17.2. The above estimates do not take into consideration some new developments, such as:

- (1) Konkan railway and resultant demands.
- (2) Fertiliser complex at Thal Vaishet in Raigad District.
- (3) Petro-Chemical complex at User in Raigad District.
- (4) New industrial areas near Tarapur and Virar in Thane District.
- (5) Nhava-Sheva port and consequent industrial development.

These developments are expected to enhance the industrial demand for water to a considerable extent. Studies for the additional requirements are under way and the results may be available in the next six months.

2.17.3. The BMRDA has carried out a study of water resources availability in the Bombay Hydro metric Area (BHA) and have assessed the availability of water at 95 per cent dependability as 496.7 T. ha. m. from the exploitable resources of Ulhas, Patalganga, Kalu, Bhatsa Vaitarna, Surya, Bhogeshwari and Amba rivers in the Bombay Hydrometric Area. Some smaller sources have also been identified and they can provide additional 35.0 T. ha. m. Prima facie, therefore, the projected demands for industrial and domestic supplies would normally be satisfied from the total availability point of view. But the irrigation demand in the Bombay Hydrometric Area which is expected to be about 311.5 T. ha. m. will also have to be satisfied from the resources of the BHA. Hence a very careful and detailed planning of the water resources in the BHA is immediately necessary. It may be necessary to import waters from the rivers outside the BHA.

2.17.4. In this context, it may be kept in mind that about 80 per cent of the domestic and industrial demand may appear as return flows. The sites of the treatment plants may therefore have to be so chosen that the effluent could be used for irrigation to the extent practicable. Steps will have also to be taken to ensure that the industrial effluents are pretreated adequately, so that they do not pollute the supply and make it unfit for irrigation.

2.17.5. Apart from the demand for MBRDA, the municipal and village water supply demands for the remaining areas of Konkan indicates a requirement of 27 T.ha.m. by 2,001. Compared to the total availability of water in these areas, this demand would be quite small and will not pose any problems in the water planning of the rest of the valleys.

2.17.6. *Other Industrial Demands.*—Consumption demands for other possible uses such as, for fisheries and recreation are not expected to be large. For the Industrial area to be developed by MIDC, however, a reservation of 116.41 T.ha.m. has been requested for from the following valleys —

1. Damangana, Vaitarna and Ulhas	57.78* T.ha.m.
2. Patalganga, Amba, Kundalika and Savitri	42.10* T.ha.m.
3. Vasisthi and other basins south of Vasisthi	16.51* T.ha.m.

(*Some of these demands are already accounted for in the requirements of BMR)

2.17.7. From the point of location of industries, the Konkan Region affords a distinct advantage on account of its closeness to sea. Disposal of industrial effluents is, a relatively less difficult problem in Konkan. Because of this facility many chemical industries are situated in the MIDC's industrial areas in Konkan. More such industries are likely to be established in Konkan by taking advantage of the plentiful water resources available in Konkan and the convenient facilities for the disposal of the effluents. Industrial demand may, therefore, in reality exceed the estimates of requirements mentioned above.

2.18. Rural Electrification.

2.18.1 The impact of rural electrification in Konkan districts has been studied by Vaikunthbhai Mehta Smarak Trust and analysed in their report titled 'Impact of Rural Electrification on decentralised rural Industries (1980). The report points out that inspite of proximity to the highly industrially developed area of Bombay, the 3 districts of Konkan are still industrially backward. While some parts of Thane and Raigad Districts, have few industrial complexes by way of an over-flow of industries from the Greater Bombay District, rest of the area from these districts and practically the entire district of Ratnagiri have remained almost insulated from the influence of industrial development of Greater Bombay, mainly due to want of adequate rural electrification. So far, major thrust for rural electrification came from the funds placed at the disposal of MSEB by the Government under various electrification schemes. The funds sanctioned by the Rural Electrification Corporation (REC) to MSEB on liberalised terms had only an additive effect.

2.18.2. By 1977-78, out of a total of 4,907 villages, the total number of villages electrified was 2,725 which worked out to about 55.5 per cent as against the State average of 60 per cent. The activity of rural electrification was expected to give a fillip to the use of agricultural pump sets. However, in actual practice this has not happened. Against a target of 1,779 pump sets for power connections, only 298 i.e. 17 per cent of the target were electrified in 1978. The performance in Ratnagiri District was somewhat better, at 25 per cent, whereas for Raigad District, it was barely 3.3 per cent, Thane District occupying the middle place, at 18.8 per cent.

2.18.3. There were many reasons for this poor performance. The assumption that installation of agricultural pumps could take place simultaneously with the electrification of villages proved to be unrealistic. There was a time-lag of about 2 years. Non-availability of water in wells, limited scope for development on account of low irrigability potential of the lift schemes, preponderance of small and uneconomic land holdings and lack of interest and awareness among the farmers about the proper use of electricity and machines suitable for lifting water, have contributed to the slow development. The impact of rural electrification on rural industrialisation also shows a considerable amount of backlog for various reasons.

2.19. Techno-Economic Survey of Konkan Region

2.19.1. Indian Merchants, Chamber have carried out a techno-economic survey of Konkan region in 1963 and compiled valuable data pertaining to the potential of the region and the possibilities of future development. Some of the data contained in this report now needs to be updated. A fresh survey would be very useful. Particularly it will be of great value in identifying the areas and also the locations where future industrial water supply demands would be generated. This will be of considerable help in preparing detailed plans for water resources development.

2.20. Institutional Infrastructure

2.20.1. *Konkan Revenue Divisions.*—Till recently, Konkan region formed a part of the Bombay Revenue Division covering 6 districts, 3 from upghat areas and 3 from Konkan. Recently, Government of Maharashtra have created a separate Revenue Division for the Konkan Region with headquarters at Konkan Bhavan, New Bombay. Separate Konkan Regional Offices of the other State Departments are also likely to be opened shortly. Although the headquarters of this new Revenue Division are, for the present, located at Konkan Bhavan, the question of deciding a suitable location for the divisional headquarters is under consideration of State Government.

2.20.2. *Irrigation Department.*—With effect from 1st January 1981, a separate post of Chief Engineer, Irrigation Department, for the Konkan region has been created. Twenty-four divisions under 4 circles have been working for the Irrigation development activities in Konkan under the Chief Engineer for Konkan Region. In addition, 6 Divisions are active on the Hydro Power developments on the west flowing rivers.

2.20.3. *Agriculture Department.*—The three Konkan districts i.e. Thane, Raigad and Ratnagiri are under the administrative and technical control of Superintending Agricultural Officer, located at Thane. For implementing the various programmes and activities of the Department of Agriculture in Konkan Division; he is assisted in this work by 3 Deputy Directors of Agriculture located at Thane, one for each of the 3 districts. In addition, there are 2 Divisional Soil Conservation Officers one located at Thane and the other at Ratnagiri. The Sub-divisions under Divisional Soil Conservation Officers are located at Wada, Shahapur, Jawhar-I, Jawhar-II and Alibag (Raigad District) under the Thane Division, and at Ratnagiri, Kudal, Chiplun, Khed under the Ratnagiri Division.

Agricultural Development Officer in the Zilla Parishad looks after the agricultural activities in the district and is responsible for implementing the various programmes of the State's Agriculture Department. Amongst the important schemes and activities of the Department of Agriculture carried out through Zilla parishads are the following :—

- (1) Schemes for horticulture development—new plantation, rejuvenation and renovation coconut demonstration.
- (2) Bringing new area under cultivation, rejuvenation of existing old orchards and renovation.
- (3) Granting of loans for mango plantation.
- (4) Laying out demonstration plots for improved methods in cashew cultivation.
- (5) Scheme for package programme of mango in Maharashtra State.
- (6) Raising of vegetable and fruit nurseries for propogation.

2.20.4. *Department of Animal Husbandry.*—In each of the three districts, i.e. Thane, Raigad and Ratnagiri, there is one District Animal Husbandry Officer, who is incharge of the general activities of the Animal Husbandry Department, being implemented in the district

In addition there is a cattle breeding farm at Kudal under the charge of a Superintendent and an intensive cattle breeding project at Chiplun, under a separate Project Officer.

2.20.5. *Forest Department.*—Under the Forest Department of Maharashtra the forest work in Konkan Region is looked after by the following organisational set up :—

District	Forest Division	Forest Circle.
1. Thane	(i) Thane ..	Thane
	(ii) Shahapur ..	Thane
	(iii) Dahanu ..	Thane
2. Raigad	(i) Roha ..	Thane
	(ii) Raigad ..	Thane
3. Ratnagiri	(i) Sub-Division Ratnagiri at Chiplun	Kolhapur
	(ii) Division, Sawantwadi	Kolhapur

Other than the territorial organisational set up as indicated above, there are some functional charges as below:—

(i) One Watershed Management Planning Division at Dahanu for preparation of work plan for catchment area in river valley project of Damanaganga.

(ii) Integrated unit for processing of timber and manufacture of furniture at Dahanu.

(iii) Project formulation organisation for rationalisation of land use in Western Ghats region, under which one circle is established at Mahad with three divisions at (i) Mahad, (ii) Lanja and (iii) Jaoli.

Some area from Thane Circle is allotted to Forest Development Corporation of Maharashtra Limited for exploitation and raising plantation. In the areas incharge of the Forest Department the state plan schemes like the plantation of industrial and commercial new species, development of fodder resources, are implemented. In addition, the forestry schemes like Agave plantations, and afforestation and reboisement of the area devoid of tree growth, under the integrated development of Western Ghats are also implemented.

2.20.6. *Zilla Parishads.*—Zilla Parishads for the districts of Maharashtra have been working since 1962. This organisation with a rural developmental orientation has been working well and would provide the basic institutional infrastructure for the developmental activities in Konkan also. Implementation of the small irrigation works commanding 100 hectares and less is entrusted to Zilla Parishads. To look after this work, each Zilla Parishad in Konkan region has one Minor Irrigation Division, which is manned at the officers' level by persons from the state's engineering service. The technical liaison and supervisory control over the minor irrigation works of Zilla Parishad rest with the Superintending Engineer of the Irrigation Department.

There is a Panchayat Samiti for each development block i.e. taluka in Konkan.

2.20.7. *Water Resources Management Board of BMRDA.*—Bombay Metropolitan Regional Development Authority is an organisation created by the Government of Maharashtra to achieve a co-ordinated development of the Bombay Metropolitan Region. Water Resources Management Board is one of three functional boards of BMRDA. It looks after the planning and development of water resources in the Bombay Metropolitan region and co-ordinates requirements for various uses i.e. domestic, industrial and irrigation. The Board comprise of members who are eminent engineers or experts in economics, statistics, architecture and urban planning. The Member Secretary of the Board is usually an officer at the level of Chief Engineer from the Maharashtra State's Engineering Service.

2.20.8. *Technical Education.*—Technical and industrial education in the State is co-ordinated by the Directorate of Technical Education in Maharashtra. In the publication "Technical Education in Maharashtra (1979)," the Directorate has reviewed the development of technical education as a whole. From this, it is seen that there are 2 engineering and 6 technological colleges/institutions, 1 pharmaceutical college and 1 architectural college located in Bombay or in the metropolitan area around Bombay. There is only one polytechnic for diploma courses located in the rest of Konkan area and that is at Ratnagiri. However, there are 10 Government and non-Government Technical High Schools in the Konkan Region. There are number of institutes in Maharashtra which are selected for offering vocational courses. Of these, a substantial number is located in Bombay Metropolitan area and one is located in Ratnagiri.

2.20.9. From the above, it will be seen that the number of educational institutions in Konkan (including Bombay) may be considered as adequate but they are mainly concentrated around Bombay. In the context of the socio-economic circumstances in the Konkan region, this was inevitable. It may, however, be necessary to consider here after whether some new technical institutions could be located in other districts of Konkan and whether some of the existing technical institutions/schools from these districts, strengthened substantially. As can be seen from Annexure 2.15, the availability of technically trained personnel is very poor in these districts especially in the District of Ratnagiri. However while this is being done, the experience of Ratnagiri Polytechnic where adequate number of candidates did not join the various courses in the polytechnic in some years, may have to be kept in mind.

2.20.10. *Department of Fisheries*—The Department of Fisheries have established at Bombay a Regional Office for Konkan headed by a Deputy Director. The District Offices are at Palghar for District Thane, at Alibag for District Raigad, and at Ratnagiri for District Ratnagiri. The activities of the Fisheries Department are carried out by the offices of the Assistant. Director of Fisheries located in the districts. The schemes implemented in the districts for development of fisheries are :—

- (1) Mechanisation of fishing crafts.
- (2) Assistance for fishery requisites.
- (3) Training and education.
- (4) Infrastructural facilities for preservation, transport and marketing of fish.
- (5) Improvement of landing and berthing facilities.
- (6) Construction of full-fledged fishing harbour.
- (7) Infrastructural facilities in the coastal fishing village.

The fishermen are given guidance in modern fishing methods and financial assistance for procuring the gear and tackles, and for preservation, transport and marketing of fish. Fishermen's co-operatives have also been formed by bringing the fishermen together and encouraging them to achieve a betterment in their living standard through co-operative work.

2.20.11. Construction of 2 full-fledged fishing harbours has been planned, one at Mirkarwada in Ratnagiri and another at Agardanda in Raigad District. The construction work of Mirkarwada project has already been started and is expected to be completed by 1982—84. A similar project at Satpati in Thane District is also under the consideration of the State Government.

2.20.12. *Inland Fisheries—Stocking of tanks with carp fry.*—Almost all available water sheets in Konkan region are brought under fish culture. These tanks/reservoirs are being stocked with fast growing fish seed of major carps. The private fishculturists are also encouraged to undertake fish culture in their own tanks. Government tanks stocked and developed by the department are given on lease basis to the fishermen's cooperative societies.

Fish Seed Production.—Maharashtra State being deficit in major carp fish seed and there is limitation in fish seed procurement from outside, the department is establishing fish seed

production units. There are 3 such units in Konkan one each at Dapchari, Aarey and Khopoli. The seed produced in these units is supplied to the fishermen co-operative on subsidised basis.

Incentive for Fish Farming.—Incentive by way of loans and subsidies are provided to the fish culturists for purchase of fish seed, construction of nurseries, purchase of manure and fish food under this scheme.

Brackish Water Fisheries.—The department has already started survey of brackish water areas all along the coast of Maharashtra. Under the additional incentives for fish farming, the fish culturists will be given finance for construction of brackish water farms. The finance will be made available under NCDC programme in the form of 80 per cent loan from NCDC and 20 per cent subsidy from the State Government.

2.20.13. *Development Corporation of Konkan Limited.*—The Development Corporation of Konkan Limited was incorporated on the 3rd December 1970. The authorised share capital of the Corporation is Rs. 5 crores and the paid up capital is Rs. 3.238 crores upto 31st January 1981. The Corporation has been set up to bring an orderly growth of industries in Konkan region. The principal water resources related activities of Development Corporation of Konkan are:—

(i) *Konkan Sea Food Ltd., Satpati, Taluka Palghar, District Thane.*—The Project has been started on 15th August, 1979 in collaboration of M/s. Southern Sea Food Ltd., Madras. The production of pomfrets, shrimps, frogs etc. worth Rs. 23 lakhs have been exported upto March 1980. Turnover in the year 1980-81 is reaching Rs. 60 lakhs.

(ii) *Saphala Salt Works, Tahsil Palghar, District Thane.*—The project originally started by the Maharashtra Co-operative Fertiliser and Chemicals Ltd., is now with the DCKL since 1978. Out of 2,500 hectares of land, about 340 hectares of land is partially utilised for salt production. Further development is planned in stages. About 4,000 tonnes of salt have been sold in 1980 and with an estimate of 5,000 tonnes in 1981 season.

(iii) *Dairy Development Projects.*—The Corporation has launched artificial insemination programme from 1978-80 and is having 18 centres in Thane, 8 in Raigad and 29 in Ratnagiri Districts. 12 more such centres are being set up with the help of UNICEF before April 1981. Equipment for 100 artificial insemination centres gifted by Dutch Donor Agency, CEBEMBO is being used in implementation of artificial insemination programme. By 1982-83 these centres would cover 1,00,000 cows in Konkan.

(iv) *Mini Industrial Estate.*—DCKL has to set up mini industrial estates at 31 taluka places in Konkan. Construction of one at Kankavali and other at Shahapur is nearing completion.

(v) *Rubber Plantation.*—The project is a joint venture with local farmers. The DCKL has decided to start rubber plantation on 2,000 hectares of land at village Kasari in Ratnagiri District. During the monsoon of 1980, 11,490 seedlings have been planted. More plantation, by having 5,000 seedlings from the established nursery and 10,000 from the supplier is being planned. Sufficient water is required in summer season for these plants.

(vi) *Shrimp Farm, Ratnagiri.*—The Corporation proposes to locate a shrimp farm on commercial scale at Ratnagiri and the detailed survey is to be undertaken by SICOM.

(vii) *Integrated Area Development Programme.*—An Integrated Area Development Programme has been planned with the help of UNICEF in the Ratnagiri District, which has a predominantly large population of children and women. Orders have been issued by the Government of Maharashtra in November 1980. The DCKL will give technological support.

(viii) *Horticulture Plantation.*—DCKL has proposed to distribute at nominal rate seedlings of improved horticultural plants like mango, coconut, mainly to weaker sections of rural community.

2.20.14. Maharashtra Industrial Development Corporation was established on 1st August 1962 under the Maharashtra Industrial Development Act, 1961 (MAH. III of 1962), with a view to promote and assist in rapid and orderly establishment growth and development of industries in Maharashtra. At present it has 57 industrial areas in the State covering an area of about 16,283 hectares. MIDC have also established a water supply capacity of 750 Mld for water supply to its areas. The details of the MIDC areas and MIDC industries in Konkan Region are at Annexure 2.16.

2.20.15. *Development of Industrial Areas in Konkan.*—Major industrialisation in the State of Maharashtra was on the Bombay island. In pursuance of the State Government's policy of dispersal of industries which included decongestion from the Bombay island, MIDC set up a number of industrial areas outside the Bombay island. These stand included in Bombay Metropolitan Region. Such areas are at the Wagle Estate, Trans-Thana Creek area, Dombivli, Ambarnath, Additional Ambarnath, Badlapur, Kalyan-Bhiwandi, Tarapur and Murbad in Thane District and at Taloja and the Hindustan Organic Chemical Complex in Raigad District. These places form a strong industrial base in the BMR outside the Bombay Municipal Corporation areas. The rate of growth of industries and the rate of increase in the supporting population in the industrialised areas outside Bombay City, has surpassed even the city's growth rate at few places, in the last 18 years. Trans-Thana Creek area is one of the largest areas so far developed by MIDC

2.20.16. Existence of industries particularly the chemical units around Bombay has increased the demand for water and created an apparent conflict between the developmental needs of agriculture and industries as can be seen from the planning of the Bhatsai Project which is a major regional multipurpose project near Bombay. Since there is surplus water available in all the valleys in south Konkan, there is a case for dispersal of industries in such water surplus valleys in the Konkan Region. One such location will be near Chiplun in Ratnagiri District where large quantity of tail race waters of Koyna Project, which otherwise cannot be fully used, is available.

2.20.17. Government of India has already decided to set up a big fertilizer project at Thal-Vaishet near Alibag. Government of Maharashtra is also keen on developing a new port at Nhava-Sheva which will be supported by a suitable industrial zone nearby. In the Raigad District, 3 industrial areas, namely Taloja, Patalganga and Roha have so far been developed. Separate petro-chemical complex is to be developed at Usar near Alibag. The water supply requirements of the Thal-Vaishet are being met with by MIDC by tapping water from river Amba. The water supply scheme, which is under execution by MIDC having present capacity of 120.92 Mld, will satisfy the requirements of Thal-Vaishet Project (90.92 Mld.) and heavy water project (18.18 Mld.) and is capable of expansion to take care of water supply requirements of the petro-chemical complex at Usar alongwith enroute water supply demands. In Ratnagiri District, MIDC has developed industrial areas at Chiplun, Gane-Khadpoli, Lote-Parshuram and Kudal.

2.20.18. *Agricultural Institutes and Schools.*—The following institutes and schools for Agriculture are functioning in the region:

1. Konkan Krishi Vidyapeeth, Dapoli,
2. College of Agriculture Dapoli,
3. Agricultural Schools at :
 - (i) Lanja, District Ratnagiri.
 - (ii) Roha, District Raigad.
 - (iii) Kosbad, District Thane (Krishi Vidnyan Kendra),

The entire agricultural research work in Konkan area is being managed by the Konkan Krishi Vidyapeeth, Dapoli, with the objective of fulfilling the regional needs and for overcoming the major constraints in farming. The multifarious activities of research, education and extension education are performed through its research and instructional farms. The details of the existing research stations with their subject areas of research are shown in Annexure 2.17. In order to tackle the regional problems, the research stations located in different agroclimatic regions are concentrating on specific need-based problems of the area. There are four main regional stations and nine testing stations working in different agroclimatic zones of Konkan. Research work is undertaken on the farms of the two Agricultural Schools located at Lanja and Roha, in the College of Agriculture, Dapoli, and on the University Central Farm at Wakawali.

2.20.19. *Banking Institutions.*—There is a reasonably good network of banking organisations in Konkan. On an average one branch of a bank serves 13,000 persons in the region against the State average of 12,000. The situation is somewhat unsatisfactory in Ratnagiri District, where 18,000 persons are served by one branch. The credit-deposit ratio is only 40 per cent. It increases from 25 per cent in Ratnagiri District to 39 per cent in Raigad and 43 per cent in Thane.

2.20.20. *Voluntary Organisation.*—In addition to the Government and Semi-Government Agencies involved in the developmental activities in Konkan as described above, a large number of voluntary organisations have shown interest in the developmental activities in Konkan. Some of these organisations have an experience of the developmental work in the areas outside Konkan also. 'Peoples Action for Development' Maharashtra (PAD), is a trust established by the Government of Maharashtra in 1976 with the objective of helping the voluntary organisations to mobilise, involve and enthuse the local people for the developmental efforts. It keeps liaison with the voluntary organisations working in the field of socio-economic developments. It is expected that with the active support and guidance from PAD, the voluntary organisations in Konkan will be able to play an important role in the development of Konkan.

2.20.21. From the above, it will be evident that reasonably adequate institutional infrastructure is available in the Konkan region. In some respects it may need supplementation as more development programmes come up. But it is to be noted that the region is not well served by rail, road and tele-communications network, or in respect of medical facilities. As can be seen from Annexure 2.18, much work still remains to be done in respect of the road works included in the revised 1961-81 road plan. The upgrading of these supporting facilities will have to be considered along with the direct requirements of the development programmes prepared in the following chapters.

2.20.22. *A Need for Dispersal.*—Eventhough the developmental institutes and organisations for Konkan exist in adequate number most of them have been operating from an urban centre like Bombay with the result that these institutes do not operate amongst the people to be served. It is an impediment to the growth of proper developmental attitudes and simplified working procedures. It is desirable to have the Administrative Offices for the developmental activities in Konkan, situated within the concerned beneficiary areas and dispersed through the rural part of Konkan, away from Bombay. To provide adequate incentives for such a dispersal of Administrative Offices and to attract and retain capable developmental staff, construction of residential quarters for the staff to be posted in Konkan should be taken up as a part of the developmental activity. Easy accesses to work areas will have also to be provided by undertaking the construction of the roads. To begin with, atleast one nucleus colony of residential quarters and non-residential buildings for offices and other supporting services should be established in every taluka of Konkan for housing about 100 government employees. In addition, educational and medical facilities and communication facilities will have also to be made available.

CHAPTER III

RAIN WATER CONSERVATION AND UTILISATION

3.1. The Need for Rain Water Conservation

3.1.1. Over the last few decades, the able bodied youths from rural Konkan have sought migration to Bombay to earn livelihood, because there had been no infrastructural development or creation of new productive assets in the country side of Konkan for a long time. To reverse this trend of migration to the city of Bombay, employment generating assets will have to be created in the rural areas of Konkan with the use of its natural resources.

3.1.2. Fortunately Konkan is endowed with an abundant supply of water from the heavy rain-fall in the southwest monsoons. In Konkan, per capita average availability of the surface runoff even including the population of Bombay is as high as 5,000 m³; compared to only 3,200 m³ per capita as an Indian average (including Brahmaputra waters) and only 1,500 m³ per capita for the rest of Maharashtra. The surface waters of Konkan can provide over 3 metres of water depth for the 18.28 lakh hectares of culturable land in Konkan, as against only 0.300 metre available for the rest of the agricultural land in Maharashtra. This should afford excellent opportunities for perennial crop growth in Konkan. Moreover, one-fifth of the surface waters in Konkan originate from the high level lands 300 m above sea level. There is quite some scope for utilising the waters from high level lands for Hydro power generation.

3.1.3. However, as the precipitation in Konkan is limited to a short period of less than 120 days and the soil cover is thin, the rivers in Konkan dry up very fast after the monsoons inspite of large total volume of precipitation. Even drinking water becomes scarce from February onwards. Hence extensive measures for holding back the water received in monsoon in man-made storages across rivers will have to be a key element in the developmental plan for Konkan.

3.2. Development in Retrospect

3.2.1. When the Maharashtra Irrigation Commission estimated the irrigation potential of Maharashtra in 1962, it did not account for any irrigation in Konkan inspite of plenty of water resources available for this area, because the irrigation in hilly, dissected and undulating areas of Konkan was then considered as rather infeasible. The soils in Konkan are coarse to medium. The soil mantle is also thin. Hence it was apprehended that the drainage losses would be quite heavy. Subsequently, however, irrigation schemes were taken up initially from the tail discharges of the hydel power stations and were found to be quite successful in the development of a second crop of summer rice. After the initial encouragement received from the tail water diversion scheme on Rajanalla completed in 1964 for 1,600 ha. of irrigation, a large number of minor irrigation schemes with independent storages in Konkan were also taken up and completed.

3.2.2. Amongst the irrigation schemes completed so far the Kal Irrigation system in Raigad District has the largest irrigable command of 7,965 ha. in Konkan. In 1978, irrigation for second crop of rice on 8,743 ha. has been successfully carried out from the irrigation schemes in Konkan where no irrigation was considered possible just 15 years back. Many new projects for providing irrigation to additional 85,878 ha. are currently under construction in this region

and many more are under investigation. The net irrigation potential developed by 1980 is 35,169 ha. i.e. at 9 per cent of the estimated irrigable area in Konkan.

3.2.3. By 1980 the water storage capacity of irrigation reservoirs in Konkan has risen to 51 T. ha. m. In addition, 62.3 T. ha. m. is stored in reservoirs for domestic and industrial water supplies, such as Tansa and Vaitarna for water supply to Bombay and Barvi for the M.I.D.C.'s industrial areas. Some small size storages have also been built for municipal councils like Jawhar. But still the total water utilisation from the storage works completed so far is less than 2 per cent of the total surface water resources of Konkan and is only about 6 per cent of the identified exploitable quantity. There is, therefore, a need to move fast and harness the remaining potential early.

3.2.4. In modern times, the first dam in Konkan was taken up at Vihar in 1860 for water supply to the city of Bombay. Powai and Tulsi dams followed in 1890 and 1878 and Tansa in 1892. During 1948 to 1956 the first concrete dam in Maharashtra, the lower Vaitarna dam, was constructed by the Bombay Municipal Corporation. The Tansa masonry dam was strengthened by prestressed cables simultaneously. But by and large for a long time the development of technology for earthen or masonry dams remained limited to the requirements of small size water storages such as those required for the water supplies to small size towns like Matheran and Sawantwadi. The technology of dam construction was put to a much bolder and wider use only when more and more storages for irrigation purposes were taken up after 1970. By now more than 100 dams, large and small together, have been constructed. Of these, 3 are in the problematic lateritic areas. All this experience should enable undertaking of an intensive dam construction activity with greater confidence in the years to come.

3.3. Master Plan Work

3.3.1. In October 1980, the Government of Maharashtra constituted a 24-member High Power Committee called the "Konkan Sinchan Vikas Uchhadhikar Samiti" under the Chairmanship of Shri B. J. Khatal, Minister for Irrigation, Government of Maharashtra, for looking into the issues related with the development of irrigation in Konkan. Preparation of master plans for the river valleys in Konkan has been one of the terms of reference of this Committee. Accordingly, the master plans have been recently finalised by that Committee and submitted to the Chief Minister of Maharashtra on 8th March 1981. All major, medium, minor and local sector small size irrigation works possible in Konkan have been identified and included in these master plans. They will, therefore, serve as very important and useful guidelines for the future water resources development work in Konkan.

3.3.2. The salient features of these master plans covering the 20 principle river basins of Konkan are as follows:—

(1) Total quantum of 75 per cent dependable surface waters in Konkan is about 5,273 T. ha. m. (including permissible western diversion waters).

(2) Total utilisation permissible from the storage of identified projects is 1,971 T. ha. m. i.e. about 35 per cent. of available surface resources (inclusive of permissible western diversion waters.)

(3) Utilisation of water for irrigation by gravity supply will be 716.92 T. ha. m. Only gravity flow by canals has been provided for in the master plan. If possibilities of lift are considered requirement of water for irrigation will go up further.

(4) Area irrigable by the irrigation works identified in the Master Plans is 3.67 lakhs ha. (i.e., about 25 per cent of the culturable area in Konkan).

(5) Total number of identified irrigation projects in Konkan and their net potential is as below:—

	Total number of identified projects	Completed projects	Under construction projects	Ready shelf of projects (i.e. approved or under process for approval)	For future works
1	2	3	4	5	6
(i) Major	7	1	3	3	....
(ii) Medium	96	....	6	11	79
(iii) Minor (State Sector) ..	417	69	54	57	237
(iv) Minor-Local Sector as identified as per Toposheets.	3,141	1,147	313	....	1,681
(v) Bridge-cum-Bandharas ..	13	....	....	....	13
(vi) Irrigable area ..	3,67,132(ha.)	35,159ha.	85,878ha.	94,551ha.	1,51,544ha.
(vii) Cost ..	....	25.49 in crores	177.00 crores	295.00 crores	1,100 crores
			(As per original estimates)		(Very broad assessment)

More valleywise districtwise details are given at annexures 3.1 to 3.5.

3.3.3. Extensive field investigations will be required before feasibility reports of all the identified projects are formulated. But considering the unit cost of storages of the recently approved irrigation works which are around Rs. 2 per cu. m. (i.e. Rs. 60,000/Mcft), the cost of the entire water resources development programme would be around Rs. 3,000 crores. Roughly half of this will be for the conventional type of irrigation by gravity supply.

3.3.4. While the Maharashtra State Irrigation Commission in its report of 1962 indicated that hardly any possibilities for irrigation development exist in Konkan, the broad studies carried out on the basis of the fields survey and the experience of irrigation works completed in Konkan over the past two decades now clearly indicate a possibility of achieving 3.67 lakh hectares of irrigation in Konkan Region, which will cover almost 25 per cent of the culturable area in Konkan. Extent of irrigation in Konkan from gravity supply schemes alone is thus likely to be substantial and not far below the percentage in the rest of the Maharashtra State or not far below the Indian average also. With 3.67 lakh hectares under irrigation and a good part of it under perennial crops immense employment potential will be generated in the rural areas of Konkan. That will help in preventing the migration of population to Bombay.

3.4. High Cost of Storage

3.4.1. Even though plenty of water is available in Konkan there are very few dam sites at which the valley has good storage characteristics from the point of storage costs. A dam structure is economical if a large spread of deep water pool can be obtained in the valley with a low height of dam. In Konkan the valleys have steep slopes and are narrow. The valleys do not open out much even at the junctions of the rivers. As a result, the heights of the dams required in Konkan are relatively much more than those required in other parts of Maharashtra for the same storage. It is not uncommon to find even minor irrigation dam more than 25 m. high. Hence the unit cost for storage of water is much higher than that in the other parts of Maharashtra. Obviously, the water stored at great cost will have to be used preferably for the high value crops and other high priced uses.

3.5. Relaxation in Feasibility Criteria

3.5.1. In view of hilly terrain and the economic backwardness of Konkan, the feasibility criteria in terms of the benefit cost ratio needs to be reduced from the present norm of 1.5 to 1.00 for the irrigation projects in Konkan, on the same lines as has been done for the irrigation projects in Tribal and D. P. A. P. areas. According to the current practice Irrigation Projects are analysed for economic feasibility on the basis of costs of physical work and value of physical benefits derived. However, the irrigation projects to be undertaken in Konkan have a much wider social objective to serve in addition to the one of agricultural productivity.

3.5.2. One of the primary objectives of a developmental programme in Konkan has to be the prevention of migration of population to Bombay by generating employment in the rural areas of Konkan. If the present trend of migration continues unabated, it is apprehended that the entire increase in the population of Konkan over the next 20 years at a rate of 2 per cent per annum will have to be absorbed in Bombay. Thus, Bombay will have to accommodate at least about 20 lakhs of additional persons from Konkan alone. The report of the "Gokhale Institute of Politics and Economics" Pune-4, titled "The Community cost of industrial location at Bombay and Nasik"—sponsored by State Industrial and Investment Corporation of Maharashtra and published in 1968, clearly brings out as to how for every new additional persons migrating to Bombay for a job there arises the necessity of investing about Rs. 28,824 (1965-66 prices) to provide for him the civic amenities like housing, water supply and drainage, road and rail transport. Even if this requirement is taken at a modest figure of Rs. 25,000 and ignoring the price-rise since 1965, a capital investment of the order of Rs. 5,000 crores will be required for urban and industrial facilities in Bombay to accommodate the additional population of 20 lakhs. Compared to this, the investment required for the irrigation projects in Konkan is not very large.

3.5.3. All direct and indirect socio-economic benefits from the investments in Konkan will have to be taken into account, while evaluating the developmental projects for Konkan. Till a more rational system of rational comprehensive social benefit cost analysis comes into vogue, the existing cost-criteria should at least be relaxed adequately to account for the unquantified other benefits. On this background, it looks that the present norm of Rs. 2.63 per m^3 (i.e. Rs. 75,000 per Mcft.) for acceptance of small irrigation projects may have to be increased to Rs. 3.53 per m^3 (i.e., Rs. 1,00,000 per Mcft.) for the storage works in non-lateritic areas of Konkan and to Rs. 4.41 per m^3 (i.e. Rs. 1.25 lakhs per Mcft.) for those in the lateritic areas to cover the additional costs required for treatment of the lateritic strata.

3.6. Training for Rehabilitation

3.6.1. Whatever little agricultural land lies along the valley floor in the upstream reaches gets submerged by the construction of storages in Konkan. The displaced persons from the submergence area have to migrate to occupations other than agriculture because of shortage of good cultivable lands in Konkan particularly for the crops like paddy. If these persons are to be rehabilitated in other occupations like fishing in the sweet water bodies or in horticulture and forestry, new skills and related technology will have to be imparted to them. This is a major social transformation. Unless the training activities required for such a transformation are taken up as an essential element of the project, the problem of resettlement of the affected persons is likely to give rise to social tensions between the beneficiaries of the water storage projects and the affected persons. That may hamper the progress of the storage works. Hence a serious attention will have to be given to the requirements for rehabilitation of the project affected persons right at the stage of project formulation. A social survey of the affected villages should

be undertaken along with the other field surveys for the project's works and a scheme for rehabilitation of the project affected persons inclusive of the necessary occupational training for the affected persons incorporated in the project's proposals.

3.7. Mechanised Earth Work

3.7.1. Due to availability of about 150 working days only in a year for construction of dams and non-availability of able bodied persons in the country side in the required large number, it is difficult to undertake labour intensive construction activities in Konkan with the desired speed. Particularly the earthwork of the dam in the gorge portion cannot be undertaken with confidence. Response to the Employment Guarantee Scheme has also not been good in many talukas. Because of the lack of general amenities like drinking water and road communications—even the contractors are not forthcoming in required numbers for undertaking works in Konkan area. Hence quite a number of earthen embankment dams of even minor irrigation schemes may have to be executed by mechanised equipment departmentally to speed up the development programme. For this purpose the mechanical organisation and the machinery fleet in Konkan may require appropriate strengthening. This requirement will have to be kept in view while formulating a detailed action plan for the implementation of the master plan works.

3.7.2. At present, there are only two Mechanical Divisions for the entire region. For an effective control on the quality and output of work undertaken by the Mechanical Organisation, it may be desirable to have an independent Mechanical Division for each district of Konkan. Creation of an additional Mechanical establishment may have to be considered early.

3.8. Incentives for Staff

3.8.1. There has been dearth of technical persons and skilled artisans in Konkan. They are required to be brought from outside. Particularly there is acute shortage of staff for engineering surveys in the backward areas of Konkan. Survey work in the rugged hilly terrain is hazardous and arduous. The staff to be engaged on the survey work in Konkan will have, therefore, to be provided a special incentive in the form of Survey Allowance. In addition, facilities for family accommodation will also be required for the survey staff. Under the present system, construction camps are provided for the staff engaged on the construction works, but no accommodation is provided for the staff engaged on surveys and investigation work though they perform arduous duties. A system of nucleus colonies recommended in para. 2.20.22 will go a long way in providing relief to the survey staff.

3.9. Irrigation Schemes

3.9.1. *Time frame for Development.*—The completed irrigation schemes have an irrigation potential of 35,159 ha. while the under construction schemes have an additional irrigation potential of 85,878 ha. The shelf of projects ready on hand has a further irrigation potential of 94,551 ha. But projects for almost half of the ultimate irrigation potential of Konkan still remain to be investigated and more than 90 per cent of the ultimate potential still remains to be physically developed. It will be desirable to aim at completing the balance work by the turn of this century. To achieve this, survey and investigation work of all the major and medium projects, who have a longer gestation period, may have to be completed by the year 1990 so that all the remaining works could be taken up and completed by 2000.

3.9.2. *Priority for Minor Irrigation Works.*—In the development programme, the first and foremost priority will have to be given to the small scale minor irrigation works viz. the local sector schemes and the state sector minor irrigation works. Both of these need to be

completed by 1991. That will mitigate substantially the problems of water supply to the villages within the next 10 years, disperse the benefits of irrigation in all the watersheds and create consciousness about irrigated agriculture. If this target is to be achieved, the survey and investigation of the unsurveyed 1681 local sector schemes and 237 state sector minor irrigation schemes will have to be speeded up and completed by 86-87 latest. Correspondingly the survey and investigation organisation for these works will need an immediate strengthening.

3.9.3. *Lift Schemes.*—The experience of irrigation from the Konkan type or Kolhapur type weirs in Konkan has not been encouraging because of the high recurring expenses of lift schemes. Most of the farmers in Konkan are poor. To popularise lift irrigation schemes in this area is, therefore, difficult. Perforce, therefore the stress will have to be on irrigation by gravity flow at least for some years to come. The Surya, Bhatsa, Natuwadi, Wandri Project and other irrigation projects under construction are all gravity flow irrigation schemes. The schemes for which a shelf has been now created are also the gravity flow irrigation schemes. Once these schemes start giving their benefits the economic picture will change, the farmers will also realise the value of water much better and would be willing to pay extra for lift irrigation supplies. Thus in the scheme of priorities, lift irrigation schemes may have to wait and follow only later in due course.

3.9.4. *Financial Requirements of Irrigation Development.*—Even for completion of major, medium and minor irrigation schemes already under construction and for completing the major, medium and minor schemes on shelf, the annual requirement of funds will be of a substantial order as detailed out in Annexure 3.6. By the time projects from existing shelf get completed new schemes will come on line. Hence a financial input of a very high order i.e. of the order of Rs. 50 crores per annum may be required to cope up with the requirements of irrigation development.

3.9.5. It is therefore clear that the financial allocations to irrigation programmes in Konkan will have to be considerably stepped up from the present level of about 10 crores/year. The resources committee of Maharashtra Government may consider this requirement and proposed suitable measures to meet the requirement. Possibilities of obtaining external assistance for packages of minor, medium or major projects in Konkan may have to be immediately explored in this context. A proposal for referring 8 projects (4 major and 4 medium) namely Pinjal, Talamba, Tillari and Kalu and Amba, Hetawane, Deherja and Deogad together costing Rs. 246.59 crores and having an irrigation potential of 96,062 ha. was mooted by the Government of Maharashtra in 1980. If external assistance for these projects could be secured from the international lending agencies, that would be very helpful in implementing these projects expeditiously.

3.9.6. *Organisational Requirements.*—A separate post of a Chief Engineer for Konkan has been recently created to look after the irrigation works in Konkan. He has 4 Circles and 23 Divisions for irrigation activities with him. Their present capacity to shoulder the construction responsibility for new irrigation works is upto Rs. 12 crores per year. For the large programme of irrigation development in view, the present organisation will not suffice. It will have to be adequately strengthened to cope up with the additional work when additional financial resources are made available for the irrigation activity in Konkan.

3.9.7. *Special Designs Unit.*—The designs of dams and canal structures in Konkan need a different treatment on account of the hydrological and geological peculiarities of the Konkan region. The problems of locating the reservoirs on lateritic areas because of excessive porosity of the lateritic mass have already been mentioned at para 2.7.8. Konkan soils are light in weight and have low shear strength. Earthen Dams therefore need flatter slopes. In view of the poor

availability of good soils for embankment work, it may have to be considered if rock-fill embankments could provide a more dependable and economic structure. Some innovative approach will be necessary. In the wide valleys of North Konkan where masonry dams are more common, there is also a case for trying the buttress dams rather than the conventional type of gravity sections.

3.9.8. The intensity and frequency of precipitation in Konkan is much higher than elsewhere in the State. The valley storage is also small when the river is in floods. Hence operation of the spillway gates is likely to pose some difficult problems in handling of flash floods. Side spillways of earth dams discharging over the steep hill slopes, have been causing excessive erosion in the tail channels and at times endangering the safety and serviceability of the dam structure. In view of these peculiarities arising out of the local conditions in Konkan, a special parameters for the design of dams in Konkan will have to be evolved. It will be desirable if these issues are entrusted to a special designs unit.

3.9.9. *Strengthening of the Divisions for Local Sector Works.*—Because of the dissected topography, large irrigation projects with extensive canal systems are not possible in Konkan. On the other hand, there is considerable scope for the development of a large number of small size storages. Small irrigation works with less than 100 ha command are executed by the Zilla Parishads. It is seen that there has been considerable lag in the implementation of the local sector schemes already identified by the Irrigation Department in the District Master Plans prepared in 1970-72. In Chapter IV, we have laid stress on the integrated development of small water sheds. In that context, the small size local sector dams will assume greater importance. Much greater attention to the requirements of these works is called for than here to before. It is therefore necessary to strengthen the implementing organisations for the Local Sector works under the Zilla Parishads. At present the executive divisions in Zilla Parishads are inadequately staffed. Strengthening of these divisions and sub-divisions for bringing them on par with the normal Minor Irrigation Divisions and Sub-Divisions in the State Sector in respect of strength of staff and administrative, technical and financial powers is immediately necessary for speeding up the activities on the small storages throughout Konkan.

3.10. Command Area Development

3.10.1. For major irrigation projects in Maharashtra Six Command Area Development Authorities have already been functioning. They provide the missing infrastructural facilities, agricultural extension service, co-operative credits for the various inputs and introduce the latest water management technics. These Authorities have proved very useful in improving the picture of irrigation utilisation and in introducing new methods of water distribution and water application.

3.10.2. In the Konkan Region, there is one completed major irrigation project i.e. Kal Project in Raigad District. In addition, 69 M.I. Schemes and 1147 Local Sector Schemes have been completed creating a total irrigation potential of 35,159 ha. Surya Major Irrigation Project with a projected irrigation command of 14,700 ha has started giving irrigation service in the initial reaches of the canal. Irrigation from Bhatsa Project with the final irrigation potential of 23,000 ha is scheduled to commence from October 1981.

3.10.3. Looking to the substantial area already brought under irrigation and much more scheduled to come under irrigation shortly, it is necessary that a Command Area Development Authority be established for the Irrigation works in Konkan immediately in 1981-82. The farmers from Konkan are not much familiar with irriculture because irrigation was not in practice except for some old coconut and aracanut plantations and for waingani paddy at stray places. It is, therefore, necessary to establish the irrigation practices on scientific lines by introducing the correct water management techniques right from the beginning.

3.10.4. In view of the long stretch of the Konkan strip and the physiographical, geological and climatological differences in the northern and southern portions of Konkan, eventually two separate Command Area Development Authorities (C.A.D.A.) one for North Konkan and one for South Konkan will be required. To begin with C.A.D.A. for Konkan may be established in North Konkan, because at present much of the Irrigation area has developed in this part of Konkan. It will initially look after the irrigation developed under the minor irrigation works in Ratnagiri District. But a separate authority for South Konkan will be required in due course when Tillari and Talamba projects in Ratnagiri District take shape.

3.10.5. *Farmers' Associations*—The pattern of the Konkan C.A.D.A. should not be the same as that of the other C.A.D.A. authorities created in the past. Active participation of the beneficiaries has to be sought in the command areas' development and administration. For achieving this, some modifications will have to be introduced in the present structure of a command area authority. Command Development is to be a venture of joint partnership of the farmers. Hence formation of Farmers' Associations will have to be encouraged in the command areas and representatives of these associations given a due place in the authorities, administrative set up and working.

3.10.6. *Rotational Supply*.—Due to steep slopes of hills, small land holding and high intensity of rains the traditional pattern of water use in Konkan is the one of field to field irrigation. "Ayacut" development and maintenance of field channels is also a costly and an yearly repetitive affair. Hence, there is a tendency amongst the farmers to neglect these requirements with the result that they use far more water than what is required for the crop. Consequently, the area irrigated per unit of water is far less in Konkan. This is a major hurdle in securing the irrigation service to the entire command as planned. Some farmers use water excessively while others from the command are left without it. It takes some time before farmers can get used to the system of rotational supply of water to their fields through water courses in lieu of continuous field to field flooding. With some efforts it has been possible to introduce systematic rotational operation of distributaries and water courses in the command of Kal-irrigation project. But much remains to be done in respect of water application techniques.

3.10.7. *Research in Water Management*.—The development of irrigation in Konkan has suffered because the lessons and experiences of the irrigation development in the upghat areas are tried to be superimposed on Konkan areas. An irrigation is a location-specific technique. Hence, separate norms of land and water management will have to be developed for Konkan. The scientific requirements of water for irrigated crops in Konkan are not yet clearly known. There are two distinct soil types found in Konkan region. Those are :—

- (i) Medium black soil, and
- (ii) Lateritic soil.

It is necessary to take up research work on water requirements of different crops and other related aspects with reference to these two soil types, immediately.

3.10.8. It is seen that the Konkan Krishi Vidyapeeth has undertaken research work of practical utility in various fields under its perview. However, the work on water requirements of different crops grown in the region has not yet been taken in hand on a systematic way. Only some preliminary work has been initiated. Research in water management needs to be given priority and much greater attention in view of the large number of new irrigation projects already under construction so as to achieve the effective utilization of water that would be made available from them.

3.10.9. Konkan Krishi Vidyapeeth already has a Trial-cum-Demonstration Farm at Rapoli in District Raigad where some research work has been taken up on water requirements of

different crops and on alternative crops which could be grown on residual moisture or with protective irrigation. Some of the important research findings from the studies done at this farm so far are as below :—

(i) After the harvest of Kharif rice, the crops like Jowar (M-35-1), Maize for fodder (Ganga-101), Wal (6-5-24), Gram (Chana), Tur (T-21), Udid (Sindhkheda 1-1), Cow pea (C-152), Kulthi (Dapoli local), Niger (Ottakamund) and Seasmum (D-7-11-1) could be grown satisfactorily on residual moisture when sown immediately after harvest of the Kharif rice.

(ii) The results of partially irrigated multiple cropping trial showed that the sequences of cropping as rice-Jowar-Vaisakhi mung, Rice-Fallow-groundnut and rice-gram-maize for fodder were observed to be technically sound.

(iii) From the experiment to determine the optimum irrigation schedule of wheat crop, it was revealed that irrigation schedule as per 24 mm Cumulative Pan Evaporation (CPE) with 50 mm depth of water per irrigation, produced significantly high grain yield of wheat, variety UP-215 (22.78 q/ha) than 48 mm and 72 mm CPE and irrigation at 4 critical growth stages. The total depth of water applied under these treatments during crop growth period was 465.00 mm.

3.10.10. In order to initiate irrigation experiments of long term nature which require investment by way of construction of tanks, lysimeters, etc. it will be desirable if the farm at Rapoli is permanently transferred to Konkan Krishi Vidyapeeth, Dapoli. This farm was established by the State Government in 1964 and was handed over to the Vidyapeeth on a 5 years lease basis in 1976. Vidyapeeth proposes to undertake research in respect of irrigation water requirements of crops, crop rotations, development of suitable criteria for scheduling irrigation under different agro-climatic and soil conditions. Cropping patterns under different situations and input constraints irrigation methods for different conditions of topography, soil, climate, crop and studies on increasing moisture use efficiency by using different mulches. The total financial outlay for this work over the next five years is estimated to be Rs. 4,15,000 on recurring items and Rs. 17,10,000 on non-recurring items.

3.10.11. *Research Station at Wakawali.*—The research findings of the experiments on irrigation conducted at the Trial-cum-Demonstration Farm at Rapoli cannot be made applicable to the lateritic soils of Konkan as the physio-chemical properties of the soil and agro-climatic conditions are quite different. The lateritic soils are more percolative than the medium black soil and as such it is necessary to initiate research work at a separate Farm such as at Wakawali in Ratnagiri district which represents the lateritic soils. Konkan Krishi Vidyapeeth proposes to initiate research in water management at Wakawali farm immediately. The financial outlay for five years for the work at Wakawali farm is estimated to be of the same order as at Rapoli. It is recommended that a water management research programme at Wakawali farm should be undertaken immediately as many new irrigation works with commands in lateritic areas are being taken up in Ratnagiri District.

3.10.12. *Canal Lining*—Regarding the need and efficacy of canal lining in respect of minimising seepage losses, it is rather too early to form any specific rules for the canals in Konkan. Extensive field trials and measurement should be undertaken immediately on a few canal systems operating in the different geological settings to assess the contribution of the different factors in the seepage process. Suitable remedial measures can be suggested thereafter on basis of scientific evaluation of different factors. It is difficult to generalise the solution in Konkan as the terrain is rugged and soil conditions vary from valley to valley and also within the same valley in a short distance.

3.10.13. Even otherwise canal lining has been a controversial issue in the field of irrigation because of high costs of lining work, problems of maintenance and the scarcity of lining materials like cement and bricks which are required on a massive scale for a lining programme. The projects are also likely to get delayed or stuck up by the shortages of lining material. It will therefore be prudent to proceed cautiously and scientifically in this matter rather than rushing to any generalisation. In the meanwhile canal lining should be provided for on a selective basis in the estimates of the irrigation projects with consideration of the geological setting of the project area. Seepage from the canals is likely to be heavy particularly at the junctions of canal embankments with Masonry cross-drainage works. They will therefore generally need greater protection by lining. By and large, canals in lateritic areas will also need a relatively greater length to be treated with lining.

3.10.14. *Crop Pattern.*—In the land pattern the soil conditions change rapidly in a short distance from the toes of the hills to the river bed or towards the coast. Hence, it is not correct to specify any uniform pattern of irrigated crops from head to tail of the irrigation canals. The crops will have to be different in the upper lands and in the lower lands and the canal systems designed on that basis. On the varkas lands that lie within the irrigation command, there is considerable scope to introduce horticultural plantations. It would be advantageous to do so rather than converting them into rice fields as is implied in some of the crop patterns for the approved projects. A review of these crop patterns is immediately necessary.

3.10.15. *Incentives for Small Farmers.*—One of the impediments to the rapid growth of irriculture in Konkan has been the predominance of small land holders. At present the irrigation rates charged to the small land holders are the same as for others. In view of the economic backwardness of the Konkan Region and low level of income of the small land holders, it will be desirable to provide some incentives and concessions in irrigation rates for small farmers to help them to take the best advantage of the irrigation facilities. In particular liberal incentives will be required for those who are willing to raise garden crops rather than taking only a second crop of rice under irrigation.

3.10.16. *Socio-Economic Surveys.*—The need for considering the socio-economic impact of the Irrigation works in Konkan has already been emphasised in the foregoing paras. Presently it has not been feasible to quantify even on an approximate basis the socio-economic gains from an Irrigation project in Konkan in absence of any bench mark surveys and follow-on surveys. In view of the very massive investments envisaged in the Irrigation Development programme for Konkan, the methods of social cost benefit analysis will have to be placed on firmer footing with adequate support from the field data.

3.10.17. To this end it is suggested that socio-economic bench mark surveys may be undertaken immediately for the incoming new major irrigation projects like Talamba in Ratnagiri District and Pinjal and Kalu-Shai Projects in Thane District. In addition, such surveys should be undertaken for a couple of minor or Medium Irrigation projects from each district. Some studies may also be taken up about the change in the socio-economic conditions brought about by the completed projects like Kal in Raigad District. Undertaking of such surveys and a continuing analysis of the socio-economic conditions should be one of the important functions of the proposed Command Area Development Authority for Konkan.

3.11. Hydro Power

3.11.1. A broad assessment of the hydro power potential of the west flowing rivers of the Western Ghats in Maharashtra State has been made from toposheet studies and reconnoitry survey of some of the sites. It shows that there is quite some scope for the development of mini

and microhydel stations (with 1 MW to 10 MW and below 1 MW installations respectively), in addition to some large size peaking stations. The high and steep Western precipice of Sahyadri also affords excellent sites for pumped storage schemes.

3.11.2 For the consideration of hydro power potential, the river lengths in Konkan can in general be divided into three reaches

I. *The mountain reach*—The west flowing rivers of Konkan originate high up in the the Western Ghats region of Sahyadri range at an elevation of about 915 to 760 metres where there is very heavy precipitation. Then they drop down to a level of about 300 metres within a short horizontal distance of about 5 to 15 km. The river length in this part is naturally characterised by steep falls. It is this drop in the short length, that needs to be harnessed for Hydro power generation. The surrounding country is highly rugged with high steep hills and narrow valleys in which storages can be constructed at suitable locations.

II. *The middle reach*.—In the intermediate portion of the rivers, the fall is less steep as compared to reach I. The rivers traverse a comparatively low level area with wider valley configuration. At places the valleys are intercepted by protruding spurs. Most of the irrigation dam sites in Konkan have been located in this reach by taking advantage of such spurs. Hydro stations will have to be coupled with the Irrigation storages in this reach.

III. *The coastal reach*.—The portion near the coast is generally flat and the bed fall of the river is almost negligible. The tidal waters flow quite a few kilometres up the river length. Reach III is unsuitable for any conventional hydel power generation. Only development of tidal power may have to be attempted in this reach.

3.11.3 *Power Potential of the Mountain Reach*.—This reach can be considered as the one lying between the continental divide where the rivers originate and upto 300 metres contour as shown on Plate 8. The total area between 300 metres contour line and continental divide is about 4860 Sq. km. which is about 16 percent of the total geographical area of (29791 Sq.km) Konkan. Based on the English runoff formula for Ghat sections, the yearly average run-off from this area works out to 911.6 T.ha.m. The corresponding 75 per cent dependable yield from this area will be about 683.7 T.ha.m. This can yield a continuous discharge of 217 Cumecs. From the Hydro Projects which have been already identified in this reach, i.e. Damanganga, Par, Bav, Kal and Kumbhe it is seen that an average head of 140 metres is available for power generation. With the available quantity of high level water and a potential drop of about 140 metres, 240 MW continous power can be generated if all the waters above 300 metres contour line can be harnessed for such a purpose. However, this may not be feasible in practice due to non-availability of suitable storage sites in all the valleys and sub-valleys.

3.11.4 From Plate 8, it may be seen that areas A,B. and C. appear to be promising from the point of view of harnessing of power potential. An approximate Hydro Power potential of these areas will be as below:—

Hydro Power Area		Theoretical power potential (MW) for 100 per cent L.F.
A	..	85
B	..	35
C	..	20
Total	..	<hr/> 140 <hr/>

The power potential which has already been exploited or which has been identified, *vide* list below, mostly lies in or near these areas only:—

Hydro power Project	Power potential at 100 per cent L.F. (MW)
Vaitarna	16.0 (existing)
Tillari	16.0 (under construction)
Damanganga	10.0 (under investigation)
Par	5.5 Do.
Kal	2.5 Do.
Kumbhe	3.0 Do.
Bav	10.0 Do.
Jagbudi	5.0 Do.
Patgaon	10.0 Do.
Total	78.0 (At 30 per cent Load factor, actual installation required will be about 250 MW)

A further critical examination of these areas will have to be carried out to assess the exploitable power potential of this reach. Some innovative ways for maximising harnessing of the water falling on these high level areas will have also to be thought of. Project layouts with inter-linked storages in the sub-valleys or with catchwater canals for diverting runoffs from hill slopes to a principle storage site will have to be tried.

3.11.5. *Power potential of the middle reaches.*—The fall in this portion of the river is gradual and as such independent hydro schemes would be costly. Hence in this portion of the river, it is desirable that hydro projects are planned as supplemental works in conjunction with the irrigation dams. On the basis of the preliminary studies carried out so far by the Irrigation Department of Maharashtra it is seen that seasonal power potential as indicated below appears feasible. Detailed studies for these sites will have to be undertaken early.

Name of Irrigation Scheme	Tentative Power Potential (MW) at 100 Per cent L.F.
<i>Thane District—</i>	
1. Pinjal	9.6
2. Kalu	6.5
3. Shai	4.6
4. Middle Vaitarna	10.0
5. Bhatsa	15.0
<i>Raigad District—</i>	
6. Hetawane	2.0
7. Poshir	3.8
Total	51.5 (At 30 per cent Load Factor actual installation required will be about 160 MW)

3.11.6. Similar studies will have to be carried out at remaining irrigation dam sites like Tillari, Talamba, Deogad and Natuwadi. At the dam sites like the one on Gadgadi river, where full water potential of the valley is not required to be utilised for the irrigation requirements, it needs to be checked up as to how far it would be feasible to raise the proposed dam and store additional water to provide larger discharges to a power project. In view of the rising fuel costs,

hydro-power projects which are not economically attractive at present are likely to be found acceptable after a few years. Hence such potential storage sites where raising of the dam heights is possible will have to be kept identified for future hydro-power developments.

3.11.7. In 1978, Irrigation Department of the Government of Maharashtra has already decided that penstocks should be provided in irrigation dams where the Hydro-power generation is expected to be of the order of 3 to 4 MW and above because the cost of providing and laying a penstock in a dam which is approximately Rs. 10 to 20 lakhs is relatively insignificant compared to the total cost of the irrigation dam. If penstocks are not provided at the time of construction of the dam, any possibility for future generation of power at the dam site gets lost for ever. It may be worthwhile extending this policy immediately to all the dams that store more than 25 m of water. Dam heights in Konkan are generally substantial. Hence, this position should be turned into an advantage by establishing a hydro-power station on the irrigation releases from such dams.

3.11.8. *Hydro Projects on Canal Drops.*—Apart from the above, there is scope for construction of small micro size Hydro Electric station on canals with drops such as on the Surya Canal with a fall of about 11 m. or even at the foot of canal outlets such as at the Dolwahal weir (Kal Project). These will be the units between 50 KW to 1,000 KW but they will be able to meet the local needs of the community.

3.11.9. *The Chinese Experience.*—It is now widely known that China has established the acceptability of Mini and Micro-hydel Schemes as a feasible solution to the energy crisis. A UNIDO GROUP has already carried out a tour of these Chinese Projects in May-June 1979 in which Indian delegates were also included. Their study notes give very valuable information about such schemes. One officer from Hydro Organisation from Maharashtra was also one of the delegates in this UNIDO'S STUDY GROUP. Hence, first-hand information regarding the experience acquired by Peoples' Republic of China in the field of small scale Power stations for meeting the local energy needs is available to Maharashtra. The number of such stations in China is over 60,000. The installed capacity comprises of units of even smaller than 25 KW (upto 6 KW) capacity. Through a large number of Mini and Micro Hydel stations China has built up a huge installed capacity of 5,200 MW. This task was achieved by motivating the people to construct and maintain their own mini and micro hydro-power stations at country level.

3.11.10. *Micro Hydro Projects.*—In the mountain reach mentioned at para 3.11.3 above, there are many small streams. A careful examination of these streams will be necessary to see if small size storages could be sited at high level and the water utilised in small Micro Hydel installation in the range of 50 KW to 1 MW. These local stations would be able to meet the requirements of small Wadies and Villages located far into the interior of the valley. In fact, it should be possible to even standardise the size of generating units and the lay out of the Power House for such small stations.

3.11.11. To begin with an effort should be made to identify, formulate and take up at least two Micro Hydel Projects (less than 1 MW installation) as Pilot Schemes. Each of these projects is estimated to cost not more than Rs. 20 lakhs but will serve as a demonstration for the assured supply of energy to the rural hinterland. A chain of such projects can be developed in Konkan on the lines of Minor Irrigation Projects. It will be desirable to have these Schemes operated right from the beginning by the Co-operatives of the local consumers on the Chinese Pattern. Hence the proposed pilot projects may be taken up only where such co-operative effort is forthcoming.

3.11.12. Mini and Micro Hydel Stations are supposed to cater for the local needs. Hence, they save the transmission costs and distribution costs which are required for conveying the

power from the large size central stations. The break-up of the present unit charge to the L.T. consumer in Maharashtra shows that out of the net unit cost of 45.92 paise as much as 4.74 is accounted for by the high voltage transmission and 18.18 is accounted for the distribution on L.T. net work. For the generating stations catering to the needs of the local consumers, the economic criteria for the feasibility of a scheme needs therefore to be considerably relaxed. It appears that a generation cost up to 30 paise per unit may be economically justifiable in the case of the mini micro hydel projects for Konkan.

3.11.13. *Pumped Storage Schemes.*—The Hydro Electric Potential Reassessment Cell under the Central Electricity Authority (C.E.A.) has carried out detailed study of West Flowing Rivers between Vaitarna to Savitri Basins. As per the report published by C.E.A. in September 1980 the topography is best suited for development of pumped storage schemes. In all following twelve pump storage sites envisaging a total installation of 37,150 MW have been identified. Estimate of these twelve schemes at present day cost level would work out to about Rs.18,600 crores.

Serial No.	Name of Scheme	Capacity MW
1	Pinjal	700
2	Kengadi	1,550
3	Koimondapada	5,000
4	Chornai	3,150
5	Jalond	3,600
6	Kalu	1,150
7	Sidghar	1,500
8	Ulhas	4,200
9	Amba	2,500
10	Utra	6,200
11	Ambavane	4,200
12	Savitri	3,400
Total		37,150

3.11.14. Out of the above schemes, the State Government had earlier carried out studies in respect of Pinjal P.S.S., Ghatgar P.S.S. (Chornai P.S.S.), Pimpalgaon Joge P.S.S. (e.g. Kalu P.S.S.). The draft project report of Ghatgar P.S.S. (250 MW) is under finalisation. The installation of pumped storage schemes in Maharashtra State, having predominantly a thermal base for power would help in the optimum utilisation of thermal stations. The State's main load centres (Bombay, Thane and Pune) are very rear to the location of the identified pumped storage schemes. Hence these pumped storage schemes will improve the power position of the entire Western Maharashtra Power Zone. The implementation of above pump storage schemes will depend on the needs of peaking capacity of Western Regional Power System and the availability of off-peak pumping energy at nights and on holidays.

3.11.15. The upper reservoirs of some of the pump storage schemes are situated on the East Flowing Rivers while lower reservoirs are on the West Flowing Rivers. The consumptive use of water in a pumped storage scheme is the evaporation loss from the two reservoirs and the transit losses. This requirement can be met with from the waters of West Flowing Rivers which are available in abundance. Thus, implementation of such pumped storage schemes need not in any way consume the waters of the east flowing rivers.

3.11.16. *Master Plan for Hydel Schemes.*—A systematic and comprehensive assessment of Hydro Power Potential in Konkan remains to be done. A Master Plan covering all the possible Hydro Power developments including the mini and micro Hydro Power Stations needs to be immediately prepared on the same lines as for the Master Plans recently drawn up for the Irrigation Works in Konkan. For this work and for the detailed investigations of identified Hydro Electric Projects in Konkan, one independent Hydro Electric Project Investigation Circle with four Divisions one each in Thane and Raigad and 2 in Ratnagiri District needs to be created immediately. The cost of detailed investigation of the identified 20 Hydro projects has been estimated as Rs. 146 lakhs including the cost of establishment. If the above organisation is created immediately, it would be possible to complete the investigation and start full-fledged construction activity on at least a couple of feasible sites in the 3rd or 4th year of this Sixth Five-Year Plan after completing the designs work.

3.11.17. *Financial Requirements of Hydel Schemes.*—On the basis of studies carried out so far in the Irrigation Department of Maharashtra, 20 Schemes have been identified in the Konkan Region (Plate 9). The total power potential at these sites works out to 175 MW at 30 per cent load factor. The present day cost of Hydro Power Development in Konkan Region is likely to be between 9,000 to 10,000 rupees per KW. On this basis, the total estimated cost to exploit the power potential of these sites would work out to Rs. 160 crores approximately. Many more projects are expected to be identified once a separate investigation organisation is created for the purpose. The real perspective picture will therefore be known only after that organisation has worked for the Master Plans for over a couple of years.

3.12. Use of Average Flows

3.12.1. Under the current practice, major and medium projects planned are for utilising 75 per cent dependable yield at the storage site. This implies utilisation of 20 to 30 per cent less water than the average yield of the valley. With the objective of total conservation of the available natural supplies, planning on the basis of average flows may have to be considered in due course, beginning with those valleys first where shortages are anticipated. In the minor irrigation works planning on the basis of average flows has already been adopted. In the case of Major and Medium Projects also it will be prudent to keep the further needs of storing the average flows in view so that subsequent raising of dams can be avoided or at least done without much of a technical difficulty later. Otherwise the opportunity for utilising the balance waters is likely to be permanently lost.

3.12.2. Traditionally hydro-power projects have been planned for 90 per cent dependability. Recently some projects are being planned for 75 per cent dependable flows. It is seen that for a Hydro peaking station the storage cost generally forms a relatively small component of the projects costs. The water conductor system, the powerhouse and the generating equipment account for a major share of cost. Any increase in the storage can be effected without altering the water conductor system. A larger storage will enable operation of the power house for a greater number of hours in years of good rainfall. Additional units so generated will be a direct benefit at marginal extra cost. Hence it will be worthwhile checking up the extra cost of storing the average flows (rather than restricting the storages to 75 per cent or 90 per cent dependable flows) and the benefits due from extra generation of power units and then provide for a larger storage for utilising the average flows in the river wherever found economically justifiable.

3.12.3. It is also necessary in the national perspective to plan to store as large quantities of water as possible, so that they can be used for future developments in a variety of ways. In this context it is desirable to investigate all the possible storage sites in Konkan, even though they may not be exploited immediately.

3.13. Tidal Power

3.13.1. Investigations for ascertaining the potential for tidal power generation along the Konkan coast were carried out in Maharashtra from 1974 to 1976. The preliminary analysis then showed that the tidal power generation was not likely to be economical at the prevalent level of prices. However, in view of the continuing rise in the cost of fuel, a continuous follow up on the possibilities of tidal power generation will be desirable. The monthly march of maximum and minimum tide heights for Konkan coast in Maharashtra are given in Annexure 3.8 enclosed. From this data it appears that in sheltered bays with narrow openings into the sea it may be possible to have a Tidal Power Station in due course of time, even though at the present level of cost such a Station would be costlier than the conventional Hydro Power Station. Yet the search and initial experimentation for the development of a Tidal Power Station may have to be continued.

3.14. Sweet Water Lakes Across the Creeks

3.14.1. In Konkan, a substantial length of the river under the tidal influence near the mouth of the creek is not useful for domestic, industrial or agricultural water supplies because of the excessive salinity in it. This length may at best be used for local navigational requirements of the country crafts. Such reaches can be brought into more effective use, if the tidal inflows into these portions could be prevented by construction of Bandharas/Submersible dams across the creeks and as close to their mouths as possible. These will have to be essentially gated structures, so that the river channels get flushed of any debris and bed deposits by the flood in monsoon.

3.14.2. But the sites closer to the mouths of the creek have deep clay deposits along the floors of the creek. Construction of submersible dams on such clay beds pose intricate problems of structural stability. It will only be after more critical studies and research on the properties and behaviour of these marshy clays that large structures on these marshy clays can be undertaken. Till then the sites for barrages across the creeks will have necessarily to be chosen relatively away from the mouths where rock for foundation is easily available.

3.14.3. Such sites with good foundation have been utilised for the barrage at Pise on Bhatsa for Bombay's water supply and for a barrage across Amba for the Thal-Vayshet's water supply. An attempt was also made for constructing a bandhara across the creek of Surya river at Mhasvad, taluka Palghar, District Thane, on partially good foundations.

3.14.4. Close to the barrage at Pise on Bhatsa, a more elaborate structure across the river Kalu has been in view for quite some time. Kalu has a relatively flatter bed slope than that of Bhatsa. Consequently, the lake spread behind the bandhara across Kalu will be much more extensive.

3.14.5. On similar lines a bandhara-cum-earth dam at Ramraj across the creek of Sambarkund river in District Raigad, has been under investigation. There have also been proposals for investigating the similar possibilities on the Savita creek near Dahanu in District Thana, and across the creek near Mahsala in District Raigad.

3.14.6. Even though there is plenty of run-off in the rivers in Konkan, storage sites are not available in the lower reaches of the Konkan rivers. Hence storages will have necessarily to be at the toes of the western ghats from which regulated releases will have to be let into the rivers which can be picked up at the downstream barrages of the abovementioned types and used for irrigation by lifts. The lifts from the sweet water lakes in the creeks will be useful for horticultural gardens as also for the cultivation of second rice crop on the lands reclaimed by Khar-Bund Schemes in the neighbourhood. In fact it will be very advantageous if some of the Khar-Bund-Schemes could be integrated with the proposals of submersible dams/bandharas across the creeks.

3.14.7. **Regional Rural Water Supply Schemes** for the villages on the banks of the creeks could also be planned from the sweet water lakes on the creeks. In some of the narrow winding gorges, formation of such lakes will add to the scenic beauty and afford opportunities for development of Tourists resorts.

3.14.8. A careful examination of all the creeks will have to be undertaken for assessing the potential available for the development of sweet water lakes and for identifying the technical and ecological problems associated with such development.

3.15. Water Supply Schemes

3.15.1. **Urban Water Supply.**—There are 24 Municipal Councils in the three districts of Konkan and their total urban population as per 1971 census is 11.47 lakhs. By now all Municipal Councils are having piped water supply except for three Municipal Councils of Shriwardhan, Malvan and Vengurla. Schemes for these are also under execution or under processing. Thus all the urban population will shortly stand covered by the drinking water supply facility. For all these schemes, water supply is by surface drawal from a river or an impounded storage built up by the Maharashtra Water Supply and Sewerage Board or from a Minor or Medium Tank of the Irrigation Department. The rate of water supply in case of urban water supply schemes is 70 lit/per day/person. The present annual demand of water in urban area is estimated at 3 T.ha.m. net. With the increasing trend for urbanisation, the demand for urban supplies is expected to rise to 17.6 T.ha.m. in the next 30 years.

3.15.2. **Rural Water Supply.**—There are 4,927 villages in the three districts with a total population of 43.88 lakhs. Of these a population of 2.56 lakhs from 294 villages has already received a piped water supply. Water Supply Schemes for the difficult villages are taken up under Accelerated Rural Water Supply Programme of the Government of India. The 2,676 Villages in Konkan with a population of 29.05 lakhs have been identified as difficult villages. Out of this a population of 4.62 lakhs will get covered under the piped water supply schemes which are in progress and an additional population of 9.86 lakhs will be covered by the future identified piped water supply schemes. It still leaves a rural population of 10.94 lakhs from the difficult villages as uncovered by any contemplated schemes at present. Formulation of piped water supply schemes for this population will have to be taken up early. The total requirement of all the rural piped water supply schemes is expected to rise to 7.9 T.ha.m. within the next 30 years.

3.15.3. In addition to this about 3.63 lakhs of population from difficult villages is proposed to be covered by a programme of dug wells and bore wells. A population of 12.27 lakhs from non-difficult villages will have also to be covered by simple measures such as dug wells and bore wells. Thus a population of 15.90 lakhs i.e. almost one-third of the rural population in Konkan will have to depend on wells for their water supplies. For them a supply of 2.6 T.ha.m. will be required from the underground source.

3.15.4. Assured water supply is one of the primary needs for the economic well being. It is necessary that this facility is made available to the rural population of Konkan immediately to check their tendency of migration to Bombay. As can be seen from above much work still remains to be done even in respect of the formulation of schemes. A very major effort will be required in the years to come to provide the water supply facility to all the rural population of Konkan before the close of the coming decade.

3.16. Ground Water Development

3.16.1. As already mentioned in para 3.9.2. above the work on all the small size storages and other local sector schemes for water conservation and utilisation may have to be completed on priority. The local sector schemes are generally in the form of

village tanks or small Bandharas with canals on both sides. These village tanks and Konkan Bandharas arrest the waters of nallah for a longer time and may help in enriching the ground water storage. Exactly how much would be the contribution to underground potential of water cannot yet be indicated in absence of geohydrological data. More investigation and field research needs to be carried out in this respect. But in the meantime, a programme of digging of a few wells close on the downstream of small tanks needs to be undertaken. This study should lead to the identification of geological conditions under which ground water recharge can be successfully obtained. Eventually the results of such a study may help in undertaking a systematic programme of construction of wells in Konkan.

3.17. Use of Koyna Tail Waters

3.17.1. When the Power Station at Pophali was commissioned in 1962, the river Vasisthi became perennial with a large dependable flow available in it throughout the year. Various suggestions have been under consideration since then as to how best this copious supply of water should be put to further use. Initially, there were suggestions for developing Irrigation Projects from these Tail Waters as has been done in the case of Amba and Patalganga rivers which receive the Tail discharges of the Tata's Hydro Power Stations. A suggestion for conveying the Koyna Tail Water's released at Pophali at a level of 130 metres above the sea level to Bombay for meeting the increasing water supply needs of Bombay was also mooted.

3.17.2. But Stage III development of the Koyna Power Complex was taken up in 1965 with a new underground Power House at Kolkewadi for utilising the available head of 130 metres between Pophali and the sea level. The tail discharges from the Stage III Power House at Kolkewadi are now released close to the tide levels in Vasisthi. As the power generated from the Kolkewadi Power Station is very vital for the power needs of Maharashtra, any suggestion which envisage the diversion of water directly from the higher levels at Pophali cannot be considered further. Use of Koyna Stage III tail waters in Vasisthi will hereafter necessarily imply lifting of water from R.L. 4.55 m. above the sea level. The water so lifted will be a high cost water on account of the cost of lifting and can be put to use only for high priced products. For any industrial units located around Chiplun in the Vasisthi valley ample supply of water can be assured. There is, therefore, a scope in this valley for establishment of industrial units that have a large consumption of water.

3.17.3. Sometime past there were enquiries regarding the possibility of exporting clean and fresh waters to the Oil Supplying desert countries. The possibilities of using the Koyna tail waters for such exports may have to be kept in view. The creek of Vashisthi river at Dabhol is fairly navigable and can admit barges of a fairly large size during tide times right upto Gowalkot near Chiplun where a jetty has already been constructed for receiving the imported Koyna Hydro Station's equipment by sea.

3.18. Tourist Resorts

3.18.1. The large numbers of storages proposed in Konkan is bound to add to the natural scenic beauty of this area which abounds in varied land scapes. The picturesque valleys studded with storages, large and small, will provide an added new attraction to the Tourists from the neighbouring regions as well as to those coming from abroad. In view of the perennial flows of water in Vasisthi from the tail discharges of Koyna complex, flowing by the foothills of Purshuram, the historical and religious centre at Purshuram village has acquired a permanent asset in land scape recreation. Hence the village Purshuram has a very good scope for development as a tourist resort. It will be useful if such other spots of scenic beauty are

identified with reference to the water resources development programme for Konkan and got covered by Silvi-pastoral and Horti-pastoral developments to further enhance the scenic value and the socio-economic status of that area. They can then come up very well as Tourist Centres as soon as the storages go up.

3.19. Cost-sharing through multi-purpose Uses

3.19.1. As has been indicated in the various foregoing paras, water from the valleys in Konkan can be put to multiple and multi-purpose uses such as Hydro Power Generation, Irrigation or Industrial and Domestic Water Supplies and in addition to recreational purposes also. In view of the high cost of storages in Konkan, it will be economically more attractive if the projects are formulated as multi-purpose projects with sharing of costs amongst the different uses. Particularly there is a great need for combining the Hydro Power Development with the irrigation development and sharing the cost of development between the two.

3.19.2. Master Plans for irrigation works have already been finalised. The Master Plans for Hydro Power Projects and the Domestic and Industrial Water Supply Projects should also be finalised immediately so that an integrated view of the water resources development in every valley and sub-valley is possible and all future projects can be appropriately planned as multi-purpose projects.

CHAPTER IV

LAND AND WATER USE PLANNING

4.1. Need for a Change

4.1.1. The Konkan region is one of the examples in our country where the people are poor even though the area is rich in natural resources. A challenge lies in transforming these resources into wealth, meaningful to the people. It is a known fact that the land resources of Konkan are in most cases not properly used; and water resources are not yet fully developed. Though, many efforts have been made in the past to rectify such mistakes, hardly any impact is visible. Therefore, some new strategy for development needs to be adopted.

4.1.2. *Eco-systems of the Western Ghats.*—The uniqueness of Konkan is reflected in its relief, climate and biotic factors among the areas of the Western Ghats. The area differs in agro-climatic factors from south to north. Unlike 35 to 40 weeks of rainy days in the southern most tip of Western Ghats, the rains in Konkan occur in less than 15 weeks at its southern most tip thinning further to 10 to 11 weeks at its northern most extension. There is a further evidence of variation from coast to crest across the breadth of the region within a distance of 50 to 60 km.

4.1.3. Such diverse and variegated conditions have resulted into different patterns of flora and fauna in the different water sheds. This has given rise to numerous sub-eco systems, often incompatible with each other, depending upon their location with reference to one side or the other of the slopes. For the purposes of planning and development, Konkan region has, therefore, to be divided into small size eco-units mainly based on the physical factors which have direct relations with and influence on the various activities. The subsistence farming with marginal commercial horticulture and practically neglected forestry has been an outcome of the diversities.

4.1.4. Such variations have rendered the Konkan region unsuitable for implementation of extensive large size models of land and water utilisation popular in other areas viz. mere construction of water storages with extended canal system in other parts of Maharashtra can give sufficient impetus to intensive farming in the surrounding areas, but the same strategy may not necessarily achieve parallel results in this region.

4.2. Eco-regions in Relation to Land Use Planning

4.2.1. Ecologically, the Konkan region can be divided into three main divisions:—

- (i) Coastal belt : Breadth about 10 to 20 km from sea coast.
- (ii) Middle strip with breadth of 30 to 40 km, and
- (iii) The mountain and foot-hills strip along the western precipice of Sahyadri.

4.2.2. The physical elements like temperature, rainfall, soil, humidity, height from sea level, etc. differ considerably from one strip to the other. However, the entire area has high humidity and receives heavy rains (on an average 2500 mm annually) mostly concentrated over a period of 100 days.

4.2.3. The coastal belt could be sub-divided into two micro eco-regions; (i) Area facing open sea, (ii) Area adjoining creeks and swamps. The middle strip could be visualised as two micro eco-regions; (i) Flood plains starting from the foot-hills and extending upto river banks (ii) Hill-spurs forming undulating landscapes.

In the case of mountain and foot-hills strip, two distinct landscapes are prominent;

(i) Low hill ranges upto 300 m above sea level,

(ii) Middle and high hill ranges in the extreme eastern border of the region with a maximum height up to 1600 m above sea level.

4.2.4. Travelling from north to south, one has to cross a number of hill-spurs, plateaus, streams, estuaries. Similarly in the east-west direction, not only one has to pass through undulating region but has also to climb up the slopes of Western Ghats to reach the eastern border of the region. The area thus poses unique problems, not only of land and water utilisation but also of their management.

4.3. Deficiencies in the Present Land Use

4.3.1. As may be seen from para 2.6.2 the net area sown in Konkan is only 8.10 lakh hectares out of a total geographical area of 30.09 lakh hectares i.e. 27 per cent of the total, while 22 per cent of the land is either fallow or cultivable waste. Hardly 3 per cent of the net area sown is under irrigation, thereby, making the farmers solely dependent on the single paddy crop which is predominantly grown in the region. Horticulture accounts for less than 4 per cent of land-use and is in an undeveloped stage. Though area under forest is 26 per cent of the total area, (2.11.1) density of trees is very low and except for parts of Thane District, this sector is also not well developed.

4.3.2. Though there is adequate scope and potential for development of inland or brackish water fishery activity in the region, the fishing industry survives mainly by the catch brought in by the sea-going vessels and only recently some efforts are being made to popularise inland sweet water and brackish water fisheries in the region.

4.3.3 Dairying and animal husbandry industry are also under-developed. The breedable cattle and buffaloo population in the region is 6.46 lakhs. At its peak, the milk collection in the entire region is below one lakh litres per day, giving an average production of less than 100 litres per lactation per animal. Apart from the poor quality of the milch animals, scarcity of the quality fodder resources is responsible for this low performance.

4.3.4. Wherever farmers have made appropriate use of land and water resources and used modern farming methods, they have reaped rich harvest e.g. irrigated areas in Raigad district have high yields of rabi paddy in the command area of Kal project. The farmers have developed successful chikoo-plantations in the Dahanu Taluka of the Thane District, where the net realisation per hectare exceeds Rs. 5000 per annum in some cases. The mango plantation is also giving similar high returns to farmers in Deogad Taluka of Ratnagiri District, purely on rainfed mango gardens.

4.3.5. Thus the region has immense potential in increasing its production of foodgrain and horticultural produce by appropriate use of land and water resources and by employing a right

package of practices. Apart from paddy land, bulk of the area is available for developing suitable tree crops. Potential areas for such development could be estimated as under:—

	Per cent.
Barren and un-cultivable land	19
Cultivable waste	12
Permanent pasture	5
Fallow land	9
Total ..	45
	or approximately 13 lakh hectares.

Some kind of socio-administrative machinery to prevent the keeping of such large areas of useful lands unutilized will be necessary.

4.4. Eco-units for Development

4.4.1. The existence of various sub-eco-systems have led to development of typical micro cultures wherein inhabitants have taken to traditional land and water management systems with varying degrees of success. Unfortunately, attempts in improving the prevailing resource management systems were often based on the developmental planning of administrative units which are not necessarily in harmony with ecological requirements. Thus, instead of linking the micro eco-regions with common themes, the administrative divisions have often led to the breaking up of the systems leading to poor success in development programmes in general.

4.4.2. *Panchkroshi*.—Reorganisation of administrative blocks according to farming systems and for basinwise water and land management leading to valley approach is essential. If management of resources is to be handled in a successful manner, it is essential to deal with a homogeneous cluster of villages which are physically, as well as socially, bonded together as a unit. Fortunately, Panchkroshi as a concept, both in theory and to some extent in practices exists in Konkan. It literally means a cluster of settlement within a radius of five Kroshis, (each Kroshi is about 3 km) By and large, they represent micro cultures developed in the region over centuries. It is necessary that this 'Panchakroshi' is now made co-extensive with a water shed of upto 100 sq. km and used as a unit of developmental planning in Konkan. They can be identified on the basis of homogeneity and interrelatedness of the eco-system.

4.4.3. "Panchkroshi" will introduce an intermediate level of administration and planning between the village and the traditional development block i.e. a taluka. This arrangement will be similar to the system of "Panchayat Mandal" that exists in some other States in India. The "Panchayat Mandal" of a 'Panchkroshi' will have to be entrusted with the responsibility of evolving an integrated development plan of the 'Panchkroshi' and implementing it.

4.5. Integrated Planning of Eco-units

4.5.1. Isolated sectoral approach cannot lead to much of a success, particularly in a highly undulating region like Konkan. On the other hand, it may only disturb the ecological balance of the micro regions. Therefore, an integrated approach to the development of small water-shed is essential along with the full participation of the local inhabitants. The integration should be with a view to maximising the returns, through optimum resource utilisation. The responsibility for conservation and effective utilisation of resources should be a joint-sector activity between the people and the Government Departments.

4.5.2. To fulfil these objectives, there has to be a clear cut distinction between the strategy to be followed for the operations at micro-level and for the operations at macro-level. Formation of specific integrated developmental schemes for individual micro regions is essential. In few cases, even these micro regions may have to be further sub-divided into smaller units on the basis of natural resources and/or the administrative constraints for the implementation of the development programme. The pilot water shed development schemes suggested in para 4.10 below are representative of this type.

4.5.3. Some of the schemes, such as rubber or oil palm plantation that have been tried outside the region, may have a place in Konkan region too. Even though some of them may have been already tried in some areas, they could be attempted in new areas with additional inputs. But the applicability of these schemes may have to be restricted to specific eco-regions, that have been proved to be suitable for the growth of these varieties of plantations. Thus, while an integrated approach will hold good for all the eco-regions, the composition of an integrated scheme will differ from eco-region to eco-region. Though such schemes will have to be tuned with the specific requirements of the micro eco-regions, they will have to be developed around a core activity of the larger region.

4.5.4. Accordingly, the methodology for the formulation of integrated schemes will have to be as under :—

- (a) Identification of an eco-unit.
- (b) Selection of a core activity for development.
- (c) Weaving of allied activities around the core activity.
- (d) Assessment of the potential worth of the schemes in terms of impact on employment and income generation.
- (e) Evaluation of comparative advantages of the integrated scheme *vis-a-vis* existing schemes.

The competitiveness of the various land and water use models will have to be assessed keeping in view the above consideration, and only proven models yielding both immediate and sustaining benefits, recommended for adoption.

4.6. Conservation Approach

4.6.1. After considering the topography, the rainfall pattern, the geology, soils and the existing cropping systems, the manner of utilisation of the land and water resources will have to be such that it will help to maintain the benefits from the ecological endowments of the area on a continuing basis. For this, it is essential to adopt a conservation approach rather than an exploitation approach. A long term perspective plan has to be drawn up first, and the schemes for short term benefits fitted into the long term programme. In this context, overall environmental planning, including organisation of marine national park and biosphere reserves, will need proper attention and priority. The resources will have to be developed in such a fashion that the short terms and long term goals of development are in mutual harmony.

4.6.2. *Agro-forestry*.—In view of this, Konkan is an apt case for introduction of suitable agro-forestry practices. Tree farming, both for fuel and other purposes, and silvi-pastoral and silvi-horticultural systems should have predominance over cereal and other arable cropping, particularly in undulating terrain. This is because the latter requires changes to be brought about in the land system of the region. Paddy cannot be grown unless lands are levelled, and excessive levelling of steep hill slopes would not only be a very expensive operation but also one that may bring about ecological disturbance. Taking crops like Nagli and Vari on steep and bare

hill slopes would also accelerate erosion of the land. The land use pattern, therefore, has to be one which will cover the steep slopes by silvi-pastoral crops, the moderate slopes down below by silvi-horticultural crops, leaving only the flat lands in the valleys to cereal crops. This system alone will answer the energy and economic needs of the region, also generate employment, and ultimately lead to restoration of the ecological balance of the region.

4.7. The Strategy for Development

4.7.1. The entire cropping system as above will have to be followed on watershed basis. Fortunately, delineation of watersheds in Konkan is easy due to the multitude of configurations already existing in the area. Very steeply sloping top reaches of such watersheds will have to be put to a three-tier forest, consisting of tall and medium trees and grasses. The relatively moderate lower slopes will have to be put to a proper mix of horticultural, energy and fodder trees, as well as to grasses, and the lower reaches in the valleys will have to be put to cereal and pulse crops after due corrections of slopes and other characters of the land. Such a cropping system is also supportable on the basis of the data provided by the soils (Plate 4) and land-use capability surveys carried out by the Department.

4.7.2. Supplemental engineering works such as bench terracing of land, gully plugging, nala bunding, trenching of hill slopes, will be required for arresting runoff water and making it percolate down the profile into the ground for improving the availability of moisture in the soil cover and for improving the ground water resources wherever possible. Excavation of appropriate number of wells down below such water harvesting structures have also to be considered wherever situations are favourable for the building up of ground water resources.

4.7.3. In addition, a surface water storage will have to be built up in the watershed to facilitate production of rabi crops and for mitigating the drinking water problem in that area. Supplies from surface water storages would also support nurseries for production of paddy seedlings and help the rearing of seedlings for horticultural plantations.

4.7.4. Water storage would also be utilised for inland fisheries culture. The farmers, whose lands are submerged by the water storages, may be given rights of fishing in these water storages to mitigate their loss on account of flooding of their fields. The landless and scheduled caste and scheduled tribe families can also be rehabilitated, by providing opportunities for fishing in inland water bodies. They will have to be provided initial help, training and equipment. As reservoirs go on developing, the number of families can be increased. Fish-culture could also be taken in the paddy fields where about 150 mm water depth would be available all the time. If this depth is likely to be reduced, then fish-culture should be practised in trenches adjoining the paddy fields.

4.7.5. Land use is a function of home needs, market opportunities and the level of technology available to the farmers. The entire package has, therefore, to be drawn up keeping these factors in view. Intensive farming in the valleys, with the support from irrigation schemes, would provide large scale employment opportunities to the farm labourers, and generate the necessary foodgrains surplus in that area. This would reduce their dependence on the hill slopes, thereby making them available for horticulture and forest plantations which have a longer gestation period. The hill slopes plateaus and pasture lands could be brought gradually under either horticulture plantations or under different social forestry schemes implemented by the Forest Department or under three-tier plantation schemes.

4.7.6. It is proposed that a few watersheds should be selected and developed on these lines, by introducing the silvi-horti-pastoral cropping systems on hill slopes of varying degrees, and using the valley lands for cereal cropping. Building up of nurseries should form an important component of the programme for land development and horticultural schemes. Watersheds developed along the lines suggested above would make great impact. Such demonstration or

pilot watersheds, being relatively few in number, could be provided with adequately instrumented monitoring systems, so that measurements can be made on receipt, disposal and utilisation of rain water. Such measurements will bridge the gaps in our knowledge about hydrology and ultimately lead to a refined planning for the optimum utilisation of land and water resources.

4.7.7. In order to make this strategy work, a 'skill development programme' coupled with orientation in conservation policy, will be required for the concerned villagers. Hence all development schemes should be supplemented with training, including training in appropriate small scale and village industry, L. T. distribution, micro-hydel generation, managerial skills and motivation and extension work. After all, man is the focal point of all development. Hence the schemes should be tailored to suit his equation with the natural resources. Moreover, in this region of vagaries, he will also be the sole integrating factor in the process of development. Failure or success of programmes in the region, vitally depends on his involvement. This requirement should not be lost sight of.

4.8. Recommended Land-Use Activities.

4.8.1. Based on the above approach, specific recommendations for the development of the lands of different types and capabilities, as listed below, have been offered in the following paragraphs:—

(A) Kharif paddy lands—

- | | | | |
|-------------------|----|----|---|
| (a) Irrigated | .. | .. | (i) Flow irrigation. |
| | | | (ii) Well irrigation. |
| (b) Non-irrigated | .. | .. | (i) Lands prone to flooding. |
| | | | (ii) Varkas paddy land on hill slopes and terraces; |

(B) Land under hill millets and shifting cultivation;

(C) Cultivable waste land;

(D) Land under plantation and tree crops;

(E) Land under permanent pastures;

(F) Land under forest;

(G) Fallow land;

(H) Barren and uncultivable land;

(I) Khar land;

(J) Other coastal land.

On the basis of the experience of the State and private agencies working in Konkan, mixed farming patterns, yielding higher returns in respective land and water use combinations, have been recommended.

(A) Kharif Paddy Lands

4.8.2. These could be considered in two broad categories—irrigated and un-irrigated. The irrigated paddy lands, with facility of flow irrigation, may be used for kharif paddy followed by summer paddy. The bunds of these paddy fields would be planted to coconut. The productivity of paddy lands would need to be improved after conducting proper soil survey and soil testing.

4.8.3. The non-irrigated paddy lands, which are prone to flooding in the monsoon, could be used for fish-cum-paddy culture. In those fields where local variety is cultivated and insecticides are not used, it is possible to have paddy-cum-fish culture in the same plot, and wherever insecticides are used, it may be necessary to separate fish culture from paddy cultivation.

4.8.4. The non-irrigated paddy lands, which are mostly on hill slopes and terraces, could be used for paddy cultivation in kharif, while a pulse crop would be taken up in rabi season on the residual moisture. The bunds of these fields could be planted to mangoes and cashew nuts.

4.8.5. When irrigation facilities get developed, the varkas lands should be utilised for horticulture for growing fruit crops like chikkoo, banana, papayya and pineapple in preference to cereal crops. It will be desirable, to provide new forms of irrigation, such as sprinklers, for the upland areas to assure minimum moisture requirement all the year for horticultural growth. At least four pilot projects, of about 10 hectares each from the existing irrigation storages, which are not being fully utilised, should be taken up immediately in this Plan. The estimated outlay for these pilot projects would be about Rs. 2.80 lakhs. (Annexure 4.1)

(B) Lands under Hill Millets and Shifting Cultivation

4.8.6. These lands could be inter-cropped with fodder trees, like Koo-babhoole and Agasta at 1.2 m × 1.2 m interval, along with hill millets. This would help in nitrogen fixation in the soils as well as provide additional fodder resources after harvesting of millets. The social problems involved in arresting the shifting cultivation need much closer and serious attention immediately. Specific training and employment oriented schemes will have to be formulated for the persons who are dependent for their livelihood on shifting cultivation.

(C) Cultivable Waste Land

4.8.7. This should mainly be brought under horticultural plantations like mango, cashew-nuts and jackfruit. They may be inter-cropped with fodder grasses like stylo and ceratro, which would give immediate returns to the farmers. Horticultural nurseries will have to provide bud-sticks in adequate number.

4.8.8. *Horticultural Nursery.*—Konkan Krishi Vidyapeeth, Dapoli, proposes to establish one horticultural nursery on an area of 40 hectares at Dapchari with a capital investment of Rs. 14.2 lakhs and the recurring expenses of Rs. 18 lakhs for a period of 5 years (Annexure 4.1). Considering that as many as 10 lakh hectares are available for being covered by horticultural plantations, it would be worthwhile establishing this nursery immediately.

4.8.9. *Mango Nurseries.*—Konkan Krishi Vidhyapeeth, Dapoli, also proposes to establish 30 nurseries in Konkan for producing 15,000 alphonso mango grafts every year from fifth year onwards, at each nursery. The capital investment for each nursery will be of the order of Rs. 50,000 and the recurring expenditure would be about Rs. 1.7 lakhs for a period of five years (Annexure 4.1). Such nurseries will be very useful and should, therefore, be established early.

4.8.10. In order to cover extensive areas with mango trees, much more effort than is ever possible, purely through the departmental schemes as mentioned above, will be required. In fact, it will have to be a people's programme with financial and technical assistance from Government rather than a programme as a departmental scheme. It will be worthwhile involving the voluntary organisations in Konkan in such a programme.

4.8.11. *Mango grafts Programme.*—One of the principal bottlenecks in the speeding up of the mango plantation work in Konkan, is the low availability of mango grafts. It is, therefore, necessary to think of ways and means to raise quality mango grafts outside the Departmental

nurseries. One direction, in which such a programme can be built, is that the mango gardens raised on cultivators' fields under the departmental scheme can be used as progeny orchards, and the mango trees grown there used as mother trees for borrowing grafting material i.e. bud-sticks. While planting mango grafts on cultivators' fields under the department schemes, quality grafting material was used since the grafts were raised under expert supervision at the Departmental nurseries. The trees growing out of such grafts, therefore, carry the same seal of quality. Good trees from the lot can be chosen in consultation with the horticultural experts of the Konkan Krishi Vidyapeeth, and the budding material borrowed from such trees on private cultivators' lands, for making grafts.

4.8.12. *Grafting in situ* can be done by the cultivators themselves after they are properly trained. Training to such cultivators can be imparted by the Konkan Krishi Vidyapeeth. If this activity is done on a large scale in all the three Districts, the mango orchards, grown under the departmental scheme will act as potential nurseries, where the cultivators themselves will carry out a large volume of grafting programme in situ resulting into large scale commercial plantation of mango all over. It is true that the farmers may not get any fruit yield from trees used as mother trees but they will start realising cash receipts much quicker by the sale of grafts. Such a programme needs to be properly formulated, and carried out by the Department of Agriculture with the help of the Konkan Krishi Vidyapeeth, Dapoli.

4.8.13. *Medicinal and Aromatic crops*.—There is also a possibility of undertaking medicinal and aromatic plantations such as Cinchona, Cintronella, Lemongrass, Digitalis, Beladona, Hyoscyamus, Ipecac, Dioscorea, Vinca-rosea, as a part of horticultural programme. A demonstration plantation of about 100 hectares may be taken up initially. The financial requirement to set up this plantation would work out to Rs. 16.5 lakhs for a period of five years.

4.8.14. *Rubber Plantation*.—Rubber plantation will have to be tried as a part of the horticultural programme. Cultivation on an area of about 500 hectares, divided into blocks of about 100 hectares each may be taken up as a part of Western Ghats Development activity. According to the standards worked out by the Rubber Board, the cost of planting and maintenance of rubber plantation during the seven years of gestation period is estimated at around Rs. 15,000 per hectare. Hence the cost of plantations on 500 hectares would be around Rs. 75 lakhs. Plantation areas may be selected preferably within or near an irrigation command, so that suitable measures, to assure adequate moisture for the plants throughout the year, can be conveniently incorporated in these pilot schemes. Depending on the performance of these pilot plantations, the programme can be extended to larger areas in stages. It is learnt that a suitable patch is likely to be available in the extensive command of the Surya irrigation project where canal system has just started functioning.

(D) Land under Plantation and Tree Crops

4.8.15. Most of the existing plantation in the Konkan region requires additional inputs for reaching the optimum level of production. It is essential to strengthen the existing plantations by providing required inputs through normal credit channels. In order to improve their returns, they may be intercropped either with grass or any other suitable cover crops.

(E) Land under Permanent Pastures

4.8.16. Permanent pastures may be further strengthened by introduction of stylos, ceratro or other high yielding grasses. They could also be intercropped with keo-babul and agastha.

4.8.17. *Fodder Research*.—In this connection, it is essential to undertake the work in developing high yielding superior quality forages, to meet satisfactorily nutritional requirements

of the animals. Konkan Krishi Vidyapeeth has a grass breeding station at Palghar, where the work in fodder research is carried out. But the land, staff and irrigation facilities at this station are inadequate. The Vidyapeeth proposes to undertake extensive research work on this subject if 60 hectares of irrigated area is allotted to it at Dapchari for this purpose. An immediate decision on establishing the said farm is necessary. The capital investment involved would be of the order of Rs. 10.5 lakhs only, with recurring expenditure for a period of five years at Rs. 12.5 lakhs. (Annexure 4.1.)

(F, G & H) Land under Forest, Fallow Land and Barren Uncultivable Land

4.8.18. This land should be brought under social forestry schemes. Since these schemes are of an integrated nature, they would help the land owner in securing their normal earnings, despite undertaking of forest plantations. It may also be possible to identify large private forest areas, and offer them to private companies for development under the modified government schemes. However, this may be done only if local farmers are unwilling to come forward to develop them.

4.8.19. *Forest Development Programme.*—The Forest Department has already drawn up their own programmes for afforestation of lands in their possession. Their perspective programme for forestry development in Konkan will require an outlay of Rs. 50 crores. The programme encompasses silvi-pastoral, silvi-horticultural developments and other plantations on private and government land. It also includes forest research activities, soil conservation measures environmental protection measures and infra-structural development. The Sixth Plan requirement of this programme is around Rs. 16.64 crores. But the annual plan of 1981-82 is proposed for Rs. 108.91 lakhs only, as the main thrust of this programme during the Sixth Five-Year Plan will be felt from 1982-83 onwards. This programme needs to be speeded up.

(I) Khar Land

4.8.20. *Strengthening of the Khar Land Research Station, Panvel.*—Large areas along the sea coast called as Khar Lands (coastal saline), covering about 66,000 hectares from the districts of Thane, Raigad and Ratnagiri, have become unfit for normal cultivation due to the periodical ingress of sea water. Starting with the initiative of the local people, the construction of Khar Land Protection Bunds has been taken up since long to reclaim and bring under cultivation the Khar land areas. From the continuous onslaught from the sea waves, the khar land protection bunds, suffer considerable damages every year. With the rising costs and migration of able bodied persons to Bombay the heavy repairs required for the khar land bunds are not taken up in time, with the result that many of the old schemes are now in dilapidated condition, and need immediate repairs. The Ughadies i.e. only one way opening automatic wooden gates which prevent ingress of sea water on the protected land but discharge the rainfall-run off into the creek during the low tide period, are also left unattended for long. Some research in the use of appropriate material for the gates in lieu of wooden gates, such as plastic coated gates to prevent decay, would help to avoid the problems arising out of decaying of wood and rusting of hinges.

4.8.21. *Khar Land Development Schemes.*—At present, the Irrigation Department is entrusted with the responsibility of maintenance and management of the existing khar land bunds. The Department has estimated that 252 of the old Bunds require considerable renovation, which will cost about Rs. 9 crores. In addition, bunds for 2,514 hectares of land are under construction, and a shelf of 17 schemes to protect 2,120 hectares of land are ready on hand. The ongoing schemes and the new works together are expected to cost about Rs.1.62 crores. Further, 22,235 hectares of reclaimable land still remains to be protected by khar land bunds. It will thus be seen that investment of a substantial order will be required in the khar land development activity. Comparatively, the financial allocation made available for this activity has been very poor. So far, only Rs.15 to 20 lakhs are made available for these works every year. In view of

the net addition of new cultivable land to a region which is short of cultivable land and the potential for development of pisci-culture along with the cultivation of these lands, it will be desirable if allocations for this activity are stepped up substantially.

4.8.22. *Khar Land Research*.—Mere construction of embankment does not make the land fit for cultivation immediately. The soils, being clayey in nature, have low infiltration rate. The content of soluble salt is also high and the predominant salt is sodium chloride. Due to high concentration of salts in soil, the crops fail to survive. Considering the seriousness of the problem, the State Department of Agriculture established Agricultural Research Station at Panvel, in the year 1943, to evolve suitable salt tolerant rice varieties for khar lands and a khar land Research Station at Panvel to evolve quick reclamation techniques and management practices in respect of khar lands, in the year 1959.

4.8.23. Though research on some aspects of khar land management and on salt tolerant rice varieties is already being conducted, there is an urgent need to strengthen the research work at these research stations. Particularly, it is necessary to strengthen research on hydrology of khar land which is quite different from that of other areas. Konkan Krishi Vidyapeet has drawn up a scheme for the extension of this research station which requires Rs. 14 lakhs of capital investment and a recurring expense of about 16 lakhs over a period of 5 years (Annex 4.1.). Extension of the research facilities at Panvel may have to be considered early. Moreover, assistance from the Central Salt Research Institute, Bhavnagar and Central Salinity Research Institute of ICAR at Karnal would be available and should be sought for resolving the problems in khar land development. Guidance and help from the experts from Netherlands may also be available under the Indo-Dutch Protocol, which is recently signed.

4.8.24. The principal objective of the programme of khar lands protection bunds is the reclamation of the land for paddy cultivation. But at places, the khar lands can be used for developing salt extraction ponds also. Khar lands can also be used for developing brackish water fishery. The economics of khar land utilisation for purposes like agricultural, brackish water fishery and salt extraction needs to be studied by an inter-disciplinary team so that such lands can be developed and utilised effectively.

(J) Other Coastal Lands

4.8.25. Khar and other coastal lands can be used for development of pisci-culture. For this purpose, detailed surveys of brackish water areas along the creeks may have to be carried out. Pilot projects for brackish water farms will have to be taken and the technique of prawn seed production may have to be perfected.

(K) Other Related Activities

4.8.26. Fishery Technology is available for immediate introduction of pisci-culture, in brackish water as well as in sweet water. All the existing ponds and water storages holding water upto 6 months in a year should be identified for development of suitable fish culture. All irrigation storages should be seeded with appropriate varieties of fish. Those farmers whose lands are going to be inundated due to development of storages, may be given preference for harvesting the fish. In fact pisci-culture should form an integrated part of reservoir development and irrigated paddy culture in Konkan region.

4.8.27. *Animal Husbandry*.—Along with the development of lands for pastures and for fodder the animal husbandry activities will have to be properly strengthened. The present live stock population in Konkan is sizeable (Annexure 4.5). But its quality is poor. The programme of upgrading milch cattle through cross-breeding, which is already launched in this region, will

have to be strengthened. Half a million breedable population in the region necessitates extensive coverage. Simultaneously, a programme for introduction of improved variety of goats in pilot blocks for stalk feeding and slaughter could be taken up, since goat rearing has a smaller gestation period than cattle. However, the menace of goats for forest development has to be kept in view and controlled grazing practice will have to be strictly observed. The schemes in animal husbandry, that may be undertaken in Konkan during the Sixth Plan period are indicated at Annexure 4.6.

4.8.28. A separate organisation for carrying out the soil surveys needs to be established early. It is to be remembered that because of the highly undulating nature of Konkan the physical characteristics of the soils at close distance, vary greatly. Hence very close sampling would be necessary. The man-power requirements for the soil classification survey in Konkan are, therefore, bound to be quite high in comparison with those for other areas.

4.9. Schemes for Adoption

4.9.1. Pilot projects, based on the approach outlined in the preceding paragraphs, have been suggested at Annexures 4.1. to 4.4. and 4.6. They would encourage the development of appropriate technology for Konkan region and will also have a demonstration effect. Depending upon physiography and climatological characteristics of the micro-eco-unit, a suitable pilot project from an appropriate sector will have to be taken up for implementation. Whatever be the nature of the pilot project, the concerned departments should only play the role of an Adviser. Voluntary local agencies should be encouraged to take over the operational responsibilities for the implementation of the programme.

4.10. Water Shed Development Schemes

4.10.1. In addition to the pilot projects suggested under the different sectors, it is necessary to take up integrated development schemes for small water sheds of about 25 hectares. It has been estimated that a typical scheme will require a financial support of Rs. 3 lakhs per year as below :—

	Area in hectares	Total cost for 1981-82 (Rupees)
Agriculture	11.50	40,250
Forestry	11.50	30,000
Pisciculture	2.00	2,00,000
Total ..	25.00	2,70,250
	say	Rs. 3,00,000

The areawise break-up under Agriculture, Forestry and Pisciculture mentioned above is only indicative for the purposes of estimation. The allocation of areas in the schemes for different water sheds will vary according to the natural characteristics and the development potential of that water shed. The implementation of such integrated schemes will have a very deep impact on the village economy. The success of these schemes will also pave the way for the undertaking of similar schemes or schemes for larger water sheds.

4.10.2. The integrated schemes should also be entrusted to the voluntary agencies of the local village people for implementation. The concerned departments of the Government should only provide the necessary know-how and guidance in the implementation of the

programme. It is suggested that in the financial year 1981-82, nine such integrated small watershed development schemes should be taken up immediately requiring a total financial provision of Rs. 27 lakhs. The money for distribution to voluntary agencies may be disbursed through the People's Action for Development, Maharashtra, who may also be entrusted with the responsibility of monitoring the integrated schemes.

4.10.3. Since the possible programme content of the proposed schemes is discussed by the Committee with most of the implementing agencies, it should be possible, to initiate the implementation of these schemes in 1981-82. A quick survey of the selected watersheds will, however, be necessary before the programme details are formulated by the concerned departments. Large scale maps and an inventory of resources will have to be prepared for each watershed scheme for working out the full details of the scheme. The National Bureau of Soil Survey and Land Use Planning, Nagpur, may be able to help the State's Organisation for the detailed soil surveys required on watershed basis.

4.10.4. Simultaneously, socio-economic bench mark surveys, and ecological bench mark surveys, will have also to be carried out. Subsequently, a periodic evaluation of the socio-economic status and ecological conditions will be necessary for assessing the impact of the integrated programme.

4.11. Environmental Protection

4.11.1. Konkan region endowed with picturesque valleys and plentiful supply of water in monsoon has a natural high potential for clean and productive environment. It is unfortunate that the environment is getting degraded because of the neglect of its land and resources. To begin with, environmental bench marks will have to be established in all the basins. Thereafter, the environmental status will have to be monitored regularly to check further degradation, and also to evaluate the impact of the watershed development programmes on the improvement of the environment. An Environmental Monitoring Cell working under a Central Umbrella Organisation, entrusted with the responsibilities for the overall development of Konkan, should be able to undertake this overview function. The Science and Technology Cell in the Education Department of Maharashtra may have to initiate action for the surveys and also suggest suitable follow up procedures in collaboration with the Department of Atomic Energy of Government of India, who have dealt with such issues in the past.

4.11.2. *Bio-sphere Reserve.*—In addition to the general measures that may be taken for the environmental protection, it will be necessary to develop some area as specific biosphere reserves. The Matheran plateau, Mahabaleshwar plateau and the Koyna catchment areas will have to be examined from this point of view early. These have biological wealth and original forest cover which is now under considerable stress. But if systematically preserved, it could meet the criteria that have been laid down for the naming of biosphere reserve. Immediate field surveys to assess the actual present status of these areas and formulate a scheme for bio-sphere reserve would be necessary. These could be carried out under the auspices of Forest Department or through a society, like the Bombay Natural History Society. A survey of each of these areas may take a year or two and cost would be about Rs. one lakh for each area (Annexure 4.8)

4.11.3. *Marine National Park.*—The coast line of Konkan is rich in marine flora and fauna. However, so far no effort has been made to develop marine reserves and parks. There are several suitable areas along the coast which are not subjected to much biotic stresses and strains. It is, therefore, desirable to think in terms of protecting and conserving these areas before the most vulnerable part of marine life gets depleted. With this objective in view, the Malwan coast may be taken up for development of a marine park. The approximate cost for the first five years may be about Rs. 25 lakhs (Annexure 4.8). The development work can be taken in different phases.

4.11.4. *Mangrove*.—In recent years mangrove eco-systems are being given increasing attention all over the world. This is particularly from the point of view of their maintenance and utilisation at optimal levels so that their capability for sustaining the human population, dependent on them, becomes better. Understanding of the different components, biotic and abiotic, of such eco-systems, especially their inter-relationship has also assumed importance. The west coast which lacks in major river deltas is comparatively poor in mangroves. While fringe mangroves occur throughout the coast line where suitable conditions occur, really dense formations are few such as in the Bassein creek, Revdanda creek and the Mhasala creek. Steps should, therefore, be taken to protect these mangroves from uncontrolled and unregulated exploitation so as to avoid further destruction. Steps should also be taken for re-afforestation with suitable types of plants in these areas.

4.11.5. A Survey of the status of the mangroves in the Konkan as a whole is immediately called for. The silvi-culture and management of mangrove forests are dependent on several factors, the most important among them, being the economic importance of the crop of timber, accessibility (and consequent ease of removal of the produce) and quantum of regeneration. The economics of management require the removal of species for which there is little or no demand and replacing these by species sought for by men. Good management must necessarily combine conservation of the total eco-system with optimal use of the mangroves and their products. This will *ipso facto* balance extraction with replenishment through regeneration.

4.12. Training Programme

4.12.1. The successful development of local resources needs a scientific and technological awareness in the rural population. The best way to bring about such an attitudinal change would be, by extending the activities of Krishi Vigyan Kendra to all the 'Panchakroshies'. Such activities of Krishi Vigyan Kendra should, in fact, precede the undertaking of a watershed programme or an irrigation development programme, so that the village people are cultivated first and seeds of scientific outlook sown in them, before their lands can be successfully put to better use.

4.12.2. *Krishi Vigyan Kendra*.—A scheme for 'Krishi Vigyan Kendra' was initiated by ICAR at the end of Fourth Five-Year Plan with a view to impart skill-oriented training to farmers through work-experience on the principle of learning by doing. The Kendra at Kosbad in District Thane started on 1st April 1977. The important objectives of the Kendra are—

- (i) To impart learning through work experience.
- (ii) To organize production-oriented training for practising farmers, men, women and field level extension workers.
- (iii) To organize non-formal educational activities for young farmers, specially the school dropouts.
- (iv) To establish farm science clubs in rural schools.
- (v) To provide practical training facilities for work-experience at +2 stage in rural schools.
- (vi) To develop practical training facilities in all fields including village industries for integrated rural development.

Such Kendras will have to be established immediately in the remaining two districts of Konkan also, so that the training of the rural youth required for the implementation of the various development programmes, suggested in this report can be undertaken in an extensive manner early. Cost of establishing one Vigyan Kendra would be Rs. 27 lakhs.

4.12.3. The development activities will also need new skills to be brought into use. These will have to be developed from the local talent only. Fortunately, primary and secondary education has been fairly widespread throughout Konkan. What is now required is to orient these literate and semi-educated local young boys into different technical and occupational skills. Particularly, for the displaced persons from the submergence areas of the water storage works, technical training schemes will be of great help in solving the problem of their resettlement.

4.12.4. *Trysem*.—The Government of Maharashtra, with the assistance from Central Ministry of Rural Reconstruction, have provided incentives and facilities for training schemes for the rural youth on the lines of the National Scheme for 'Training of Rural Youth for self-employment' (Trysem) approved by the Government of India in 1979. [*Vide* Industries and Labour Department Resolution, No. TRYSEM/1080/1203/IND-2, dated 14th August 1980] Training for farmers, veterinary clinics, poultry farms, artificial insemination and cross-breeding programmes, dairy development, fodder growing, food and fruit canning, preserving and packaging is also eligible for the support under this scheme. Important financial incentives and assistance available under this scheme, are :—

- (i) A stipend of Rs. 100 p.m. to each trainee.
- (ii) The training institution will be entitled to receive Rs. 50 per trainee per month.
- (iii) Remuneration to the Master craftsman at Rs. 50 per month per trainee and a reward of Rs. 50 per trainee after successful completion of training.
- (iv) Lump sum of Rs. 25 to each trainee towards travelling expenses.
- (v) On completion of training the trainees, would be entitled to assistance in the form of subsidy upto 33 $\frac{1}{3}$ per cent of the project cost, subject to a limit of Rs. 3,000, to cover purchase of tools and equipments, and to provide for share capital to secure further assistance or for promotion of common funds to form a co-operative society.

The TRYSEM can also provide for strengthening of the infrastructure of training facilities in the existing Institutions.

It is suggested that these facilities should be made use of, for supporting the integrated watershed development programme. They will be particularly useful for the horticultural extension programmes and for resettlement of persons from submergence areas of reservoirs.

4.12.5. *Expansion of Lab to Land Programme*.—Under the "Lab to Land" programme, the Indian Council of Agricultural Research, New Delhi has allotted 600 farm families to the Konkan Krishi Vidyapeeth. The various activities under "Lab to Land" programme have been initiated by the Vidyapeeth since the kharif of 1979-80. A rural family is often a basic unit of production and consumption under our agricultural situation. Under the 'Lab to Land' programme the selected farm families are given help and guidance in achieving all-round development. It is necessary to extend the benefit of this programme by adopting more number of small and marginal farm families from Konkan.

4.12.6. The programme carried out so far has shown encouraging results in a limited time. It has been useful to motivate large number of farmers to adopt modern farm technology and has helped them in raising farm production and consequently their income. The programme has also provided an excellent mechanism for feed back to the scientists. It was helpful in popularizing the improved varieties of rice, nagli, pulses and oilseed crop in the adopted villages and in the near by villages. Highest yield of rice and nagli obtained by the farmers adopted under 'Lab to Land' programme was 57 and 30 quintals/hectare respectively, with average yields as 45 quintals/hectare and 20 quintals/hectare respectively.

4.12.7. Hence, it would be worthwhile extending this programme further to more families. It is learnt that Konkan Krishi Vidyapeeth will be able to adopt 400 more farm families from

problematic areas. The Vidyapeeth has 15 agricultural research stations (including agricultural schools) and one college each belonging to the Faculty of Agriculture, Veterinary and Fisheries. The additional 400 farm families can be conveniently distributed amongst the above Research Stations/Colleges. As per the ICAR's norms, an amount of Rs. 1,000 per family, under problematic soil situation and an amount of Rs. 590 per family, under general soil area, can be spent. The additional expenditure in 1981-82, to cover additional number of families, is expected to be around Rs. 7.5 lakhs and may have to be made available to the Konkan Krishi Vidyapeeth early.

4.12.8. *Mobile Training Units.*—For the success of a development programme, participation of the villagers, particularly of the village youths and village women folk, is very essential. They are required to be informed, instructed and motivated to participate fully and wholeheartedly. For this purpose orientation in the form of training through meetings, discussions, films, entertainment, folk songs is required. This can best be arranged through mobile training units.

4.12.9. It will be perhaps too much to expect the villagers, particularly the village women folk, to come to far away places for taking training or knowing something of the development schemes. They are a little free only after returning home from the day's laborious manual work and after finishing the domestic duties. This free time will have to be made use of for communicating to them new ideas, new thoughts and related information for motivating them for developmental programmes.

4.12.10. Mobile training units comprising of male and female organisers, will have to move from place to place and organise camps of villagers, or rallies of village youths and village women folk in which entertainment and educative films can be shown. The experts in various fields may also be invited to address these camps. A very wide range of subjects can be covered through such talks or film shows. Special emphasis will have to be given on the role of voluntary agencies in the developmental activities. Latest techniques in cultivation of high yielding varieties, vegetables and fruits-trees, post-harvest processing and preservation and breeding of milch animals—can be communicated to them through the media of films and evening get-togethers. The enlightened villagers will then be able to serve as vanguards of rural development. It will also make them enlightened in the field of nutrition wealth and family welfare. A new generation of villagers will come up with modern ideas and with a will to participate in the developmental efforts. It is necessary that at least one mobile training unit is established in each district of Konkan to undertake the training programmes on the above lines. The financial requirements of a mobile training unit are indicated in Annexure 4.7.

4.12.11. *Training Programmes in Fisheries.*—It is proposed to pool the resources of the Central Institute of Fisheries Education, Versova (CIFE), Fisheries Department of Maharashtra and the Co-operative Federation at Ratnagiri to train and educate the people in fisheries and to demonstrate the feasibility of the fisheries development schemes. It appears that the CIFE will be able to provide the manpower needs for training and technology transfer in respect of schemes relating to fish seed farms hatcheries, brackish water fish culture, prawn hatchery and reservoir fishery. But the Institute will need facilities of land for establishing one brackish water fish farm and one fresh water fish farm in Konkan, preferably near Bombay. The total cost of training programme in fisheries has been estimated as Rs. 80 lakhs. CIFE may also be able to take up a batch for training immediately, if some facilities for hostel and residential accommodation could be made available to them near Versova.

4.12.12. *Education in Ecological Consciousness.*—In the past, Konkan region had the abundance and diversity of flora and fauna. The thick forests inter-spersed with orchards of mango, cashewnut, coconut, arecanut and other fruit crops gave a picturesque appearance. The picture has, however, changed very fast due to indiscriminate felling of trees in last few decades.

In an attempt to satisfy the needs for foodgrains, cultivation of *ragi*, even on lands upto 40 per cent slope has been taken up. This has resulted in severe erosion of soil and consequently the silting of ports and harbours. The wild life, such as big cats, deers, rabbits, wild pigs, etc. which till recently roamed freely in the Konkan forests is getting vanished rapidly. Capture of frogs from rice fields for export of frog legs has also created plant protection problems. Man has thus become instrumental in disturbing the food chain in the eco-system.

4.12.13. It is feared that the Konkan region may become barren in near future if such activities of disturbing the balance of nature continue uninterrupted. Hence, it is necessary to educate the people of the region to live in harmony with the nature and to create in their mind an ecological awareness. A regular scheme for educating the people of the region in the measures for preservation and enrichment of the precious environment, in which they live will have, therefore, to be taken up early.

4.12.14. This will be purely an extension scheme under which training classes for the rural people will have to be organised. It should be possible to cover atleast about 60,000 people in the crucial locations at 1,000 per month over a period of 5 years. Emphasis will have to be on the topics of afforestation soil conservation, wild life management and modern methods of agriculture with due consideration to the eco-system.

Issues connected with environmental pollution and judicious exploitation of marine resources may also be covered in coastal areas.

4.12.15. This type of training will have to be conducted mainly by the scientists with the help of suitable audio visual aids, exhibitions, mass media and extension literature and group discussions. Science and technology cell in the Education Department of Maharashtra will have to formulate the details and plan for the necessary manpower and financial support. It has been estimated that this scheme would require about Rs. 2 lakhs for initial non-recurring expenditure and Rs. 12 lakhs as recurring expenditure over 5 years. At the field level, it may be worthwhile associating Konkan Krishi Vidyapeeth in the implementation of the scheme.

4.13. Financial Requirements

4.13.1. *Western Ghats Development Programme.*—The Planning Commission had allocated an outlay of Rs. 20 crores for the development of entire Western Ghats in the five States of Maharashtra, Karnataka, Tamil Nadu, Kerala and Goa in the Fifth Five-Year Plan (1974–79). The Central Assistance for this programme was made available in the form of loan 50 per cent and grant 50 per cent. The following types of schemes from Konkan have been getting assistance under this programme :—

(i) *Techno-Economic Surveys;*

(ii) *Agriculture.*—Terracing of land, mango plantation, cashew plantation, contour bunding, nala bunding;

(iii) *Forestry.*—Agave plantation, afforestation and reboisement areas devoid of tree growth, construction of anicuts, check-dams, and wells, plantations of : Teak, Hirda, Khair, Bamboo. Reforestation of degraded forests, underplanting of Agave in old Eucalyptus, Coffee cultivation, opening of Research Stations;

(iv) *Animal Husbandry.*—Upgradation of Veterinary Aid Centre, Distribution of milch animals, Supply of cross-bred hifers;

(v) *Industries.*—Seed-money assistance, Bee-keeping, Seri-culture;

- (vi) *Roads*.—Improvement to roads, S.H. diversion roads, construction of missing C.D. works and bridges;
 (vii) Minor irrigation;
 (viii) Dairy development;
 (ix) Water supply schemes in difficult villages;
 (x) Family beneficiary schemes on IRD pattern;
 (xi) Inland fisheries.

4.13.2. The Planning Commission had allocated to Maharashtra, an amount of Rs. 309 lakhs for the year 1980-81. Major focus is hereafter to be on the development of ecology and soil and water conservation and accordingly larger outlays are now expected under the sectors, like forest and agriculture. For the year 1981-82, a probable allocation of Rs. 334 lakhs is expected under Western Ghats Development Programme in Maharashtra.

4.13.3. *Financial Requirements*.—The consolidated financial requirement of all the suggested schemes is given at Annexure 4.8. The requirement can be summarised as below :

	In Sixth Plan	(Rs. in lakhs) In 1981-82
(a) Agriculture and khar land Research stations	224.00	83.80
(b) Forestry	115.10	31.24
(c) Sericulture	0.17	0.17
(d) Fisheries	234.60	71.90
(e) Animal husbandry	41.00	8.52
(f) Integrated programme by voluntary agencies	108.00	27.00
(g) Environmental Protection	28.00	11.00
(h) Training programmes.	185.50	60.00
Total	936.37	293.63

Thus, the cost of the entire programme over Sixth Plan period is Rs. 936.37 lakhs while the outlay in 1981-82 is Rs. 293.63 lakhs. This integrated scheme would very well meet the objectives of the WGD Programme and may therefore be considered for being financed under that programme. It is proposed that money for the entire programme be released to the concerned agencies through the Planning Department of the Government of Maharashtra as in the case of other Western Ghats Development Schemes. The money for distribution to voluntary agencies should be disbursed through the Peoples' Action for Development, Maharashtra who would also be entrusted with the responsibility of monitoring the entire scheme.

4.14. Role of Voluntary Organisations

4.14.1. In any programme related to rural development, participation of the local people is vitally essential. This is particularly so in the case of developments concerning land use and water management, i.e. in the fields of agriculture, horticulture, social forestry and fisheries, which provide opportunities for self-employment to the rural population. The participation of the people can come up in an organised manner only through the medium of local voluntary organisations.

4.14.2. So far as the Konkan Districts viz. Ratnagiri, Raigad and Thane of Western Ghats area are concerned, there are many voluntary organisations of villagers. Some are already registered with PAD, Maharashtra. There might be many more, which are latent or not formally registered. They are not active because of lack of information and the knowledge of various kinds of processes which one has to go for registering the organisation.

4.14.3. Amongst the programmes that can be taken up with the help of local organisations, an immediate preference will have to be given to the development of nurseries and tree plantations. In fact, programmes in social forestry can be entrusted to such organisations. Nurseries for the quick growing fuel trees are likely to become popular, as such plantation, will reduce the drudgery of the rural women who have to spend considerable time for collection and conveyance of the fuel from long distances.

4.14.4. Mango is the most important fruit plant suitable for dryland horticulture. Its seedlings would be planted in thousands at the onset of the monsoon. These seedlings could be grafted by better variety through two methods viz. stone grafting and side grafting. The voluntary organisations can take up these programmes on a large scale. Similarly, Bor, which is drought tolerant plant can provide cash income to the poor families. The voluntary agencies can take up the work of community nurseries in water-shed areas and supply the seedlings at the beginning of the rain to a number of small and marginal farmers for planting them in their respective fields.

4.14.5. Another programme which can be taken up with the help of voluntary organisations is that of cultivation of various types of fodders containing high proteins. The agricultural institute at Kosbad, District Thane, has seeds of such nurseries brought from Australia and Phillipines.

4.14.6. Rural Development is not only economic development, it is the enrichment of the total quality of life in rural areas and its availability at minimum levels to all sections of rural peoples. This is possible only when the rural poor are freed from the exploitation and have the minimum necessary income to participate actively in the rural life. The voluntary organisations of local people can play an effective role in achieving this objective if they are properly encouraged by giving them the necessary financial support in the initial capital investments. As an experimental measure, the integrated water-shed development programme for small watershed unit of 25 hectares recommended in para 4.11. may be entrusted to the voluntary organisation, in Konkan, who have already shown interest in the rural development work in Konkan.

4.15. Land and Water Use Committee

4.15.1. The Government of Maharashtra have constituted the Maharashtra State Land Use Board in 1976, under the Chairmanship of Chief Minister, Maharashtra. It is entrusted with the responsibilities in respect of—

- (i) Control of erosion by water to the means to soil water conservation;
- (ii) Control of erosion by sea;
- (iii) Planning for the optimum use of available land and water resources in irrigated area; and
- (iv) Prevention of indiscriminate diversion of marginal and the forest lands to agriculture.

4.15.2. A committee for the land and water use planning for Konkan, consisting of the representatives of Planning Commission, various departmental heads, experts, PAD, Maharashtra, Land Development Corporation of Konkan Ltd. may be formed under the auspices of Maharashtra State Land Use Board. This Committee should suggest scientific land and water use plans for the different valleys and sub-valleys in Konkan. An appropriate package of incentives and disincentives may also be suggested by this committee to redirect current land use pattern on the basis of sound principles of ecology, economics, energy conservation, employment generation and nutrition requirements.

4.16. Public Policies

4.16.1. The various measures suggested in the foregoing paras may fail to make an impact, in fact, some of them may not even catch up, if the form of absentee land ownership that still prevails in Konkan is allowed to continue. Under the present socio-economic system, in the case of many land owners, the principle means of livelihood is from some occupation other than agricultural, and land is held only to retain a source of some supplementary income for the family. The types of developments, proposed in the foregoing paras envisage a whole-hearted and total involvement of the land owners and cultivators in the different programmes. To ensure such an involvement, suitable measures of land reform may have to be introduced atleast in the pilot block areas as a first step.

4.16.2. It is only thereafter, that effective organisations of farmers can develop, which can participate in the recommended development programmes as effective joint partners with the Government administration. It would be advisable to introduce the development schemes, particularly the ones which require heavy investments, only in those areas where active farmers' organisations come up for such a participatory effort.

4.16.3. Attention to primary productive activities alone may not provide the desired economic relief to the rural population unless an appropriate marketing system is evolved simultaneously. The farmers' organisations and the other voluntary organisations which will be involved in the developmental activity, will have, therefore, to be encouraged and enabled, financially and legally, to undertake marketing activities of their own so that they are able to get an appropriate and attractive return from their efforts and investments.

4.16.4. In the recent past, the Government of Maharashtra have passed laws relating to utilisation of private forests but they have met with very harsh public reaction. Hence they had to be revised and reformulated in some respects. Since quite a substantial portion of land in Konkan comes under this category, a realistic public policy properly backed by popular support needs to be evolved easily.

4.16.5. In view of the coastal development programmes now prepared, a specific policy regarding coastal zone development and management appears imperative.

4.16.6. Encouraging the voluntary agencies to participate in the developmental activities is an important plank of the programme. Hence, undertaking of special studies and extension work in the related developmental activities may have to be made obligatory to the private institutions which receive support in one form or the other from the Government.

4.16.7. A new approach to association of youth with development programmes needs to be taken. Since there is tremendous labour demand at the time of planting and harvesting, school and college vacations may have to be synchronised to match the farming needs.

4.16.8. The present employment bureaus, at best, assist the employment seekers by informing them about the job opportunities that come to the notice of these bureaus. But where there is lack of job opportunities, as in Konkan, the bureau can hardly be of any help to the employment seekers. A more positive role will have, therefore, to be entrusted to the employment bureaus in solving the problem of unemployment by involving them into the Districts' manpower planning. They should advise the concerned educational and training institutions regarding the types of skills for which there is a scope or likely to be a scope in near future, in the employment market or in the field for self-employment. In association with the District Development Councils, they should also suggest ways and means for generating newer and newer avenues of employment. Unless the employment bureaus are actively involved into this type of 'Employment generation' efforts, they will not be able to provide an effective service to the employment seekers. District manpower planning and employment generation councils need to be established immediately in each district in accordance with the guidelines given in the Sixth Plan document.

CHAPTER V
SUMMARY OF RECOMMENDATIONS

Serial No.	Recommendation	Refer Para No.	Action needed
1	2	3	4
(A) Data Gap			
1	Agrometeorological stations be installed in the commands of some irrigation projects for measurements of evaporation/evapotranspiration.	2.3.8	Irrigation Department of Maharashtra to undertake installations.
2	Toposheets No. 47 G6, 48 E9 & 48 E15 do not yet show the contours. Preparation of contour maps for the areas under these three toposheets should be taken up on priority basis.	2.5.5	Survey of India to undertake preparation of contour maps.
3	Estimates of cultivable area and areas under forests worked out by different agencies do not tally. There is a need for updating the land-use statistics particularly with reference to the area under forests.	2.6.4 2.11.5	Revenue Department of Maharashtra to compile the latest information, the Forest Survey of India to reassess the area under forests.
4	Indian Merchants' Chamber carried out a techno-economic survey of Konkan in the year 1963. Data contained in that report now needs up-dating. A fresh techno-economic survey is necessary.	2.19.1	Planning Department of Maharashtra to initiate a new survey.
5	Socio-Economic bench mark surveys need to be carried out for (a) new major irrigation projects like Talamba, Pinjal, Kalu & Shai, (b) completed major project of Kal and (c) two completed minor or medium irrigation projects from each district. Undertaking of such surveys and a continuing analysis of socio-economic conditions should be one of the important functions of the proposed CADA for Konkan.	3.10.16	Irrigation Department of Maharashtra to initiate surveys.
6	In Konkan, physical characteristics of soil vary greatly at close distance. An organisation for intensive soil classification surveys need to be established early for Konkan.	4.8.28	Agriculture Department of Maharashtra to create the Organisation, in consultation with the National Bureau of Soil Survey and Land Use Planning.

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4

(B) Knowledge Gap

- | | | | |
|---|--|---------|---|
| 1 | Rainfall run-off relationships are yet to be established for Konkan valleys except for Bhatsa and Kalu basins. There is an immediate need for establishing river discharge gauge sites on all the important rivers of the region. | 2.8.2 | Irrigation Department of Maharashtra to undertake the installations. |
| 2 | In view of the importance of the small water sheds in the land and water based development programme for Konkan, it is necessary to establish immediately, at least, three more experimental water-shed stations in different parts of Konkan for determination of the hydrological parameters, on the lines of the Station of CWPRS near Khopoli. | 2.8.3 | Central Water and Power Research Station, Pune to establish additional stations. |
| 3 | It is necessary, that the ground water potential in the three districts of Konkan is assessed on a more firm basis. | 2.9.5 | GSDA, Pune to strengthen its field units by adding two more sub-divisions to undertake the investigational programme. |
| 4 | Research on the behaviour of ground water in lateritic areas is necessary immediately. | 2.9.6 | Irrigation Department of Maharashtra to initiate a research programme. |
| 5 | Extensive field trials and measurements should be undertaken immediately on a few canal systems in Konkan, for measurements of canal losses, and for identifying the contributory factors. | 3.10.12 | Irrigation Department of Maharashtra to initiate studies. |
| 6 | Detailed investigations for hydrological and drainage characteristics of Konkan soil from the point of irrigability are necessary. | 2.7.7 | Directorate of Irrigation, Research and Development, Pune, to undertake investigations. |
| 7 | The scientific requirements of water for irrigated crops in Konkan are not yet clearly known. Research in water requirements of crops and water management practices needs to be pursued on priority. | 3.10.7 | Irrigation Department of Maharashtra to initiate research programme. |

Serial No. 1	Recommendation 2	Refer to Para No. 3	Action needed 4
8	Numerous thermal springs are seen to occur in the Konkan Region. Whether the hot water of these springs can be used with advantage as a source of thermal energy needs to be fully investigated.	2.4.7	Geological Survey of India to continue investigations.
9	Experimentation for development of Tidal power needs to be continued.	3.13.1	Energy Department of Maharashtra to pursue.
10	A careful examination of all the creeks needs to be undertaken for assessing the potential for development of sweet water lakes and for identifying the associated technical and ecological problems.	3.14.8	Irrigation Department of Maharashtra to initiate surveys.
(C) Rain Water Conservation and Utilisation			
<i>(a) Irrigation Development—</i>			
1	Socio-economic impact of the irrigation projects, in terms of employment generation and prevention of migration to Bombay, should be kept in view, and taken note of in the project economic evaluation.	3.5.1 to 3.5.3	Irrigation Department of Maharashtra to consider.
2	The feasibility criterion in terms of benefit-cost ratio needs to be reduced from the present norm of 1.5 to 1.00 for the irrigation projects in Konkan.	3.5.1	Planning Commission to examine the matter.
3	It will be desirable to create and utilise the full irrigation potential in Konkan by the turn of the century. To achieve this, survey and investigation work of all major and medium irrigation projects needs to be completed by 1990.	3.9.1	Irrigation Department, of Maharashtra to prepare a perspective plan.
4	Substantial financial resources will be required to implement the Irrigation Development Plan for Konkan. The Resources Committee of Maharashtra Government may examine the requirements and propose suitable measures to meet the requirements.	3.9.5	Planning Department of Maharashtra to initiate action.
5	Special parameters for design of dams in Konkan will have to be evolved in view of the distinct hydrological and geological features of Konkan. It will be desirable if these issues are entrusted to a special designs unit.	3.9.8	Irrigation Department of Maharashtra to create the designs unit.

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4
6	Because of the short construction season in Konkan, use of appropriate machinery for construction of earth dams may be necessary.	3.7.1	Irrigation Department of Maharashtra to examine required organisation.
7	The staff to be engaged on the survey work in Konkan will have to be provided a special incentive in the form of survey allowance. In addition, family accommodation will also be required for the survey staff in the nucleus colonies.	3.8.1	Irrigation Department of Maharashtra to consider.
8	There is acute shortage of cultivable land in Konkan for crops like paddy. Hence displaced persons from submergence areas of reservoirs need to be given training in occupations other than the cultivation of paddy, such as fishing in sweet water bodies, horticulture or forestry. A social-impact-survey of the affected villages should be undertaken alongwith other field surveys for the storage works in order to formulate a scheme for rehabilitation of the affected persons.	3.6.1	Directorate of Resettlement, Maharashtra to formulate schemes for social impact surveys and relevant training.
9	The possibilities of developing tourist-resorts along the water bodies, such as at Parshuram village should be explored.	3.18.1	Department of Tourism, Maharashtra to study the possibilities.
<i>(b) Minor Irrigation—</i>			
1	In the programme of irrigation development, the first and foremost priority will have to be given to small scale minor irrigation works. All these works in the master plan should be completed by 1991. Correspondingly, the organisation for these works will need immediate strengthening.	3.9.2	Irrigation Department of Maharashtra to initiate action.
2	Irrigation divisions and sub-divisions carrying out small scale irrigation works under Zilla Parishads should be brought on par with the normal divisions under the Irrigation Department in respect of staff pattern and administrative, technical and financial powers.	3.9.9	Rural Development Department of Maharashtra to consider.

Serial No. 1	Recommendation 2	Refer to Para No. 3	Action needed 4
3	The present norms for acceptance of minor irrigation projects need upward revision both in lateritic and non-lateritic areas.	3.5.3	Irrigation Department of Maharashtra to examine.
<i>(c) Command Area Development—</i>			
1	It is necessary to establish irrigation and on-farm water-management practices on scientific lines right from the beginning. A Command Area Development Authority for Konkan needs to be established immediately in 1981-82.	3.10.3	Irrigation Department of Maharashtra to create the Authority.
2	The active participation of farmers in the command area's development is necessary. Formation of Farmers' Associations should be encouraged. Representatives of Farmers' Associations should be given a place in the CADA'S administrative set-up and working.	3.10.5	Irrigation Department of Maharashtra to formulate new procedures.
3	It will be desirable to provide suitable incentives for small farmers in Konkan to adopt ecologically sound land-use practice, such as raising of garden crops under irrigation.	3.10.15	Irrigation Department of Maharashtra to consider.
<i>(d) Hydro-Development—</i>			
1	A master plan covering all possible hydro-power development sites including mini and micro hydro-power-stations needs to be drawn up immediately.	3.11.16	Irrigation Department of Maharashtra to initiate action.
2	An independent Hydro-Electric Projects Investigation Circle for Konkan needs to be created immediately for the detailed investigation of the identified 20 Hydro Projects, and preparation of feasibility reports.	3.11.16	Irrigation Department of Maharashtra to create the organisation.
3	There is scope for undertaking micro-hydel stations from small storages in high level areas. As transmission costs are saved, feasibility criteria for micro and mini-hydel stations serving local needs should be reviewed.	3.11.12	Energy Department of Maharashtra to consider.

Serial No. 1	Recommendation 2	Refer to Para No. 3	Action needed 4
4	To begin with, an effort should be made to identify, formulate and take up, at least, two micro-hydel projects (less than 1 MW installation) as pilot schemes. It will be desirable to have these schemes operated right from the beginning by co-operatives of local consumers. These pilot projects be taken up only where such a co-operative effort is forthcoming.	3.11.11	Energy Department of Maharashtra to consider.
5	Dam-heights in Konkan are generally substantial. This position should be turned into an advantage by providing for hydro power stations at the toes of the dams.	3.11.7	Irrigation Department of Maharashtra to consider.
6	Storage for hydro power peaking stations may not be restricted to 90 per cent or 75 per cent dependable flows, but planned for average flows if economically justified.	3.12.2	Irrigation Department of Maharashtra to consider.
<i>(e) Water Supply Schemes.—</i>			
1	Formulation and implementation of the water supply schemes for the villages in Konkan needs to be expedited.	3.15.3	Rural Development Department to expedite actions.
(D) Land and Water Management—			
<i>(a) Integrated Development of Water Sheds:</i>			
1	An integrated approach to the development of small water-sheds is essential for the efficient management of the resources of the water-sheds.	4.5.1.	The Planning Department of Maharashtra to institute suitable planning procedure.
2	' Panchkroshi ' as a concept both, in theory and practice, exists in Konkan. It is necessary that a ' Panchkroshi ' is made co-extensive with a water-shed and used as a unit of developmental planning in Konkan.	4.4.2	Planning Department of Maharashtra to re-organise the local planning machinery.
3	The pattern of land and water utilisation should help to maintain the benefits from the ecological endowments of the area. Tree farming, silvi-pastoral and silvi-	4.6.2. 4.8.7 4.8.18	The Revenue Department of Maharashtra to establish machinery for land use planning and regulation.

Serial No. 1	Recommendation 2	Refer to Para No. 3	Action needed 4
	<p>horticultural systems should have predominance over annual crops in undulating terrain. Hill slopes, plateaus, pasture lands and culturable waste lands, as well as fallow, barren and uncultivable lands should be considered for horticultural plantations and social forestry.</p>		
	<p><i>(b) Horticultural Development—</i></p>		
1	For fixing up atmospheric Nitrogen in the soil and getting additional fuel and fodder resources, lands under hill millets and permanent pastures need to inter-cropped with koo-babool or Agastha trees.	4.8.6 4.8.16	Forest Department of Maharashtra to initiate suitable extension programmes.
2	(a) To derive optimum advantage from the facilities of flow irrigation, kharif paddy should be followed by summer paddy. The bunds of these paddy fields could be planted to tall × dwarf and coconut hybrids.	4.8.2	Agriculture Department of Maharashtra to undertake coconut plantation programmes.
	(b) Bunds of non-irrigation paddy lands on hill slopes should be planted with crops like mangoes and cashewnuts.	4.8.4.	Agriculture Department of Maharashtra to undertake plantation programmes.
3	Building up of nurseries is important for horticultural development. Even part of mango plantations on private cultivators' fields may be considered for conversion into nurseries. The plantations raised on cultivators' fields may be used as progeny orchards wherever appropriate, for the supply of grafting material.	4.8.11	Agriculture Department of Maharashtra to initiate schemes.
4	For providing bud-sticks in adequate number, Konkan Krishi Vidyapeeth has a proposal for establishing a horticultural nursery on 40 hectares at Dapchari. Similarly, for producing Alphanso Mango grafts, KKV proposes to establish 30 nurseries in Konkan. These should be established early.	4.8.8, 4.8.9	Agricultural Department of Maharashtra to give necessary support to KKV, Dapoli.
5	Four Horticultural development pilot projects of 10 hectares each should be taken up in the upland areas of the existing storages with sprinkler irrigation facility.	4.8.5	Agriculture Department of Maharashtra to formulate the Schemes.

Serial No. 1	Recommendation 2	Refer to Para No. 3	Action needed 4
6	There is scope for undertaking medicinal and aromatic crop plantations such as cinchona, citronella and lemongrass. A demonstration plantation on 100 hectares should be taken up immediately.	4.8.13	Forest Department of Maharashtra to formulate a Scheme.
7	A rubber plantation programme over 500 hectares of suitable lands in the vicinity of irrigation projects should be taken up immediately.	4.8.14	Forest Department of Maharashtra to formulate schemes.
<i>(c) Forests—</i>			
1	The Forest Department's programme for new plantations and for improving the management of existing forest lands may be speeded up.	4.8.19 (F, G, H)	Forest Department of Maharashtra to prepare and implement a perspective programme.
<i>(d) Fisheries—</i>			
1	Inland fisheries should be encouraged by—		
	(a) utilising all water storages ..	4.7.4	Fisheries Department of Maharashtra to formulate a perspective programme.
	(b) taking advantage of the standing water in the paddy fields,	4.8.3	
	(c) utilising non-irrigated paddy lands prone to flooding for fish-cum-paddy culture.	4.8.26	
2	The economics of khar land utilisation for purposes like agriculture, brackish water fishery and salt extraction needs to be studied by an inter-disciplinary team, so that such lands can be utilised effectively.	4.8.24	Planning Department of Maharashtra to initiate necessary studies in collaboration with CIFE.
<i>(e) Research and Extension—</i>			
1	The trial-cum-demonstration farm at Rapoli in District Raigad may be transferred to Konkan Krishi Vidyapeeth on permanent basis to pursue research work in water management practices on a long term basis.	3.10.10	Agriculture Department of Maharashtra to consider transfer of station to Konkan Krishi Vidyapeeth.
2	For research into water management practices in lateritic areas, an independent trial-cum-demonstration farm may be organised in Ratnagiri District, as proposed by the Konkan Krishi Vidyapeeth.	3.10.11	Agricultural Department of Maharashtra may provide necessary facilities to KKV, Dapoli.

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4
3	To evolve salt tolerant rice varieties and to improve the productivity of khar lands. there is an urgent need to strengthen the Agriculture and Khar Land Research Station at Panvel working under Konkan Krishi Vidyapeeth.	4.8.22 4.8.23	Konkan Krishi Vidyapeeth to pursue the proposal.
4	For improving the quality of fodder grasses, Konkan Krishi Vidyapeeth proposes to establish a grass research farm at Dapchari. It will have to be established early.	4.8.17	Agriculture Department to help KKV, Dapoli.
5	For imparting training to the rural youth a Krishi Vigyan Kendra has been established at Kosbad in Thane District. One such Kendra needs to be established in Raigad and another in Ratnagiri District immediately.	4.12.2	The Agriculture Department of Maharashtra and KKV to pursue the matter with ICAR.
6	A rural family is often a basic unit of production and consumption. The Lab to Land programme of the Indian Council of Agricultural Research, being implemented in the Konkan region by Konkan Krishi Vidyapeeth, needs immediate expansion to cover larger number of families.	4.12.7	Konkan Krishi Vidyapeeth to pursue the matter.

(f) *Training*—

- | | | |
|--|------------------|--|
| 1 The Government of Maharashtra with the assistance from Central Ministry of Rural Reconstruction provides incentives and financial assistance for training under TRYSEM. These facilities should be made use of (a) in the integrated watershed development programme, (b) in horticultural extension programme and (c) for resettlement of persons from submergence areas of reservoirs. | 4.12.4
3.6.1. | The Industries Department of Maharashtra to provide for allocations. |
|--|------------------|--|

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4
2	Participation of rural youth and women is necessary for ensuring the success of a development programme. For orienting and motivating the rural folk, one mobile training unit may be created in each of the three Districts of Konkan.	4.12.10	The Rural Development Department of Maharashtra to form the units.
3	For meeting the manpower training needs in fisheries advantage may be taken of the facilities available with the Central Institute of Fisheries Education, Bombay.	4.12.11	Fisheries Department of Maharashtra to initiate action.
<i>(g) Voluntary Organisations—</i>			
1	In any programme related to rural development, participation of local people is essential. It will, therefore, be desirable to implement the integrated water-shed development programmes through suitable organisations of the people of the area.	4.14.6	Rural Development Department of Maharashtra to select the programmes and the agencies.
(E) Ecological Security			
1	Matheran and Mahableshwar plateaus, and Koyna catchment area have biological wealth which need to be conserved through the establishment of biosphere reserves. Detailed field surveys of these areas for formulating a scheme should be taken up immediately.	4.11.2	The Forest Department of Maharashtra, in co-operation with the Department of Environment, Government of India, to formulate schemes.
2	There are several suitable areas along the coast for development of marine reserves and parks. A scheme for development of Marine National Park near Malwan Coast may be considered.	4.11.3	Fisheries Department of Maharashtra to take action in consultation with the Department of Environment of Government of India.
3	A regular scheme for educating the people of the region in preservation and enrichment of the precious environment, in which they live, should be taken up immediately.	4.12.13	Science and Technology Cell in Education Department of Maharashtra to initiate schemes.

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4

- | | | |
|---|--------|---|
| 4 An environmental monitoring cell, under a central umbrella organisation for development of Konkan, should establish environmental-bench marks and monitor the environmental status. | 4.11.1 | Science and Technology Cell in Education Department of Maharashtra to initiate proposals in consultation with the Department of Atomic Energy, Government of India. |
|---|--------|---|

(F) Institutional Structures

- | | | |
|--|---------|--|
| 1 It is necessary to locate the administrative offices for development activities within the concerned rural areas. To retain capable developmental staff, a nucleus colony should be established in every Taluka. | 2.20.22 | (1) All Departments to review the H.Q.s of their units, (2) PW&H Department to undertake colonies programme. |
| 2 An intermediate level of administration and planning between a village and a block (i.e. a taluka) will have to be introduced. This administrative unit should be entrusted with the responsibility of developing an integrated plan of the Panchkroshi and implementing it. | 4.4.3 | Planning Department of Maharashtra to initiate action. |
| 3 A land and water use committee for Konkan consisting of the representatives of Planning Commission, PAD, Maharashtra, Konkan Development Corporation, various Departmental heads and experts, may be formed under the auspices of the Maharashtra State Land Use Board. The aim of such a committee should be to assist in promoting land and water use patterns based on consideration of ecology, economies, employment generation, energy conservation and nutrition, through appropriate packages of incentives and disincentives. | 4.15.1 | Agriculture Department of Maharashtra to constitute the Committee. |

Serial No.	Recommendation	Refer to Para No.	Action needed
1	2	3	4
4	District manpower planning and employment generation councils need to be established immediately in each district, in accordance with the guidelines given the Sixth Plan document.	4.16.8	Planning Department of Maharashtra to establish the councils.

(Sd./-)

Dr. M. S. Swaminathan

*(Chairman)**Members*

(Sd./-)

Dr. V. Subramanian

(Sd./-)

Dr. M. Q. Dalvi

(Sd./-)

Dr. Rama

(Sd./-)

Shri P. M. Mane

(Sd./-)

Shri S. N. Agashe

(Sd./-)

Shri K. S. S. Murthy

(Sd./-)

Dr. R. B. Bhumbra

(Sd./-)

Dr. R. S. Murthy

(Sd./-)

Dr. A. N. Michael

(Sd./-)

Shri M. G. Padhye

(Sd./-)

Shri M. A. Chitale

(Member-Secretary)

ANNEXURES

ANNEXURES

Annexure No.	Title	Page
1.1	The Planning Commission's office Memorandum No. PC (P) 19/1/WG/WRSC/81-MLP, dated 14th January 1981 (for constituting the WGWSR committee).	79
1.2	Talukas from Konkan Region included in the Western Ghats Area.	80
1.3	The Planning Commission's office Memorandum No. PC (P) 19/WG/TF/SAR/81-MLP, dated 18th February 1981 (for Task Force on State of the Art).	81
1.4	The Planning Commission's office Memorandum No. PC (P) 19/WG/TF/RWCU/81-MLP, dated 18th February 1981 (for Task Force on rain water conservation and utilisation).	82
1.5	The Planning Commission's office Memorandum No. PC (P) 19/WG/TF/L&WP/81-MLP, dated 18th February 1981 (for Task Force on Land and Water Use Planning).	83
1.6	Notes received by the Committee ..	84
1.7	List of Special invitees ..	87
1.8	Government of Maharashtra's Resolution No. DKR 1078/(18)-KNR, dated 17th October 1980 appointing the High Power Committee for preparing a Master Plan of Irrigation Development in Konkan.	88
2.1	Age Groupwise and Sex-wise distribution of Population (1971 Census) in the three Konkan Districts and in the Maharashtra State.	91
2.2	Monsoon Rainfall Statistics of Konkan ..	92
2.3	Spells of Dry Days Related to Agricultural Drought in Konkan Region.	92
2.4	Evaporation data for Konkan Region ..	93
2.5	Rain Gauge and River Gauge Stations in Konkan.	94
2.6	Number and area of Operational Holdings in Konkan.	96
2.7	Statement showing Land-use classification for the year 1977-78 in respect of Konkan districts.	97
2.8	Properties of Soils in Konkan ..	98
2.9	Ground water potential of the river basins in Konkan.	102

ANNEXURE 1.2

Talukas from Konkan Region included in the Western Ghats area

Serial No.	District/Taluka	Total Geographical Area (in Hectare)	Population
1	2	3	4
<i>(1) Thane District</i>			
1	Mokhada	68,047	54,430
2	Shahapur	1,57,242	1,43,325
3	Murbad	90,741	99,585
Total ..		3,16,030	2,97,340
<i>(2) Raigad District</i>			
4	Karjat	65,117	1,10,122
5	Sudhagad	45,801	44,915
6	Mahad	81,047	1,32,488
7	Poladpur	37,146	45,832
Total ..		2,29,111	3,33,357
<i>(3) Ratnagiri District</i>			
8	Khed	1,01,606	1,54,999
9	Chiplun	1,11,631	2,02,613
10	Sangameshwar	1,25,117	1,76,452
11	Lanja	73,929	89,573
12	Kankavali	77,474	1,17,662
13	Sawantwadi	1,34,109	1,53,857
14	Kudal	81,902	1,24,868
Total ..		7,05,768	10,20,024
Grand Total ..		12,50,909	16,50,721

ANNEXURE 1.3

No. PC(P)19/WG/TF/SAR/81-MLP

GOVERNMENT OF INDIA

PLANNING COMMISSION

Yojana Bhavan, Parliament Street, New Delhi,

Dated February 18th, 1981.

Office Memorandum

The Western Ghats Water Resources Study Committee set up *vide* Planning Commission O.M. No. PC(P) 19/WG/WRSC/81-MLP dated the 14th January, 1981 under the Chairmanship of Dr. M. S. Swaminathan, Member, Planning Commission, at its first meeting held on 21st January 1981 at Bombay has constituted a Task Force on State of the Art Report. The Convener of this Task Force would be Shri M. G. Padhye, Member (WR), Central Water Commission, New Delhi. The other members of the Committee are:—

- (1) Dr. M. Q. Dalvi, U.N.D.P., Adviser, Planning Commission, Govt. of India, New Delhi 110 001.
- (2) Shri P. M. Mane, Consulting Engineer, 12-Gautam Darshan, 133, off J. P. Road, Versova, Andheri (West), Bombay 400 059.
- (3) Shri K. S. S. Murthy, Adviser (I & CAD), Planning Commission, New Delhi 110 001.
- (4) Dr. V. Subramanian, Executive Chairman, Maharashtra State Planning Board, Mantralaya, Bombay 400 032.
- (5) Shri S. V. Purohit, Chief Engineer (Hydro), Mercantile Bank Building, Bombay.
- (6) Dr. R. P. Sarkar, Deputy Director General, Meteorological Department, Shivajinagar, Pune-5.
- (7) Shri M. A. Chitale, Chief Engineer (IWD) and Joint Secretary, Irrigation Department, Mantralaya, Bombay 400 032.

3. The Task Force may associate with its deliberations such other experts as are considered necessary.

4. The terms of reference of the Task Force would be to take note of :

- (1) Water Resources and Geological and Climatological data.
- (2) Existing pattern of utilisation for domestic animal, agricultural and industrial uses.
- (3) Projects under way or proposed to be taken up during the VI Plan.
- (4) Institutional Infra-structure now available.
- (5) Major gaps in technology, services and public policies.
- (6) Peoples' participation.

5. TA/DA of the official members will be met by the respective Departments/Organisations to which they belong. TA/DA of non-official members will be met by the Planning Commission.

6. The Task Force may complete their deliberations and place their findings before the Committee at its second meeting scheduled to be held at Bombay on 27th and 28th February, 1981.

(Sd.) R. S. SAKSENA,
Director (Admn.)

ANNEXURE 1.4

No. PC (P) 19/WG/TF/RWCU/81-MLP

GOVERNMENT OF INDIA

PLANNING COMMISSION

Yojana Bhavan, Parliament Street New Delhi.

Dated February 18th, 1981.

Office Memorandum

The Western Ghats Water Resources Study Committee set up vide Planning Commission O.M.No. PC(P) 19/1/WG/WRSC/81-MLP dated the 14th January, 1981 under the Chairmanship of Dr. M. S. Swaminathan, Member, Planning Commission, at its first meeting held on 21st January, 1981 at Bombay has constituted a Task Force on Rain Water Conservation and Utilisation. The convenor of this Task Force would be Shri G. S. Ghanekar, Chief Engineer, Irrigation Department, Konkan Region, Bombay.

2. The other members of the Committee are—

- (1) Dr. Rama, Professor, Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay 400 005.
- (2) Shri S. N. Agashe, Consulting Engineer, Engineering and Training Consultancy, " SATYAVATI ", Jathar Peth Road, P. B. No. 8, Akola 444 001.
- (3) Dr. D. R. Bhumbha, Project Director, Lab to Land Programme, ICAR, Krishi Bhavan, New Delhi 110 001.
- (4) Dr. A. N. Michael, Director, Water Technology Centre, JARI, New Delhi.
- (5) Shri P. C. Saxena, Director, Central Water and Power Research Station, P. O. Khadakwasla, Research Station, Pune 411 024.

3. The Task Force may associate with its deliberations such other experts as are considered necessary.

4. The terms of reference of the Task Force would be to examine:

- (1) Technologies already developed and in use.
- (2) Patterns of water-shed management and irrigation.
- (3) Enriching the aquifer and minimising run-off losses and storage losses.
- (4) Hydel Power generation.
- (5) Pilot Projects to be initiated during south-west monsoon season, 1981, including design, organisational and financial aspects.
- (6) Linking with I.R.D.P., N.R.E.P., E.G.S. and other programme like social forestry.

5. TA/DA of the official members will be met by the respective Departments/Organisations to which they belong. TA/DA of non-official members will be met by the Planning Commission.

6. The Task Force may complete their deliberations and place their findings before the Committee at its second meeting scheduled to be held at Bombay on 27th and 28th February 1981.

(Sd.) R. S. SAKSENA,
Director (Admn.)

ANNEXURE 1.5

No. PC(P)19/WG/TF/L&WP/81-MLP

GOVERNMENT OF INDIA

PLANNING COMMISSION

Yojana Bhavan, Parliament Street, New Delhi
Dated 18th February, 1981.

Office Memorandum

The Western Ghats Water Resources Study Committee set up *vide* Planning Commission O. M. No. PC(P) 19/1/WG/WRSC/81-MLP, dated the 14th January, 1981 under the Chairmanship of Dr. M. S. Swaminathan, Member, Planning Commission, at its first meeting held on 21st January, 1981 at Bombay has constituted a Task Force on Land and Water Use Planning. The Convenor of this Task Force would be Dr. R. S. Murthy, Director, National Bureau of Soil & Land Use Planning, Civil Lines, Nagpur-6.

2. The other members of the Committee are—

- (1) Shri Jayantrao Patil, Kosbad, District Thane.
- (2) Dr. P. V. Salvi, Vice-Chancellor, Konkan Krishi Vidyapeeth, Dapoli.
- (3) Dr. S. N. Dwivedi, Director, Central Institute of Fisheries Education, Kakori Camp, Versova, Bombay 400 061.
- (4) Shri D. T. Joseph, Managing Director, Konkan Development Corporation, Warden House, P. M. Road, Bombay 400 001.
- (5) Dr. B. Rudramurthy, Adviser on Rural Development, Mafatal Centre, 12th floor, Nariman Point, Bombay 400 020.
- (6) Shri Suresh Kumar, Director of Agriculture, Central Building, Pune-1.
- (7) Shri S. S. Naik, Director of Fisheries, Taraporewala Aquarium, Charni Road, Bombay.
- (8) Shri P. D. Mokasdar, Director of Animal Husbandry, Central Building, Pune-1.
- (9) Shri I. M. Qureshi, Chief Conservator of Forests, Maharashtra State, Central Building, Pune-1.
- (10) Shri C. R. V. Raman, Nehru Fellow, C/o Systems Research Institute, 17-A, Gultekdi, Pune-411 009.
- (11) Dr. Manibhai Desai (B.A.I.F.), Urli Kanchan, District Pune.
- (12) Shri B. N. Nene, People's Action for Development, C/o A & C Department, Mantralaya, Bombay-32.

3. The Task Force may associate with its deliberations such other experts as are considered necessary.

4. The terms of reference of the Task Force would be to examine and to recommend:—

- (1) Land and Water Use patterns based on ecology economics, energy needs and employment generation—competitive advantages of this region in relation to crops.
- (2) Knowledge available concerning combined land management systems—e.g. Sylvi—Pastoral, Sylvi-Horticultural, agri-acqua-culture and other farming systems.
- (3) Steps needed for promoting scientific land and water uses.
 - (a) Technological package;
 - (b) Package of services;
 - (c) Package of public policies—package of incentives and disincentives.

5. TA/DA of the official members will be met by the respective Departments/Organisations to which they belong. TA/DA of non-official members will be met by the Planning Commission.

6. The Task Force may complete their deliberations and place their findings before the Committee at its second meeting scheduled to be held at Bombay on 27th and 28th February, 1981.

(Sd.) R. S. SAKSENA,
Director (Admn.)

Note.—Dr. K. K. Khatu, Associate Director, Operational Research Group, Baroda-7, was co-opted as a member of this task force.

ANNEXURE 1.6

Notes received by the Committee

Subject	Author/Source
Geology and Tectonics of Konkan	Shri S. D. Pawar, Geologist, G.S.I.
Ground water status in the districts of Thane, Raigad and Ratnagiri of Konkan.	Ground Water Survey and Development Agency of Maharashtra, Pune.
Soils of three districts of Konkan Region	Directorate of Agriculture, Pune.
Construction of small reservoirs for flood control, water harvesting and recycling for crop use.	Dr. D. R. Bhumla, Project Director, Lab to Land Programme, ICAR, New Delhi.
Outline of MIDC's Activities in Thane, Raigad and Ratnagiri Districts.	Superintending Engineer, M.I.D.C., Bombay-93.
Technical Education in Konkan	Directorate of Technical Education, Maharashtra State, Bombay-1.
Water Demand for the Bombay Metropolitan Region ..	Member Secretary, W.R.M.B. of B.M.R.D.A., Bombay.
Conservation and utilisation of rain water in Konkan ..	Irrigation Department, Government of Maharashtra.
Land use classification for the year 1977-78 in respect of Konkan Districts.	Directorate of Agriculture, Pune.
Comparative properties of Soils in Konkan and other regions of Maharashtra.	Directorate of Irrigation Research and Development, Pune-I.
Brief Climatological Summary of Konkan Region ..	Director General of Meteorology (C & G), Pune.
Tahsilwise existing land use pattern of Ratnagiri ..	Divisional Soil Conservation Officer, Ratnagiri.
Borewells drilled under rural water supply scheme in the districts of Thane, Raigad and Ratnagiri of Konkan.	Director, Ground Water Surveys and Development Agency, Pune.
Institutions working in the Konkan Region in the field of land and water use and rural development.	Development Corporation of Konkan Limited.
Water rates on Irrigation Schemes in Maharashtra with special reference to Konkan Region.	Irrigation Department, Maharashtra State.
Geology of Thane, Raigad (Kolaba) and Ratnagiri Districts, Maharashtra.	Geological Survey of India.
Work done in the west coast Hot Springs area of Maharashtra.	Geological Survey of India, Central Region.
Water Supply Scheme in Konkan Region	Maharashtra Water Supply and Sewerage Board Bombay.
Land and Water use, Planning for Konkan Region for Animal Husbandry.	Director of Animal Husbandry, Maharashtra State, Pune.
Augmentation of Irrigation Potential through harnessing of monsoon rains over the western ghats.	Shri C. R. V. Raman, Systems Research Institute, Pune.
Hydro Power Developments in Konkan Region ..	Chief Engineer (Elec.) Hydro Project, Bombay.
Master Plan for Irrigation in Konkan	Chief Engineer, Konkan Region, Bombay
Minor Irrigation Schemes in Local Sector executed by Zilla Parishad.	Rural Development Department, Government of Maharashtra, Bombay.
Irrigation project in Konkan for World Bank Aid ..	Irrigation Department, Government of Maharashtra.
Exploitation of Tidal Energy along Konkan coast of Maharashtra State.	Shri C. R. V. Raman, Jawaharlal Nehru Fellow System Research Institute, Pune.
Research studies to be taken up in Western Ghats and Konkan Region.	Central Water and Power Research Station, Khadakwasla, Pune-24.

Subject 1	Author/Source 2
A Rubber Plantation Scheme	State Industrial and Investment Corporation of Maharashtra Ltd., Bombay.
Integrated Development Scheme for Development of Konkan Region.	Shri V. V. Deshpande, Economic and Industrial Consultant, Bombay-39.
Note on Potential for Tourism Development in Konkan ..	Dr. K. K. Khatu, Operations Research Group Bombay.
Distribution of forest area as per its legal classification and private forests taken over as on 1st November 1980.	Chief Conservator of Forest, Maharashtra State, Pune.
Strengthening of nursery programme for growing mango-grafts for commercial plantations in Konkan.	Directorate of Agriculture, Maharashtra State, Pune.
Programme of forestry development in Konkan Region of Maharashtra.	Chief Conservator of Forests, Maharashtra State, Pune.
Development of oil palm Demonstration Plantation in Thane and Ratnagiri Districts.	Dr. A. G. Malshe, Science and Tech. Cell Education Department, Bombay-32.
Cultivation of Medicinal and Aromatic Plants and Plants of Economic Importance in Western Ghats.	Dr. A. G. Malshe, Science and Technology cell Education Department, Maharashtra State, Bombay.
Eco-Development Plan for the Konkan Region ..	Agriculture and Cooperation Department, Government of Maharashtra.
Tree Farming	Shri I. M. Qureshi, Chief Conservator of Forests, Maharashtra State, Pune.
Land and Water use planning for Konkan Region ..	Shri B. N. Nene, Member Secretary, P.A.D., Maharashtra.
Water Management and Fisheries	Dr. S. N. Dwivedi, Director, C.I.F.E., Bombay.
Fisheries Schemes for Konkan area	Central Institute of Fisheries Education, Bombay-58.
Fisheries Development in Konkan Region	Director of Fisheries, Bombay.
Development of Konkan Region	Dr. R. S. Murthy, Director National Bureau of Soil and Land Use Planning, Nagpur.
Conservation and utilisation of rain water in Konkan ..	Dr. Rama, Professor, Tata Institute of Fundamental Research, Bombay.
Ground Water Conditions in Konkan, North Region and Plan for its exploration and Development.	Dr. B. D. Pathale, Chief Hydro Geologist and Member, Central Ground Water Board, New Delhi.
A scheme for Development of Western Ghats	Shri S. N. Agashe, Retired Chief Engineer, M.S.E.B., Akola.
Scheme to Educate the People of the Konkan Region regarding ecological consciousness.	Konkan Krishi Vidhyapeeth, Dapoli.
Scheme for strengthening of the Khar Land Research Station, Panvel.	Konkan Krishi Vidyapeeth, Dapoli.
Scheme to strengthen the Lab to Land Programme in Konkan.	Konkan Krishi Vidyapeeth, Dapoli.
Development Fresh Water Bruckish Water Fisheries of Konkan Region, Maharashtra.	Fisheries Department, Government of Maharashtra.
Aquaculture and Fish processing Technologies through Institutional financing.	Dr. S. N. Dwivedi, Director, C.I.F.E., Bombay.
Fisheries Schemes for Development of Fisheries	Central Institute of Fisheries, Education, Indian Council of Agriculture Research, Bombay.
Major gaps in Technological Services	Shri P. M. Mane, Consulting Engineer, Bombay.

ANNEXURE 1.6—*contd*

Subject 1	Author/Source 2
<i>Other Notes/published Reports made available for reference</i>	
Land Use Action Plan Konkan	Development Corporation of Konkan, Bombay.
Role of the Development Corporation of Konkan ..	Tata Economic Consultancy Services, Bombay.
Impact of Rural Electrification on Decentralised Rural Industries.	Vaikunthabahi Metha Smarak Trust, Bombay.
Spells of dry days related to agricultural drought in Konkan Region. (Extract from published articles).	Director General of Meteorology (C & G), Pune.
Soil and suggested land use of Maharashtra. ..	National Bureau of Soil Survey and Land use Planning, Nagpur.
Draft Five Year Plan 1980-85 and Annual Plan 1981-82, Fisheries (Extract from Published Report).	Planning Department, Government of Maharashtra.
Marine Park at Malwan	National Institute of Oceanography, Goa.

ANNEXURE 1.7

List of Special Invitees

A—First meeting of the Western Ghats Water Resources Study Committee held on 22nd January 1981 at Bombay.

- (1) Shri H. G. Vartak, Chairman, Maharashtra State Industrial and Investment Corporation, Bombay.
- (2) Shri A. S. Bhise, Chairman, Konkan Development Corporation, Bombay.
- (3) Shri N. G. K. Murti, Chairman, Water Resources Management Board of BMRDA, Bombay.
- (4) Shri Gokul Prasad, Chief Engineer (Drought Prone Area Study & Investigation), Central Water Commission, New Delhi.
- (5) Shri S. C. Sakhalkar, Chief Engineer (WR) & Joint Secretary, Irrigation Department, Mantralaya, Bombay.
- (6) Shri D. V. Dixit, Joint Director of Agriculture (Representing Secretary, Agriculture and Co-operation Department, Mantralaya.)
- (7) Shri M. B. Korlekar, Deputy Secretary, (Representing Secretary, Energy Department, Mantralaya).
- (8) Shri P. B. Kanyalkar, Member Secretary, W.R.M.B. of Bombay Metropolitan Region Development Authority, Bombay.

B—Second Meeting of the Committee held on 20th February 1981 at New Delhi.

- (1) Shri A. S. Bhise, Chairman, Development Corporation of Konkan, Bombay.
- (2) Shri D. V. Dixit, Joint Director of Agriculture, Pune.
- (3) Shri K. K. Khata, Associate Director, Operation Research Group, Baroda-7.
- (4) Shri S. Nath, Director, Central Water Commission, New Delhi.
- (5) Shri R. B. Joshi, Conservator of Forest.
- (6) Shri V. R. Page, Chief Development Executive, Development Corporation of Konkan, Bombay.

C—Third Meeting of the Committee on 9th March 1981 at Bombay.

- (1) Mrs. P. P. Trivedi, Adviser, Planning Commission, New Delhi.
- (2) Shri D. D. Joshi, Consultant (Hill Area), Planning Commission, New Delhi.
- (3) Shri Sayed S. Shafi, Chief Planner, Town & Country Planning, New Delhi.
- (4) Shri I. M. Qureshi, Chief Conservator of Forest, M.S., Pune.
- (5) Shri C. R. V. Raman, Jawaharlal Nehru fellow, Pune-9.
- (6) Shri A. S. Bhise, Chairman, Konkan Development Corporation, Bombay.
- (7) Shri P. J. Rajagopalachari, Meteorologist Gr. I, India Meteorological Department, Pune.
- (8) Shri K. V. Sundaram, Deputy Adviser, Planning Commission, New Delhi.
- (9) Shri P. D. Mokasdar, Director of Animal Husbandry, M. S. , Pune.

ANNEXURE 1.8

Appointment of High Power Committee for preparing master plan, for Irrigation Development in Konkan.

GOVERNMENT OF MAHARASHTRA

IRRIGATION DEPARTMENT

Government Resolution No. DKR 1078/(18) -KNR

Mantralaya, Bombay 400 032, dated 17th October 1980

Introductory :

In spite of abundant water resources, favourable climate and suitable cultivable land for paddy and cash crops like coconut, cashewnuts, mangoes etc., Konkan region has remained undeveloped in irrigation facilities. As compared to other regions of Maharashtra, there is very little irrigation development in Konkan region owing to peculiar Geographical nature climatic conditions, land and rainfall pattern, prevailing irrigation methods and crop patterns could not be successfully applied in Konkan region. Government, therefore, feels that an independent detailed study needs to be carried out in this respect.

To give an impact to the Konkan irrigation development, the Estimate Committee, in 1977-78, had made a mention in its report regarding shortfalls in command areas of Konkan region and had recommended that Government should give special attention in consultation with experts and make good the big short-falls in the irrigable land in Konkan. Accordingly under Government Resolution No. ESR 1078/1385/WRI-1, dated 21st May 1979, a committee under the Chairmanship of the Chief Engineer (Irrigation) Bombay Region was constituted to suggest the remedial measures to make up short-falls in irrigation areas in Konkan. The Committee was expected to submit its report to Government within a period of one year, however, the same is yet to be received. Government feels that unless detailed study is made of the irrigation problems in Konkan and effective remedies applied; short-falls in command area can not be made up. A proposal to that effect was under consideration with Government to reconstitute the said committee by elevating its status and making it more representative, thereby vesting more powers with it and expanding the scope of the Committee.

Government Resolution :

Government is pleased to constitute a High Power Committee under the Chairmanship of Minister (Irrigation) for preparing the Master Plan for development of the Konkan region, for its time bound and planned irrigation and make appropriate recommendations to Government on irrigation development in Konkan, after detailed technical study of the available water resources, Geography, climate, Rainfall cultivable land, prevailing crop pattern and new cropping schemes.

The details of the terms of reference of the Committee are given in accompanying annexure.

2. The below mentioned officers/persons have been appointed as Members of the Committee—

- | | | | | |
|--|----|----|----|-----------------|
| 1. Hon'ble Minister (Irrigation) | .. | .. | .. | Chairman |
| 2. Hon'ble State Minister (Irrigation) | .. | .. | .. | Deputy Chairman |
| 3. Shri Mahadev Gopal Kadu, MLA, Dahanu | .. | .. | .. | Member |
| 4. Shri Tukaram Baburao Kadam, MLA, Khed | .. | .. | .. | Member |
| 5. Shri Shantaram Gopal Gholap, MLA, Murbad | .. | .. | .. | Member |
| 6. Shri Chandrakant Khanderao Deshmukh, MLA, Matad | .. | .. | .. | Member |

7.	Shri.Dattatraya Narayan Patil, MLA, Alibag	..	..	..	Member
8.	Shri Amrut Rane, MLA, Deogad	..	..	..	Member
9.	Shri Rajaram Shinde, MLA, Chiplun	..	..	..	Member
10.	Shri Ashok Ganapat Sable, MLA, Mangaon	..	..	..	Member
11.	Shri Tukaram Eknath Surve, MLA, Kolhapur	..	..	..	Member
12.	Shri Nakul Patil, MLA, Ambarnath	..	..	..	Member
13.	Shri Shantaram Laxman Peje, MLC, Ratnagiri	..	..	..	Member
14.	Shri Bhausahib Vartak, Thane	..	..	..	Member
15.	Shri Baburao Belose, Dapoli	..	..	..	Member
16.	Shri Ravindra Raut, Shrivardhan	..	..	..	Member
17.	Shri S. B. Savant, Mahad	..	..	..	Member
18.	Shri Namdevrao Khaire, Chairman, Panchayat Samiti, Sudhagad Pali.				Member
19.	Shri Keshavrao Limaye, Sudhagad Pali	..	..	..	Member
20.	Shri T. H. Vajekar, Uran, Distrist Raigad	..	..	..	Member
21.	Shri Nishikant Joshi, Editor, 'Sagar', Chiplun	..	..	..	Member
22.	Director of Agriculture, Pune	..	..	..	Member
23.	Managing Director, IDCOM (Ltd.), Pune	..	..	..	Member
24.	Chief Engineer, Irrigation Department, Konkan Region, Bombay	..	..	..	Member-Secretary

3. The Committee will submit its report to Government within a period of six months. The Travelling Allowances and Daily Allowances of the non-official members (other MLAs.) of the Committee shall be drawn as per Rule No. 1 (2)b of Section I, Appendix 42 (a) of B.C.S.R. Vol. II and as per orders issued in Government Resolution, Finance Department No. TRA/1477/1032-C/SER-5, dated 23rd September 1977. In respect of the other non-official members (MLAs.), the T.A. and D. A. shall be drawn as per orders issued in Government Resolution, Finance Department No. TRA 1470/131/18, dated 27th January 1971. The Chief Engineer, Irrigation Department, Bombay Region, Bombay will be controlling officer in respect of T.A./D.A. claims of the non-official members of the Committee. The T. A., D. A. of the official members of the Committee shall be drawn as per B.C.S.R.

The expenditure involved shall be debited to the head "331-Water and Power Development Services (A) Water Development (C) Technical Control and Supervision", Chief Engineer, Irrigation Department, Bombay (Non-Plan), and the grants sanctioned thereunder

D.A.—Annexure.

(Sd) N. M. JOG,

Deputy Secretary to the Government of Maharashtra.

**ANNEXURE TO GOVERNMENT RESOLUTION No. DKR 1078/(18) KNR OF
17th OCTOBER 1980**

Terms of reference of the High Power Committee for Development of Irrigation in Konkan Irrigation, (constituted under Government Resolution No. DKR 1078/ (18) /KNR, dated 17th October 1980.

- (1) Assessment of water in the river basins in Konkan Region and suggesting the modes of developments of available water resources.
- (2) Recommending the crop patterns in Konkan Region taking into consideration the type of land, rainfall and climate.
- (3) Studying the possibility of re-utilisation of water diverted from east flowing rivers to the west and suggesting ways and means to use this water.
- (4) Preparing a time bound basinwise programme for the various works to be undertaken for the utilisation of water resources.
- (5) Suggesting the benefit cost ratio and other norms for the acceptance of the irrigation projects in Konkan.
- (6) Suggesting ways and means for the rapid utilisation of irrigation potential created in Konkan particularly by securing active participation of the beneficiaries.
- (7) Studying the possibilities of constructing Bandharas or submersible dams at the mouths of tidal creeks and making suggestions in respect of such constructions.
- (8) Many bridges of different sizes will have to be constructed in the Konkan region for communication facilities. Studying the possibility of combining such bridges with the barrages and deciding the norms for such constructions.
- (9) Suggesting the basins from which water can be reserved mainly for industrial development after considering the irrigation needs basinwise.

ANNEXURE 2.1

Age Group-wise and Sex-wise distribution of Population (1971 Census) in the three Konkan Districts and in the Maharashtra

(Figures in hundred)

Age of Group	Thane District			Raigad District			Ratnagiri District			Maharashtra State		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-14 ..	4,672 (38.78)	4,485 (41.64)	9,157 (40.14)	2,684 (43.69)	2,653 (40.88)	5,337 (42.25)	4,143 (46.70)	4,099 (87.15)	8,242 (41.41)	106,590 (40.81)	101,810 (41.90)	208,399 (41.34)
15-19 ..	1,079 (8.96)	937 (8.70)	2,016 (8.84)	528 (8.60)	540 (8.32)	1,068 (8.46)	819 (9.23)	979 (8.86)	1,798 (9.03)	23,353 (8.94)	19,426 (8.00)	42,779 (8.49)
20-24 ..	1,094 (9.08)	994 (9.23)	2,088 (9.15)	403 (6.56)	513 (7.91)	916 (7.25)	479 (5.40)	801 (7.26)	1,280 (6.43)	20,939 (8.03)	20,081 (8.27)	41,021 (8.14)
25-29 ..	1,080 (8.96)	960 (8.92)	2,040 (8.94)	405 (6.59)	528 (8.14)	933 (7.39)	446 (5.03)	824 (7.47)	1,270 (6.38)	19,494 (7.46)	19,527 (8.04)	39,021 (7.74)
30-39 ..	1,796 (14.91)	1,454 (13.50)	3,250 (14.24)	763 (12.43)	864 (13.32)	1,627 (12.88)	866 (9.76)	1,507 (13.66)	2,373 (11.92)	34,041 (13.03)	31,772 (13.08)	65,813 (13.05)
40-49 ..	1,202 (9.98)	912 (8.47)	2,114 (9.27)	598 (9.73)	618 (9.53)	1,216 (9.63)	795 (8.96)	1,182 (10.71)	1,977 (9.93)	25,885 (9.91)	22,024 (9.06)	47,909 (9.50)
50-59 ..	651 (5.40)	541 (5.02)	1,192 (5.22)	419 (6.82)	392 (6.04)	811 (6.42)	661 (7.46)	809 (7.33)	1,470 (7.38)	16,398 (6.28)	13,870 (5.71)	30,268 (6.00)
60 & above ..	470 (3.90)	482 (4.48)	952 (4.17)	341 (5.55)	379 (5.84)	720 (5.70)	659 (7.43)	832 (7.54)	1,491 (7.49)	14,420 (5.52)	14,414 (5.93)	28,834 (5.72)
Age not stated	4 (0.03)	3 (0.03)	7 (0.03)	2 (0.03)	1 (0.02)	3 (0.02)	3 (0.03)	2 (0.02)	5 (0.03)	43 (0.02)	34 (0.01)	78 (0.02)
Total ..	12,048 (100.00)	10,768 (100.00)	22,816 (100.00)	6,143 (100.00)	6,488 (100.00)	12,631 (100.00)	8,871 (100.00)	11,034 (100.00)	19,906 (100.00)	261,163 (100.00)	242,959 (100.00)	504,122 (100.00)

(Reference.—Para 2.2.3)

ANNEXURE 2.2

Monsoon Rainfall Statistics of Konkan

	June	July	August	September	Seasonal Total	Annual
<i>Bombay</i>						
Normal Rainfall (mm)	464.8	613.4	328.9	286.0	1,693.1	1,804.8
Rainy days	14.2	22.2	18.2	12.6	67.2	72.7
Per cent of Seasonal	27	36	19	17	94	....
<i>District Thane</i>						
Normal Rainfall (mm)	413.3	903.1	512.3	303.0	2,131.7	2,258.6
Rainy days	13.5	25.4	22.7	14.6	76.2	81.8
Per cent of Seasonal	19	42	24	14	94	....
<i>District Raigad</i>						
Normal Rainfall (mm)	579.9	1,113.9	706.7	396.2	2,796.7	2,956.3
Rainy days	16.8	26.9	24.7	16.6	85.0	92.9
Per cent of Seasonal	21	40	25	14	95	....
<i>District Ratnagiri</i>						
Normal Rainfall (mm)	778.1	1,205.9	687.9	412.9	3,084.8	3,305.7
Rainy days	20.4	27.8	24.8	17.3	89.3	101.7
Per cent of Seasonal	25	39	22	13	93	....

Reference.—Para 2.3.2

ANNEXURE 2.3

Spells of Dry Days Related to Agricultural Drought in Konkan Region

The daily rainfall from 1 June to 31 October which nearly covers all growth phases of crops grown principally during kharif season for a 70 year period (1901-1970) for 26 stations in Maharashtra adopting the two categories of dry days viz. : (1) a day with less than 2.5 mm which is sufficient to wet the top most soil layer and (2) a day with less than 6.3 mm which was considered as threshold value for second category, were used for this study. The study revealed that the probabilities of occurrence of dry spells equal to or more than 5 days in length were lowest in both categories of dry days over Konkan Region of Maharashtra.

The probabilities are given below for the 4 representative stations of Konkan region.

Probability of occurrence of dry sequence (in per cent)

	Spell length in days equal to or greater than									
	Rainfall < 2.5 mm/day					Rainfall < 6.3 mm/day				
	5	10	15	20	25	5	10	15	20	25
(1) Thane ..	22.0	11.1	6.3	3.5	1.0	23.9	11.4	6.1	3.7	1.2
(2) Colaba ..	20.6	9.7	5.4	3.0	1.7	29.9	14.3	7.4	4.0	2.4
(3) Alibag ..	20.2	8.8	5.0	3.2	0.9	27.6	11.9	6.1	4.0	1.3
(4) Ratnagiri ..	18.9	7.8	4.3	2.1	0.5	21.7	9.5	5.0	2.4	0.8

Reference.—Spells of dry days related to agricultural drought in India by A. Chowdhury, (KM) S. S. Gokhale and G. S. Rentala, Meteorological Office, Pune, published in *Mausam* (1979).

Reference.—Para 2.3.6.

ANNEXURE 2.4.

Evaporation Data for Konkan Region

(Based on data for 1966 to 1975)

(I) *Mean Daily Evaporation (in mm) for the region (based on Evaporation charts).*

January	February	March	April	May	June	July	August	September	October	November	December
4	6	7	8	8	6	4	4	4	4	4	4

(II) *Mean Daily Evaporation values (in mm) of individual stations in and around Konkan (Based on data for 1966-1975)*

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
(i) Bombay	3.4	4.1	4.9	5.5	5.9	4.6	3.1	3.1	3.4	3.9	3.8	3.2
(i) Karjat (Agromet) ..	5.1	6.9	8.7	9.8	9.2	6.2	3.9	3.7	3.5	4.1	4.1	4.5
(iii) Surat (Agromet) ..	5.4	6.9	7.7	9.3	10.2	8.4	5.2	5.2	5.3	5.1	5.1	4.7
(iv) Panaji	4.8	5.1	5.7	6.5	6.6	4.3	3.6	3.7	3.7	3.9	4.5	4.7

(Reference—Data maintained by IMD)

Reference.—Para 2-3-7

ANNEXURE 2.5

Rain Gauge and River Gauge Stations in Konkan, maintained by Irrigation Department

(For locations of station refer plate 3)

(A) EXISTING RAIN GAUGE STATIONS

Thane District

1. Dahanu	32. Nadgaon	63. Yeur
2. Chikhli	33. Kasara	64. Chene
3. Shensari	34. Dand	65. Dhamne
4. Ozar	35. Veluk	66. Khadavli
5. Kawadas	36. Vashala	67. Sakhroli
6. Tilonda	37. Kotala	68. Vadavli
7. Suryanagar	38. Borli	69. Vashind
8. Kase Bk.	39. Talavde	70. Sarlambe
9. Pairapada	40. Sakadbav	71. Jambhe
10. Akre	41. Lokachpada	72. Khinavli
11. Jawhar	42. Patol	73. Nampada
12. Nandanmal	43. Khodvapura	74. Khapri
13. Walvande	44. Dolkhamb	75. Fungloshi
14. Kegva	45. Temburli	76. Kudachivadi
15. Vikramgad	46. Velholi	77. Valivre
16. Kudan	47. Sakurli	78. Maroshi
17. Andhari	48. Sarangpuri	79. Khandpe
18. Chowk	49. Musai	80. Bhagdal
19. Junijawhar	50. Kardi	81. Dhasai
20. Nandgaon	51. Sajivli	82. Loharwadi
21. Donbari	52. Bhatsanagar	83. Thakurpada
22. Khodla	53. Aure	84. Vasat Shevali
23. Jugalvadi	54. Shahapur	85. Bhoj
24. Mohokhurd	55. Tansa	86. Badlapur
25. Vaitarna Camp	56. Waghivli	87. Dahigaon
26. Uthavpada	57. Dongaste	88. Tulai
27. Shirol	58. Pelhar	89. Jamburde
28. Vihigaon	59. Bhuishet	90. Jambivli
29. Anjup	60. Usgaon	91. Kushivli
30. Ambivali	61. Umbarpada	
31. Khoste	62. Kaman	

Raigad District

92. Kurung	104. Ambeghar	115. Pali
93. Olman	105. Kamarli	116. Shirgaon
94. Bhangrvadi	106. Shiravli	117. Khadsambi
95. Nandgaon	107. Donvat	118. Dolvahal
96. Hirevadi	108. Kavelevadi	119. Kolad
97. Kalamb	109. Nadevadi	120. Sutarvadi
98. Morbe	110. Hatonda	121. Bhirvadi
99. Bhilawle	111. Dhokshet	122. Kothurde
100. Chowk	112. Kavele	123. Raigad
101. Kolote	113. Kondgaon	124. Mhasala
102. Sai	114. Unhere	125. Pabhare
103. Bamnoli		

ANNEXURE 2.5—contd.

Ratnagiri District

126. Makhjan	133. Kankavli	139. Dukanvad
127. Kuchambe	134. Phonda	140. Upwada
128. Kurdunda	135. Ghonseri	141. Shivapur
129. Pastevadi	136. Digwale	142. Ainavadi
130. Pawarvadi	137. Shivdao	143. Amboli
131. Anuskura	138. Awlegaon	144. Tillari
132. Sangulvadi		

(B) PROPOSED RAIN GAUGE STATIONS

Thane District

1. Rankol	10. Pathardi	18. Dudhnoli
2. Khutal	11. Kalamgaon	19. Ahupe
3. Ganja	12. Centre of Tansa	20. Shendurni
4. Boranda	13. Kamandurg	21. Belapada
5. Deharje	14. Ambaje	22. Harchindragad
6. Nandnipada	15. Dhasai	23. Khireswar
7. Suksale	16. Ghodyachapada	24. Bhairavgad
8. Khindra	17. Kalambad	25. Bandivali
9. Vadapada		

Raigad District

26. Damdamiya	32. Savle	38. Apte
27. Thakurvadi	33. Salpe	39. Sungdevadi
28. Sugva	34. Kalote-Khondne	40. Khanao
29. Tungivadi	35. Poyanje	41. Vakrul
30. Dhamni	36. Mohili	42. Tamanvadi
31. Lahu	37. Kalavne	

(C) EXISTING RIVERGAUGE STATIONS

Thane District

1. Kase Bk.	8. Wagivli	15. Kaman
2. Dhamni	9. Tansa	16. Dhamne
3. Kase Kd.	10. Ganja	17. Jambul
4. Murnipada	11. Saranapuri	18. Vasatshivli
5. Andari	12. Nawpada	19. Chene
6. Vaitarna Camp	13. Khapri	20. Badlapur
7. Bhatsangar	14. Khadavli	

Raigad District

21. Kalamb	24. Kamarli	26. Dolvahal
22. Chowk		
23. Turade	25. Pali	27. Ravalje

Ratnagiri District

28. Kuchambe	31. Sangulvadi	34. Awlegaon
29. Pastevadi	32. Ghonsari	35. Dukanvad
30. Pawarvadi	33. Shivdao	36. Tillari

(D) PROPOSED RIVER GAUGE STATIONS

Thane District

1. Thune	2. Khushivali	3. Titvala	4. Ogade
----------	---------------	------------	----------

Raigad District

5. Siravali	6. Sugva
-------------	----------

Ratnagiri District

7. Talamba	8. Shastri
------------	------------

ANNEXURE 2.6.

Number and area of operational Holdings in the Konkan

Serial No.	Sizes class (Hectares)	Thane District				Raigad District				Ratnagiri District			
		Total Holding				Total Holding				Total Holding			
		No.	Percentage	Area	Percentage	No.	Percentage	Area	Percentage	No.	Percentage	Area	Percentage
1	Below 0.5	46,184	28.65	11,221	2.71	64,844	33.19	16,574	4.48	138,124	34.65	26,982	2.55
2	0.5-1.0	28,201	17.49	19,937	4.81	40,787	20.88	28,966	7.83	54,762	13.74	38,674	3.66
3	1.0-2.0	32,302	20.04	46,480	11.22	40,209	20.58	56,727	15.34	64,647	16.22	93,677	8.86
4	2.0-3.0	16,218	10.06	39,673	9.58	18,530	9.49	44,789	12.11	39,097	9.81	96,284	9.11
5	3.0-4.0	9,621	5.97	33,367	8.06	9,902	5.07	34,246	9.26	25,813	6.48	89,734	8.48
6	4.0-5.0	6,718	4.17	29,490	7.12	5,768	2.95	25,808	6.98	17,863	4.48	79,789	7.55
7	5.0-7.5	9,636	5.98	58,109	14.03	7,285	3.73	44,117	11.93	26,162	6.56	1,57,739	14.92
8	7.5-10.0	4,941	3.06	42,311	10.22	3,391	1.74	29,451	7.96	12,730	3.18	1,09,284	10.34
9	10.0-20.0	5,879	3.65	80,665	19.48	3,517	1.80	47,027	12.72	15,173	3.81	2,07,085	19.58
10	20.0-30.0	1,046	0.65	24,822	5.99	671	0.34	16,183	4.38	2,710	0.68	64,825	6.13
11	30.0-40.0	268	0.16	9,238	2.23	195	0.10	6,762	1.83	853	0.21	29,067	2.75
12	40.0-50.0	86	0.05	3,811	0.92	95	0.05	4,287	1.16	323	0.08	14,204	1.34
13	50.0 and above	125	0.07	15,010	3.63	150	0.08	14,852	4.02	406	0.10	49,965	4.73
	All sizes classes	1,61,227 (100.00)	100.00	4,14,133	100.00	1,95,344	100.00	3,69,789	100.00	3,98,663	100.00	10,57,309	100.00

Source.—Agriculture Census of 1976-77 by Government of Maharashtra.
[Ref.—Para 2.6.2]

ANNEXURE No. 2.7.

Statement showing land use classification for the year 1977-78 in respect of Konkan districts.

(Area in '00 ha.)

Head of classification	Thane	Raigad	Ratnagiri	Total
Reporting area for land utilisation statistics ..	9,337 (100.00)	6,869 (100.00)	12,788 (100.00)	28,994
1. Forest	3,677 (39.38)	1,612 (23.48)	310 (2.42)	5,599 (19.31)
2. Barren and unculturable land ..	817 (8.75)	1,286 (18.72)	3,421 (26.75)	5,524 (19.05)
3. Area under non-agricultural uses ..	592 (6.34)	371 (5.40)	317 (2.48)	1,280 (4.42)
4. Culturable waste land	397 (4.25)	380 (5.53)	2,945 (23.03)	3,722 (12.84)
5. Permanent pastures and other grazing lands	878 (9.40)	327 (4.76)	169 (1.32)	1,374 (4.74)
6. Land under Misc. tree crops and groves not included in net area sown.	64 (0.69)	325 (4.73)	391 (3.06)	780 (2.69)
7. Current fallows	152 (1.63)	207 (3.01)	400 (3.13)	759 (2.62)
8. Other fallows	92 (0.99)	409 (5.95)	1,260 (9.85)	1,761 (6.07)
9. Net area sown	2,668 (28.57)	1,952 (28.42)	3,575 (27.96)	8,195 (28.26)
10. Area sown more than once	93 (1.00)	130 (1.89)	127 (0.99)	350 (1.20)
Total cropped area	2,761 (29.57)	2,082 (30.31)	3,702 (28.95)	8,545 (29.47)

Figures in brackets indicate percentage to reporting area for land utilisation.

[Source : Data with the Directorate of Agriculture, M. S., Pune 1.]

[Ref. Para. 2.6.3]

ANNEXURE 2.8.

Properties of Soils in Konkan

Compiled from the data on typical profiles taken by the Agricultural Department, Maharashtra

District	Phase and Depth in cm.	Description	per cent										m.e. 100g.			Remarks
			pH	TSS	Si-It	cl-ay	Ca-Co ₃	Ex Ca mg	Ex Na+K	Ex N	Total	Available P 205	Available K 20	mgm 100 g.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Thane	..	Medium deep 0-10.0	Dark grey brown loam; dry and hard roots visible.	7.0	0.19	28	10	....	22	9	1.5	0.06	9	11	The soils of the district are almost neutral in reaction, free from calcium carbonate, and sandy in texture. The colloidal complex is low in bases and divalents account at for more than 90 per cent of the total exchangeable bases. They are fairly well supplied with nitrogen but are low in available phosphate and potash.
	..	10-22.5	Yellowish brown sandy loam, moist and friable, full of sand particles.	6.7	0.51	35	26	....	24	13	2.0	....	....	....
	..	22.5-45.0	Yellowish brown sandy loam, moist and friable, murum particles are present.	6.8	0.20	19	19	....	25	13	2.0	....	....	....
	..	Deep 0-15	Dark brown sandy loam, moist, roots visible, black concretions present.	7.5	0.23	23	26	....	22	9	2.0	0.07	12	12	
	..	15-37.5	Dark reddish brown sandy loam, moist but slightly sticky; black and red concretions present, full of sand particles.	7.7	0.23	25	26	....	23	9	1.0	....	....	....
	..	37.5-67.5	Dark reddish brown sandy loam, moist, full of sand particles and admixture of black nodules.	7.8	0.26	17	23	....	23	11	3.0	....	....	....

Soil Profile	Description	7.4	0.23	..	25	23	25	ND	1.5	0.078	12	19
Shallow 0-21.5	Brown sandy loam, single grained loose, roots throughout the profile.	7.4	0.23	..	25	23	25	ND	1.5	0.078	12	19
Medium deep 0-11.5	Yellowish brown sandy loam, single grained dry and loose, roots present.	6.3	0.18	..	18	26	18	ND	2.0	0.088	21	18
11.5-41.0	Reddish brown sandy loam, single grained loose but little moist few murum pieces present.	6.8	0.18	..	14	15	19	ND	1.0	..	..	..
Deep 0-20	Dark brown clay loam, cloddy, dry and hard roots present.	6.7	0.15	..	28	32	24	12	2.5	..	..	..
20-40	Reddish brown clay loam, moist, friable but massive.	7.3	0.18	..	17	27	24	10	1.5	..	..	..
40-70	Reddish brown sandy loam, moist, sand particles mixed in the soil.	7.6	0.20	..	10	20	18	15	1.0	..	..	..
Very Deep 0-7.5	Yellowish brown clay loam, dry and loose, roots throughout the horizon.	7.1	0.22	..	21	24	20	9	2.0	0.053	8	20
7.5-36.0	Reddish brown clay loam, moist, cloddy roots are present.	7.3	0.25	..	20	29	23	10	1.0	..	..	..
36.0-66.0	Dark reddish brown clay loam, massive, moist and friable, sand particles and black nodules present.	7.2	0.36	..	25	32	27	13	1.5	..	..	..

It will be seen from the table that the soils of this district are characterized by nearly complete absence of free calcium carbonate, more or less neutral reaction and loamy texture. The colloid complex is nearly base saturated the divalentions accounting for more than 20 per cent of the exchangeable bases. They are fairly well supplied with nitrogen & available potash but rather low in their phosphate status. The coastal alluvium is more or less similar to the soils described above. The coastal salines on the other hand differ from the coastal alluvium in that they have higher salt content. The coastal salines are comparatively poorer than the coastal alluvium in their fertility constituents.

ANNEXURE 2.8—contd.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	66.0-106.5	Color and texture same as above moisture increasing with depth full of sand and back nodules.	7.1	0.28	..	23	30	24	10	1.5	..	..	..	..

Ratnagiri

Medium deep 0-30.0	Red clayed (gravelly) granular, moist, loose and friable roots of grasses through the horizon, full of sand and gravel.	5.3	0.13	30	..	34	2.0	1.5	1.5	1.5	..	7	12	It will be seen that the soils of the district are absolutely free from calcium carbonate, slightly acidic in reaction and sandy loam in texture. The colloid complex is low in bases. The soils are fairly well supplied with nitrogen but, are poor in available phosphate and potash.
30.0-52.5 ..	Dark red, clayey, granular moist loose and friable rootlets are present, admixture of sand and gravel.	5.4	0.04	22	..	30	2.0	1.5	1.0	1.0	..	9	16	
Below 52.5 ..	Parent lateritic rock with black coating.	5.2	0.10	25	..	34	2.0	2.5	..	..	..	7	25	
Deep 0-10.0 ..	Dark brown, clay, granular, loose and friable moist roots are visible, sand particles and gravel are seen.	5.7	0.05	30	..	35	6.0	1.5	2.5	2.5	..	8	22	

10.0-52.5	..	Red clayey, granular, moist, loose and friable roots are present. admixture of sand and gravel.	5.7	0.10	9	..	71	4.5	2.5	2.0	..	8	11
52.5-105	..	Red with yellowishinge, clayey, indefinite structure, moist loose and friable, more mixture of sand particles.	6.0	0.06	15	..	71	6.0	3.5	2.0	..	8	9
Below 105	..	Same layer continues ..	6.0	0.05	24	..	54	4.5	2.5	2.5	..	8	15

Note :—T.S.S : Total Soluble Salt (Ref. Para 2.7.6)

ANNEXURE 2.9.

Groundwater potential of the river basins in Konkan

Serial No.	District	Names of westerly flowing rivers in the dist.	Name of the watershed	Annual ground water recharge in Mcm	Annual ground water withdrawal in Mcm	Ground water balance in Mcm	Additional wells feasible	Existing Irrigation wells		
1	2	3	4	5	6	7	8	9		
1	Ratnagiri	Savitri	WF-54	25.91	0.23	25.68	1,712	213		
			WF-55	36.53	0.61	35.92	2,394	487		
			WF-56	52.79	8.24	44.55	2,970	464		
			WF-57	40.66	0.50	40.16	2,676	460		
			WF-58	70.52	0.41	70.11	4,673	380		
			WF-59	51.92	1.62	50.30	3,353	1,159		
			WF-60	75.27	1.92	73.35	4,889	1,492		
				WF-61	100.91	1.63	99.28	6,618	1,346	
				Total	454.51	15.16	439.35	29,285	6,001	
		Shatri		WF-62	67.80	1.35	66.45	4,430	1,123	
	WF-63			31.32	1.30	30.02	2,001	897		
	WF-64			47.46	1.06	46.40	3,093	903		
	WF-65			30.89	0.60	30.29	2,019	526		
	WF-66			34.67	1.48	33.19	2,213	1,127		
	WF-67			54.08	1.04	53.04	3,536	857		
	WF-69			68.87	1.43	67.44	4,496	142		
				Total	335.09	8.26	326.83	21,788	5,575	
	2	Thane		Kajvi	WF-68	78.17	2.93	75.24	5,016	2,432
				Machkundi	WF-70	119.39	4.12	115.27	7,684	3,508
				Kodavil	WF-71	90.57	2.12	88.45	5,896	1,852
				Vaghotan	WF-72	84.54	2.57	81.97	5,464	2,283
				Kharda	WF-73	65.84	1.42	64.42	4,294	1,215
				Gad	WF-76	139.31	4.91	134.40	8,959	4,487
				Damanganga	WF-7	47.90	0.10	47.80	3,186	39
					WF-8	5.16	0.01	5.15	343	8
					WF-9	12.21	0.12	12.09	886	22
					WF-10	11.97	0.49	11.48	765	36
				Total	77.24	0.72	76.52	5,180	105	
		Vaitarna		WF-13	13.02	0.42	12.60	840	48	
WF-14				69.70	0.81	68.89	4,593	125		
WF-15				47.68	0.17	47.51	3,168	35		
WF-16				10.10	1.06	9.04	602	173		
WF-17				10.14	0.27	9.87	658	33		
WF-18				8.73	0.19	8.54	569	17		
WF-20	19.03			2.05	16.98	1,132	355			
WF-21	26.87			0.39	26.48	1,765	75			
			WF-22	17.17	0.16	17.01	1,134	29		
			WF-23	31.59	0.03	31.56	2,104	20		
			WF-24	57.00	0.13	56.87	3,792	65		
			WF-26	22.81	0.23	22.58	1,506	38		
			WF-28	50.01	0.29	49.72	3,315	103		
			Total	383.85	6.20	377.65	25,178	1,116		

ANNEXURE 2.9.—contd.

1	2	3	4	5	6	7	8	9
			WF-29	69.74	4.83	64.91	4,327	939
			WF-30	130.76	1.26	126.50	8,633	401
			WF-31	15.37	0.82	14.55	970	494
			WF-32	25.64	1.02	24.62	1,641	462
			WF-33	35.57	0.39	35.18	2,345	131
			WF-34	70.81	0.07	70.74	4,716	35
			WF-35	43.22	0.16	43.06	2,870	56
			WF-38	62.14	0.11	62.03	4,135	58
			Total ..	435.25	8.66	444.59	29,637	2,516
3	Raigad	.. Patalganga Amba	WF-43	79.02	0.52	78.50	5,233	477
			WF-44	31.62	0.06	31.56	2,104	51
			WF-45	112.36	0.99	111.37	7,424	823
			Total ..	223.00	1.57	221.43	14,761	1,351
		Savitri	.. WF-49	104.52	0.64	103.88	6,925	527
			WF-50	27.28	1.44	25.84	1,722	655
			WF-51	34.55	0.03	34.52	2,300	13
			WF-52	24.83	0.06	24.77	1,651	23
			WF-53	82.05	0.33	81.71	5,447	267
			WF-54	3.720	0.009	3.711	247	3
			Total ..	276.950	2.509	274.431	18,292	1,488
		Ulhas	.. WF-37	6.38	0.03	6.35	423	28
			WF-39	25.01	0.20	24.81	1,654	....
			WF-41	67.768	0.003	63.765	4,251	3
			Total ..	99.158	0.233	94.925	6,328	31
4	Kolhapur	.. Vaghotan	.. WF-72	46.06	0.10	45.96	3,064	7
5	Nashik	.. Damanganga	WF-5	20.79	0.69	20.10	1,340	75
			WF-6	26.70	0.40	26.30	1,753	49
			Total ..	47.49	1.09	46.40	3,093	124
			Grand Total ..	2,877.40	62.04	2,829.34	1,91,855	34,090

ANNEXURE 2.10

Details of Drinking Water Borewells in Konkan

Serial No.	Geological formation	District Ratnagiri				District Thane				District Raigad				Total borewells drilled	Total borewells successful	Percentage of success
		Total wells drilled	Successful borewells	Percentage of success	Total borewells drilled	Successful borewells	Percentage of success	Total borewells drilled	Successful borewells	Percentage of success	Total borewells drilled	Successful borewells	Percentage of success			
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
1	Laterite	45	30	66	.....	.....	.....	.....	.....	.....	45	30	66			
2	Non-basalt formation	42	33	78	.....	.....	.....	.....	.....	.....	42	33	78			
3	Trap-pahoee flows AA	346	205	59	880	583	66	587	344	58	1,813	1,132	62			
	Flows	.....	.....	.....	26	23	88	92	64	69	118	87	74			
	Total	433		906	679	2,018	1,282	64								

(Source : Data maintained by GSDA)

(Ref : Para 2.9.4)

ANNEXURE 2.11

Agriculture Production Realised in Konkan (Figures For Year 1978-79)

Crop	Thane			Raigad			Ratnagiri		
	Area in 100 Ha.	Production 100 tonnes	Average yield Kg/Ha.	Area in '00 Ha.	Production '00 tonnes	Average yield Kg/Ha.	Area in '00 Ha.	Production '00 tonnes	Average yield kg/Ha.
Rice	1,498	2,662	1,777	1,464	2,691	1,838	1,473	2,462	1,671
Wheat	3	3	1,169	.....	.....	.....	.....	.....	.....
Kharif Jowar	5	6	1,169	1	1	1,640	.....	.....	.....
Rabi Jowar	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other cereals	300	266	887	281	245	872	772	586	759
Total cereal	1,806	2,937	1,626	1,746	2,937	1,682	2,249	3,051	1,357
Tur	38	12	316	16	5	312	3	1	333
Gram	11	3	302	13	4	302	.....	.....	.....
Other pulses	82	27	329	88	25	284	136	39	287
Total pulses	131	42	321	117	34	291	139	40	288
Total foodgrain	1,937	2,979	1,538	1,863	2,971	1,595	2,388	3,091	1,294
Sugarcane	1	11	11,000	.....	.....	.....	6	55	9,164
Groundnut	.....	.....	.....	.....	.....	.....	.....	.....	.....

(Ref : Para 2.10.4)

ANNEXURE 2.12

Details of Forest area in Konkan Region

Particulars	Area in Sq.km.				Total
	Name of District			Total	
	Thane	Raigad	Ratnagiri		
<i>A. Distribution according to possessions—</i>					
(i) Total Geographical area ..	9,533	7,198	13,040	29,791	
(ii) Area with Forest Department ..	3,679	1,505	397	5,581	
(iii) Private forest in possession of Forest Department	443	278	144	865	
(iv) Area with Revenue Department .. ..	....	96	31	127	
(v) Area with FDCM Limited ..	137	....	....	137	
(vi) Private forests restored to original owners ..	362	347	236	945	
(vii) Total forest area	4,621	2,226	808	7,655	
(viii) Percentage forest area	48 per cent	31 per cent	6 per cent	26 per cent	
<i>B-Break up according to types—</i>					
(i) Protection forests ..	1,004.53	400.14	50.18	1,454.85*	26.10 per cent
(ii) Tree forests ..	1,759.20	852.16	66.17	2,677.53*	48.04 per cent
(iii) Minor forests	1,100.94	190.88	32.60	1,324.42	23.77 per cent
(iv) Pastures forests .. ..	....	2.86	....	2.86	0.05 per cent
(v) Miscellaneous forests ..	85.23	28.10	0.51	113.84	2.04 per cent
Total Area in sq. km.	3,949.90	1,474.14	149.46	5,573.50	100.00 per cent

Notes.—(1) The area figures mentioned above under B are from the Working Plans/Schemes which are in operation in the area and existing at the time of the preparation of the Plans/Schemes.

(2) The remaining area (i.e. 6710 —5574=1136sq. km.) is being brought under scientific management in stages.

(3) A forest area of 945 sq.km. is in the possession of private owners.

(4) *Area under actual tree cover is only 4,132 sq. km. (i.e. 14 per cent of the Konkan's geographical area).

(5) The positions given above are as on 31st March 1980.

(Ref : Para 2.11.1)

ANNEXURE 2.13
Horticulture in Konkan

Unit '00 Ha.

Serial No.	Particulars	Thane	Raigad	Ratnagiri
1	Banana	22	1	4
2	Mango	5	9	73
3	Guava	2	....	....
4	Jack-fruit	....	....	....
5	Chikoo	7	....	....
6	Other fruits	1	Nil	1
7	Coconut	5	7	67
8	Arecanut	1	6	16
<i>Vegetables</i>				
9	Sweet Potato	1	2	2
10	Onion	2	....	2
11	Radish	2	....	1
12	Cabbage	2	....	....
13	Brinjal	14	4	2
14	Tomato	1	5	Nil
15	Bhendi	1	....	1
16	Kharbuj	Nil	1	Nil
17	Other Vegetables	5	5	1
Total Vegetables		28	17	9

Note.—In addition 6,994 thousand hectares have been brought under cashew plantations by the Forest Department of Maharashtra, since the Second Five Year Plan (Ref. para 2.12.2).

[*Source.*—Season and crop report of 1976-77 with the Deputy Director of Horticulture, Maharashtra].

ANNEXURE 2.14

Khar Land Development Schemes in Koakan

		<i>Completed schemes</i>			
		Thane	Raigad	Ratnagiri	Total
Nos.	.. ..	63	145	44	252
Cost (Rs. in lakhs)	.. ..	71.21	60.32	17.70	149.23
Reclaimed Area (in Hectares)	.. ..	9,450	22,146	19,76	33,572
		<i>Under construction</i>			
Nos.	.. ..	7	8	8	23
Cost (Rs. in lakhs)	.. ..	157.35	63.10	22.05	242.50
Reclaimed Area (in Hectares)	.. ..	1,049	631	834	2,514
		<i>Shelf</i>			
Nos.	.. ..	1	6	10	17
Cost (Rs. in lakhs)	.. ..	7.25	104.49	50.77	162.51
Reclaimable area	.. ..	50	1,285	7,85	2,120
		<i>Fuxture</i>			
Nos.	.. ..	75	93	225	393
Cost (Rs. in lakhs)	.. ..	1424	740	496	2,660
Reclaimable area (in Hectares)	.. ..	9,442	6,115	6,678	22,235
Grand Total Nos.	.. ..	146	252	287	685
Cost	.. ..	1,659.81	967.91	586.52	3,214.24
Reclaimable	.. ..	19,991	30,177	10,273	60,441

(Ref: Para 2.14.1)

ANNEXURE 2.15

Distribution of Literate Population according to Educational Level (Census 1971) in the three Konkani Districts

District (1)	Total Population			Illiterate		Literate (without educational level)		Primary		Middle	
	Persons (2)	Male (3)	Female (4)	Male (5)	Female (6)	Male (7)	Female (8)	Male (9)	Female (10)	Male (11)	Female (12)
Thane ..	22,81,664	12,04,855	10,76,809	5,98,351 (49.66)	7,55,879 (70.20)	1,77,567 (29.28)	1,06,647 (33.23)	1,81,563 (29.94)	99,851 (31.11)	1,39,766 (23.04)	73,777 (22.99)
Raigad ..	12,63,003	6,14,278	6,47,825	3,24,034 (52.75)	4,92,830 (75.97)	1,15,058 (39.64)	70,324 (45.11)	1,00,366 (34.59)	55,229 (35.45)	55,054 (18.97)	23,989 (15.39)
Ratnagiri ..	19,90,583	8,86,995	11,03,588	4,21,164 (47.48)	7,76,513 (70.36)	1,83,182 (39.32)	1,46,005 (44.64)	1,67,558 (35.97)	1,24,827 (38.16)	87,901 (18.87)	46,796 (14.31)

District (1)	Matriculation and above		Non-Technical diploma or Certificate not equal to degree		Technical Diploma or certificate not equal to Degree		Graduate and above		Total Literate	
	Male (13)	Female (14)	Male (15)	Female (16)	Male (17)	Female (18)	Male (19)	Female (20)	Male (21)	Female (22)
Thane ..	87,254 (14.39)	34,260 (10.68)	1,338 (0.22)	428 (0.13)	4,474 (0.74)	1,687 (0.53)	14,542 (2.40)	4,280 (1.33)	6,06,504 (100.00)	3,20,930 (100.00)
Raigad ..	16,033 (5.52)	5,382 (3.45)	938 (0.32)	219 (0.14)	796 (0.27)	155 (0.10)	1,999 (0.69)	567 (0.36)	2,90,244 (100.00)	1,55,895 (100.00)
Ratnagiri ..	22,276 (4.78)	8,277 (2.53)	1,618 (0.35)	283 (0.09)	955 (0.21)	259 (0.08)	2,341 (0.50)	628 (0.19)	4,65,831 (100.00)	3,27,075 (100.00)

Figures in bracket denotes percentage.

Resource : Census Record.
Ref. para 2.20.9

ANNEXURE 2.16

Industrial Area of Maharashtra Industrial Development Corporation

Serial No. 1	Name of Industrial Area 2						Units in production 3	Units under construction 4
<i>(A) In B. M. R.</i>								
1	Marol	..	..	..	..	..	201	38
2	Thane (Wagle Estate)	..	..	..	..	..	504	36
3	Trans-Thane Creek	..	..	..	..	..	175	29
4	Meera	..	..	..	..	..	10	2
5	Dombivali	..	..	..	..	..	337	47
6	Ambarnath	..	..	..	..	..	113	8
7	Badlapur	..	..	..	..	..	109	3
8	Kalyan-Bhiwandi	..	..	..	..	..	19	2
9	Taloja	..	..	..	..	..	62	21
Total ..							1,530	169
<i>(B) Rest of Thane District</i>								
10	Tarapur	..	..	..	..	..	41	20
<i>(C) Rest of Raigad District</i>								
11	Roha	..	..	..	..	..	29	23
<i>(D) Ratnagiri District</i>								
12	Pophali (Chiplun)	..	..	..	..	..	30	4
13	Gane Khadpoli	..	..	..	..	..	....	5
14	Ratnagiri	..	..	..	..	..	1	7
15	Kudal	..	..	..	..	..	8	8
Total—Ratnagiri District ..							39	24
GRANT TOTAL ..							1,631	237

Note.—The above position is as at the end of 1978.

(Ref : Para 2.20.14)

ANNEXURE 2.17

Research stations under the jurisdiction of the Konkan Krishi Vidyapeeth, Dapoli

Serial No.	Name	Location	Year of Establishment	Crop/discipline	Total area(ha)	Areas of research activity
1	2	3	4	5	6	7
	<i>(1) Very high rainfall Lateritic soil (VRL)</i>					
1	Central Farm, Wakawali	Wakawali (Ratnagiri)	1975	Paddy, hillmillet, vegetables, sugarcane, pulse, oil-seeds, horticulture and fodder crops.	712.7	To study and develop package of practices for the cultivation of different cereal, pulse, oilseeds, vegetable, sugarcane and fodder crops in the Konkan region.
2	Agricultural College, Depoli	.. Dapoli (Ratnagiri)	1965	Do.	190.00	Do.
3	Soil Conservation Research Station, Awashi	Station, Awashi (Ratnagiri)	1969	Soil conservation	.. 18.55	To undertake research on applied as well as on fundamental problems on soil conservation under high rainfall condition of the Konkan region.
4	Agricultural Research Station, Shirgaon	Station, Shirgaon (Ratnagiri)	1913	Rice	.. 15.71	To bring about botanical improvement in rice crop through selection and hybridization methods and to evolve high yielding varieties of rice in different maturity and quality groups.
5	Regional Coconut Research Station, Bhatye	Station, Bhatye (Ratnagiri)	1955	Coconut	.. 26.05	To carry out research on the various problems of coconut cultivation in the West Coast region of Maharashtra State.
6	Agricultural Research Station, Phondaghat.	Station, Phondaghat (Ratnagiri)	1947	Rice/Nagali	8.50	To bring about improvements in cereal crops viz. rice and nagli and to evolve high yielding superior varieties of these crops suitable for the region.
7	Regional Fruit Research Station, Vengurla.	Station, Vengurla (Ratnagiri)	1957	Mango	.. 39.00	To carry out research on various problems of mango cultivation in the west coast region of Maharashtra State.

- 8 Regional Cashewnut Research Station, Vengurla (Ratnagiri). .. 1956 .. Cashewnut .. 21.05 To bring out improvement of the cashewnut crop by undertaking botanical and cultural investigation.
- 9 Agricultural School, Lanja .. Lanja (Ratnagiri) .. 1949 .. Paddy, Nagli, Vegetables, Horticultural crops. 72.80 The farm serves as a research and instructional farm for the cereal, pulse, vegetables, horticultural and fodder crop.
- (II) *Very high rainfall Non-lateritic soil (VRN)*
- 10 Agricultural School, Roha .. Roha (Raigad) .. 1958 .. Paddy, sugarcane, horticultural crops vegetables. 37.3 The farm serves as a research and instructional farm for the cereal, pulse, vegetable/horticultural and fodder crops.
- 11 Trial-cum-Demonstration Farm, Rapoli (Raigad) .. 1964 .. Rice, wheat, pulses, oil-seeds, sugarcane. 22.3 To undertake trials and demonstrations on water-management and agronomic practices under command area of Kal Project.
- 12 Band Disease Research Station, Shriwardhan (Raigad) 1954 .. Band disease of arecanut .. 0.41 To investigate into the courses of "Band Disease" of arecanut palms and to suggest suitable remedial measures to control the disease and general management of arecanut.
- 13 Agricultural Research Station, Karjat. Karjat (Raigad) .. 1919 .. Rice .. 30.36 To bring about improvement in rice crop through introduction, selection and hybridization and to high yielding varieties for Konkan region. Studies are also conducted in the improvement of the agronomic practices, plant protection measures and physiological and biochemical aspects.
- 14 Agricultural Research Station, Panvel Panvel (Raigad) .. 1943 .. Rice .. 12.80 To undertake work on breeding of varieties tolerant to salt and to bring about improvement in the local khar land varieties of rice.
- 15 Khar Land Research Station, Panvel Panvel (Raigad) .. 1959 .. Rice .. 20.00 To conduct research work on the reclamation of khar land soils and to develop agronomic practices for higher crop production.
- 16 Agricultural Research Station, Palghar Palghar (Thane) .. 1957 .. Rice .. 5.09 To bring about improvement in rice crop through crop breeding methods.
- 17 Grass Breeding Station, Palghar .. Palghar (Thane) .. 1957 .. Forage Crops .. 6.08 To bring about improvement in the local grasses and other forage crops with a view to involve high yielding superior varieties of forage crops.

ANNEXURE 2.18.

Position of roads in Konkan with reference to revised 1961-81 Road Development Plan

Category of Roads		Targetted length as per revised 1961-81 Plan	Existing length as on 1st April 1979	Percentage achievements in Konkan Region	National average
1		2	3	4	5
1. National Highways	.. ..	km. 1,565	km. 805 (805)	51 per cent (100 %)†	98.9
2. State Highways	.. ..	1977 (+ 760) (Proposed N.H.)	2,172 (2,41)*	79 per cent (94%)	94.3
3. Major District Roads	.. ..	2,511	2,029 (1,796)	81 per cent (86 %)	} 69.3
4. Other District Roads	.. ..	4,486	2,688 (1,782)	60 per cent (66%)	
5. Village Roads	.. ..	7,969	4,731 (1,851)	59 per cent (39%)	
		18,508	12,425 (8,275)	67 per cent (67%)	
Including unclassified length ..		{ (i) Road Length per lack of population .. 271 km. (ii) Road length per 100 sq. km. area .. 61 km.			

Note:—*Figures in brackets are under column 3 for surfaced lengths.

(2) †Figure in brackets under Column 4 indicate the percentage of surfaced length w.r.t. to the total length of that category.

Serial No.	Name of Valley	Geographical area of the basin Km ²	Total No. of identified Irrigation projects				75 percent dependable yield in T.ha.m. of the entire basin	Utilisation from the storages of the identified projects in T.ha.m.	Irrigation potential in ha.	Proposed use of water from identified projects in T.ha.m.				Remarks
			Maj- or	Med- ium	Minor					Irriga- tion	Industrial and domes- tic use	Other use (Hydro- releases with no reuse)	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>A. District Thane</i>														
*1	Damanganga ..	1,382	....	18	....	155	188.5	151.6	15,000	27.2	7.6	....	34.8	Surplus water of Damanganga to be diverted to Ulhas and Vaitarna Valleys. Deficit valleys i.e. valleys having no suitable storage sites even though estimated yield is more than requirement of water. †This includes 34.12 T.ha.m. of Bhivpuri Tail water.
*2	Vaitarna ..	3,647	5	12	51	324	488.7	229.5	74,105	129.5	100.0	....	229.5	
3	Ulhas ..	3,804	3	14	70	512	†647.22	276.6	82,703	154.5	151.4 and 296.0 (by 2025 AD)	....	305.9 and 450.5 (By 2025 AD)	
4	Rest of rivers ..	2,567	....	3	11	139	273.8	136.9	4,283	7.0	..	....	7.0	
Total of A ..		11,400	8	47	132	1,130	1,598.22 (564.41 TMC)	794.6	1,76,091	318.2	259.0 (By 2000 AD) 403.6 (By 2025 AD)	....	577.2 (By 2000 AD) 721.8 (By 2025 AD)	

ANNEXURE 3.1--contd.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B. District Raiḡad															
1	Patalganga	940	.....	4	23	70	*169.94	53.8	23,245	43.2	23.0	.....	66.2	Deficit valley. *169.94 T.h.a.m. includes 13.4 T.h.a.m. of Tail waters of Khopoli
2	Amba	740	.....	2	18	137	††117.9	38.6	18,485	22.5	15.6	.....	38.1	Deficit valley. ††117.9 includes 13.4 T.h.a.m. of Tail waters of Bhira diverted to Amba valley.
3	Kundalika	825	1	2	7	179	††198.3	53.5	9,368	11.2	4.8	.....	16.0	††68 T.h.a.m. diverted water of Bhira Tail Race for which account is given below in the notes. Surplus valley. Surplus valley.
*4	Savitri	2,899	.....	9	25	230	578.6	76.9	21,715	40.7	5.1	.....	45.8	Surplus valley.
5	Mhasala creek and rest of rivers.	1,505	.....	2	25	138	241.1	9.6	7,106	5.5	4.1	.....	9.6	
Total of B		6,905	1	19	98	744	1,306.24 (461.29 TMC)	232.4	79,919	123.1	52.6	.....	175.7	
C. District Ratnagiri															
1	Bharja	283	2	74	16.4	4.4	1,009	1.28	1.4	2.68	Surplus valley.
2	Vashisti ward diversion from Koyna)	2,238	.....	11	49	190	640.23**	270.4	13,974	29.14	6.4	44.00	79.54	**This includes 191.13 T.h.a.m. of Tail waters of Koyna.
3	Shastri	2,174	.....	6	7	233	449.6	45.8	7,925	24.7	6.0	.....	30.7	Surplus valley.
4	Kajavi	762	.....	2	6	125	96.2	27.0	2,402	5.0	1.6	.....	6.6	Do.
5	Muchkundi	833	.....	4	25	129	117.4	87.7	7,268	12.9	1.5	.....	14.4	Do.
6	Kodavali (Rajapur)	665	.....	5	21	121	98.1	118.9	9,324	16.2	1.9	.....	18.1	Do.
*7	Waghoran	903	.....	6	13	86	140.2	76.0	13,122	27.2	0.7	.....	27.9	Do.
*8	Kharada (Deogad)	455	.....	2	8	79	58.9	41.6	6,489	15.2	1.6	.....	17.6	Do.

*9 Gad	..	891	....	4	16	76	154.20	75.5	13,684	27.0	1.7	....	28.7	Do.
*10 Karli	..	753	1	1	15	73	116.9	58.5	19,705	37.7	1.7	5.60	45.00	Surplus valley.
11 Terekhol	..	631	..	3	8	26	118.0	36.2	5,711	12.50	1.6	..	14.1	Do.
*12 Tillari	..	530	1	..	2	45	105.2	102.0	7,279	61.3†	0.7	..	62.0	Do.
13 Achra and Rest of the rivers.		1,625	..	3	15	10	258.05	20.1	3,230	5.80	1.3	..	7.10	
Total ' of C '		12,743	2	46	187	1,267	2369.38 i.e 836.74 TMC.	944.1	1,11,122.	275.62	29.0	49.60	354.22	
Total of A+B+C		31,053	11	112	417	3,141	5273.84 (1,862.44 TMC)	1,971.1	3,67,132	716.92	340.6	49.60	1,107.12 +118.0	Add for tail waters of 6 Hydro Projects(**) for which no further reuse has been planned.
														1,225.12 i.e. 432.65 TMC (by 2,000 AD)
														1,369.72 i.s. 483.72 TMC (by 2,025 AD)

†Includes allocation of 45 Th.a.m.to Goa from the Inter-State Tillari Irrigation Project but irrigation potential shown is the share of Maharashtra only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
Total irrigation and multipurpose projects which include irrigation																	
7 96 417 3,141 Non Irrigation Projects excluded are :																	
Major (4 Nos.) Medium (16 Nos.) Hydro																	
<table style="width:100%; border:none;"> <tr> <td style="width:33%; border:none;"> Tansa Upper Vaitarna Lower Vaitarna Barvi </td> <td style="width:33%; border:none;"> 6 in District Nasik in Damanganga valley Lendi } in Damanganga valley. Wagh } Momri } in Ulhas valley Aure } Middle Vaitarna in Vaitarna valley Gargai in Vaitarna valley. </td> <td style="width:33%; border:none;"> Latghar Choli Chora-wane. Vadgaon </td> </tr> </table>															Tansa Upper Vaitarna Lower Vaitarna Barvi	6 in District Nasik in Damanganga valley Lendi } in Damanganga valley. Wagh } Momri } in Ulhas valley Aure } Middle Vaitarna in Vaitarna valley Gargai in Vaitarna valley.	Latghar Choli Chora-wane. Vadgaon
Tansa Upper Vaitarna Lower Vaitarna Barvi	6 in District Nasik in Damanganga valley Lendi } in Damanganga valley. Wagh } Momri } in Ulhas valley Aure } Middle Vaitarna in Vaitarna valley Gargai in Vaitarna valley.	Latghar Choli Chora-wane. Vadgaon															
In Vashisti Valley.																	

Note:—*(1) This includes water potential of parts of—

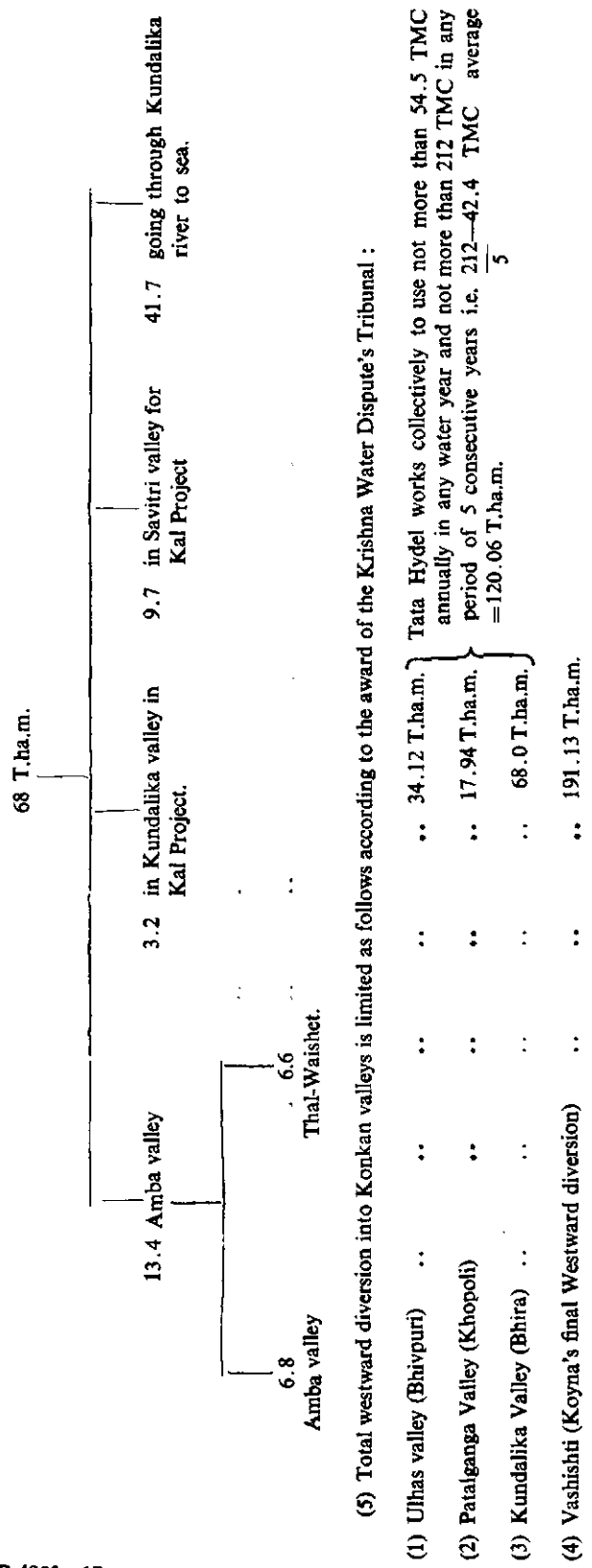
- (i) Damanganga valley area which contains 944 km² area of District Nasik.
- (ii) Vaitarna valley area which contains 228 km² area of District Nasik.
- (iii) Savitri valley area which contains 80 km. area of District Pune and 306 Km² area of District Ratnagiri.
- (iv) Waghotean valley contains 280 km.² area of Gaganbawada Taluka, District Kolhapur.
- (v), Deogad valley contains 60 km² area of Gaganbawada Taluka, District Kolhapur.
- (vi) Gad valley includes 25 km² of Bhudhargad Taluka, District Kolhapur.
- (vii) Kartli valley includes 25 km² area of Bhudhargad Taluka, District Kolhapur.
- (viii) Tillari valley area of which contains 210 km² area of District Kolhapur.

(2) 591 km.² area of District Ratnagiri lies in the east flowing Hiranyakeshi catchment in Kolhapur District—Hence Konkan area =

$$\begin{array}{r}
 \text{Thane} \quad + \quad \text{Raigad} \quad + \quad \text{Ratnagiri} \\
 9,553 \quad + \quad 7,198 \quad + \quad 13,040 \\
 = 29,791 \text{ km}^2 \quad \text{Total area of valley in Konkan} \\
 \left\{ \begin{array}{l} \text{Nasik} \quad + \quad \text{Pune} \quad + \quad \text{Kolhapur} \\ (944+228) \quad + \quad 80 \text{ km}^2 \quad + \quad 600 \text{ m.} \end{array} \right\} + \quad 591 \text{ km. of Ratnagiri} \\
 = 31,052 \text{ km}^2 \quad - \quad \text{contributing to Hiranyakeshi} \\
 \qquad \qquad \qquad = 31,052 - 1,852 + 591 \\
 \qquad \qquad \qquad = 29,791 \text{ km}^2
 \end{array}$$

(3) Some of the rivers/rivulets directly meet the sea. Such rivers/ rivulets are grouped together as rest of the rivers in Thane District. The other rivers' contribution is grouped under Mhasala creek in District Raigad. In Ratnagiri district all the rest of the rivers are grouped with Achra valley.

(4) The distribution of Tail waters of Bhira Power House (coming from Mulshi lake in District Pune) let out in Kundalika valley is as follows :—



(5) Total westward diversion into Konkan valleys is limited as follows according to the award of the Krishna Water Dispute's Tribunal :

(6) Basis of computations

(i) Yields have been worked out by the following formulae.
In Thane and Raigad Districts as follows :—

Typical Catchment

	Catchment Characteristics		Rainfall Runoff relationship R = Annual runoff (inches) P = Annual rainfall (inches)
	Average slopes and drainage (Per cent)	Range of annual rainfall	
1 Tansa	5	100" to 110"	R=0.814 P=14".
2 Bhatsa at Khadavali	6	100" to 130"	R=1.20 P=47.24".

3	Kalu at Khapri	..	..	9	Moderate forest	130" to 200 "	R=0.6346 P—10.34 "
4	Bhalsa at Sajivali	..	..	14	Thick forest	110 " to 175 "	R=0.7356 P—12 "

The above formulae have been given in the technical report on the water potential of Bombay Hydrometric Area—December 1977.—Prepared by Central Designs Organisation, Irrigation Department, Government of Maharashtra. Annual rainfall considered in above formula is the 75 per cent dependable rainfall.

(ii) For valleys in Raigad District, Tansa formula yields has been used and annual rainfall considered is the 75 per cent dependable rainfall.

(iii) For valleys in Ratnagiri district yields have been computed by Inglis Formulae Average Yield $P=0.85 R-12$ " (all units in inches). 75 per cent dependable yield is estimated at 0.75 of average yield.

(7) The Chemical industries can be located in surplus valleys such as in Kundalika valley in Raigad District and Vashishti, Shastri etc. i.e. all valleys south of Savitri valleys in District Raigad.

(8) Details of 118.0 T.h.a.m of Tail waters of Hydro Electric Projects with no further use of tail water planned at present are as follows :—

(**)	Gandhari valley Hydro Ele. Scheme by diverting Kal river waters	..	..	..	..	10.865
	Kumbhe Hydro Electric Scheme	..	..	..	..	1.875
	Twin Power House on Jagbudi river, Taluka Khed	..	..	..	..	4.247
	Bav Hydro Ele. Project	..	..	..	..	67.58
	Damanganga	..	..	..	..	16.90
	Par Hydro Electric Schemes	..	..	..	..	16.62

118.281 T.h.a.m.

i.e. 118.0 T.h.a.m, with no further use of tail waters planned at present.

ANNEXURE 3.2

Completed Irrigation Projects in Konkan

Serial No.	Name of Project	Storage Thom.	Irrigation Potential ha.	Estimated cost in Lakhs	Expenditure upto March 1981	Balance amount	Remarks
1.	2	3	4	5	6	7	8
Rs. in lakhs Rs. in lakhs							
I. MAJOR PROJECTS—							
	(A) <i>Thane District</i>	..	..	NIL	..	..	..
	(B) <i>Raigad District</i>	..	..	..	..	..	..
	Kal Project, Taluka Roha	..	21.109	7965	818.36	..	..
	(C) <i>Ratnagiri District</i>	..	..	NIL	..	..	..
	Total of Major Projects : A+B+C	..	21.109	7965	818.36	..	..
II. MEDIUM PROJECTS							
	..	..	..	NIL	..	..	..
III. MINOR PROJECTS—							
	(A) Thane (17 Nos.)	..	5.8076	3320	360.63	332.89	..
	(B) Raigad (27 Nos.)	..	8.8150	6978	597.36	364.36	..
	(C) Ratnagiri (25 Nos.)	..	4.5580	4160	313.87	326.30	..
	Total of A+B+C (69 Nos.)	..	19.1806	14458	1,271.86	1,023.55	..
IV. LOCAL SECTOR WORKS—							
	(A) Thane (104 Nos.)	..	2.283	2074	174.34	..	..
	(B) Raigad (197 Nos.)	..	3.918	3556	97.36	..	..
	(C) Ratnagiri (846 Nos.)	..	8.050	6606	145.12	..	..
	Total (1147 Nos.)	..	14.251	12736	416.82	..	..
	Total of I+II+III+IV	..	54.5406	35159	2,549.63	1,841.91	..

Note.—The storage of Local Sector Schemes in Raigad district is worked out on the basis of 2.4 ha. per Mcft. of Storage

ANNEXURE 3.3

Irrigation Projects under construction in Konkan

Serial No.	Name of the Project	Storage T.ha.m.	Irrigation potential ha.	Estimated cost in lakhs	Expenditure upto March 1981	Spillover cost	Remarks
		3	4	5	6	7	8
I. MAJOR PROJECTS—							
(A) Thane District—							
	1. Surya Project, Tal. Jawhar (including Kawdas pick-up-weir).	28.562	14700	2,573.50	1550.00	1,023.50	
	Total ..	28.562	14700	2,573.50	1550.00	1,023.50	
(B) Raigad District—							
	1. Amba Valley ..	*13.4	11210	1,419.02	380.11	1,038.91	*This utilisation in Amba valley is from Mulshi lake waters diverted westward through Tata's Bhira Power House and coming out as Tail waters in Kundalika river. 6.6 tham. of this diverted water is to be used for Thal Vaishet Project.
	Total ..	13.4	11210	1,419.02	380.11	1,038.91	
(C) Ratnagiri District—							
	1. Tillari Project ..	55.90	6254	904.10	....	904.10	Cost of Maharashtra State.
	Total ..	55.9	6254	904.10	....	904.10	
	Total for A+B+C ..	97.862	32164	4,896.62	1930.11	2,966.51	
II. MEDIUM PROJECTS—							
(A) Thane District—							
	1. Wandri Project Tal. Palghar	3.471	2044	341.73	167.53	174.20	Administratively approved. Regular works still to commence.
	2. Deherji Project ..	9.322	6333	1,152.25	....	1,152.25	
	3. Bhatsa Project ..	63.150	23006	6,537.82	2966.92	3,570.90	
	Total ..	75.943	31383	8,031.80	3134.45	4,897.35	

(B) Raigad District	..	..	..	..	..	..	..	..	..	NIL	
(C) Ratnagiri District—											
1. Natuwadi Project	..	..	3.330	2370	935.00	270.13	664.87				
2. Deogad Project	..	..	12.006	4512	1484.31	7.87	1500.44				
3. Gadgadi Project	..	..	2.475	996	287.31	0.26	287.05				
Total	..	..	17.811	7878	2,706.62	278.26	2,432.36				
Total for A+B+C	..	..	93.754	39261	10,738.42	3,472.71	7,349.71				

III. MINOR PROJECTS—

(A) Thane (21 Nos.)	..	..	4.835	3524	702.62	266.46	436.16				
(B) Raigad (14 Nos.)	..	..	4.625	2202	454.81	84.02	370.79				
(C) Ratnagiri (19 Nos.)	..	..	3.742	3036	458.98	229.70	204.48				
Total for A+B+C (54 Nos.)	..	..	13.202	8762	1,616.41	580.18	1,011.43				

IV. LOCAL SECTOR WORKS—

(A) Thane (86 Nos.)	..	..	2.133	2105	295.70	.....	.....		
(B) Raigad (20 Nos.)	..	..	0.661	714	92.37	.....	.....		
(C) Ratnagiri (207 Nos.)	..	..	2.440	2852	54.85	.....	.....		
Total (313 Nos.)	..	..	5.234	5671	442.92	.....	.....		
Total for I+II+III+IV	..	..	210.052	85878	17,694.37	5,923.00	21,643.87				

ANNEXURE 3.4

Shelf of Major, Medium and Minor Irrigation Projects (i.e. projects already approved or under processing for approval)

Serial No.	Name of the Project	Utilisation in Tham	Irrigation potential in Ha.	Estimated cost	Expenditure upto March 1981	Spillover cost	Remarks
1	2	3	4	5	6	7	8
I. MAJOR PROJECTS—							
A. Thane District—							
1	Pinjal Project, Taluka Jawhar	42.952	23600	4,211.00	....	4,211.00	
2	Kalu-Shai Complex	67.150	20400	6,715.00	....	6,715.00	
	Total	110.102	44000	10,926.00	....	10,926.00	
B. Raigad (Kulaba) District—							
	Nil			Nil			
C. Ratnagiri District—							
1	Talamba Project	35.428	17000	7,238.00	....	7,238.00	Administratively approved on 2nd February 1981.
	Total	35.428	17000	7,238.00	....	7,238.00	
	Total of A+B+C (3 Nos).	145.530	61000	18,164.00	....	18,164.00	
II. MEDIUM PROJECTS—							
A. Thane District—							
	Nil			Nil			
B. Raigad District—							
1	Poshir Project, Taluka Karjat	25.743	2860	3,637.00	0.93	3,636.07	
2	Hetawane Project, Taluka Pen	12.650	6753	1,536.00	....	1,536.00	Administrative approval received in January 1981
3	Chanera Project, Taluka Roha	2.700	2067	368.00	....	368.00	Adm. Approval received.
4	Sungadwadi, Taluka Khalapur	3.500	2640	529.00	....	529.00	
5	Chapgaon, Taluka Mahad	5.900	1880	412.00	....	412.00	
	Total—Raigad District	50.493	16200	6,482.00	0.93	6,481.07	

C. *Ratnagiri District*—

1	Dendonwadi, Taluka Kankavli	..	..	1.226	514	160.53	....	160.53	Adm. approved.
2	Dup, Taluka Khed	..	..	2.996	1336	521.32	....	521.32	—Do.—
3	Poynar, Taluka Khed	..	..	1.008	607	129.46	....	129.46	
4	Dhangarwadi, Taluka Sawantwadi	..	..	.. 710	405	188.63	....	188.63	
5	Gad, Taluka Sangmeshwar	..	..	1.268	1020	324.79	....	324.79	
6	Waki (Shelarwadi), Taluka Khed	..	..	1.555	846	324.95	....	324.95	
Total—Ratnagiri District		..	..	8.763	4728	1,649.68	....	1,649.68	
Total of A+B+C(11 Nos.)		..	..	59.256	20928	8,131.68	0.93	8,130.75	

III MINOR IRRIGATION PROJECTS—

(A) *Thane District*—

(i)	10 Nos.	..	..	2.770	2051	455.79	....	455.79	Administratively approved
(ii)	1 No.	..	..	0.223	268	44.29	....	44.29	Submitted to Government.
(iii)	2 Nos.	..	..	0.569	417	88.54	....	88.54	Being submitted to Government.
Total (i+ii+iii) 13 Nos.		..	..	3.562	2636	588.62	....	588.62	

(B) *Raigad District*—

(i)	15 Nos.	..	..	5.620	3687	1,076.60	....	1,076.60	Administratively approved.
(ii)	Nil	..	..	....	....	....	....	....
(iii)	2 Nos.	..	..	1.210	1080	249.27	....	249.27	To be submitted to Government.
Total (i+ii+iii) 17 Nos.		..	..	6.830	4767	1,325.17	....	1,325.17	

ANNEXURE 3.4—*contd.*

1	2	3	4	5	6	7	8
<i>(C) Ratnagiri District—</i>							
(i) 17 Nos.	4.062	2883	714.11	.... 714.11 Administratively approved
(ii) 8 Nos.	4.563	1929	480.79	.... 480.79 Submitted to Government.
(iii) 2 Nos.560	408	133.00	.... 133.00 Being submitted to Government.
Total (i+ii+iii) 27 Nos.		9.185	5220	1,327.90	.... 1,327.90
Total of A+B+C (57 Nos.)		19.577	12623	3,241.69	.... 3,241.69
Total of I+II+III		224.363	94551	29,537.37	0.93 29,536.44

ANNEXURE 3.5

Identified future major, medium and minor Irrigation Schemes in Konkan.

Serial No.	Name of project	Storage in T.h.a.m.	Irrigation in ha.
1	2	3	4
I. MAJOR PROJECTS—		Nil	
II. MEDIUM PROJECTS—			
A. Thane District—			
1	Tarangaon	4.928	2150
2	Hathipada	4.539	2113
3	Wagh	1.324	710
4	Domihira	2.629	1175
5	Lendi Nadi	1.283	695
6	Kholsapada	0.400	930
7	Waghirla	2.000	1220
8	Chikhli	11.700	6540
9	Chinchghar	6.200	3500
10	Kumbharkinala	1.200	.....
11	Lohape	2.600	830
12	Hatnavnala	1.900	1296
13	Susari	9.900	2830
14	Kaman	1.940	400
15	Kushirli	0.964	770
16	Monri	6.738	.....
17	Aure	4.730	.....
18	Sakhroli	2.038	1140
19	Konekvira	4.270	2400
20	Doiphodi	5.367	3000
21	Bhamckhori	10.280	5760
22	Brahmanwada	1.203	670
23	Kanvi	2.917	1000
24	Sutrakar	1.242	934
25	Sasvand	2.513	1410
Total of IIA		95.305	41473
B. Raigad District—			
1	Morbe	16.200	7000
2	Niphad	22.400	1932
3	Chimboda Jhahurwadi	7.305	3076
4	Sambar Kund	4.757	3085
5	Sakhar Bora	5.074	1732
6	Kothari	1.377	1344
7	Bhave	7.830	1927
8	Wagheri-Panderi	23.700	1968
9	Nivi	4.600	627
10	Shirwali	6.005	1509
11	Mhasala Bandhara	4.208	1862
12	Shilar	24.600	2450
13	Kondane	11.300	1294
14	Amba (diversion)	13.400	5668
15	Chanat	2.951	1225
16	Pali-Bhutavli	1.000	920
17	Varap	1.500	650
18	Amboli Nagshet	1.257	616
19	Nageshwari	1.381	810
		160.845	39995
		(Including diversion of Bhira 13.400)	

Serial No.	Name of Project	Storage in T. ha. m.	Irrigation in ha.
1	2	3	4
<i>C. Ratnagiri District—</i>			
1	Talere	1.453	546
2	Tarandale	0.797	324
3	Vilawada	1.064	405
4	Chikotri	1.762	769
5	Shiringhi	3.405	1470
6	Bardewadi	1.407	607
7	Asga	1.158	494
8	Hardakhala	1.204	482
9	Mandwe	2.282	1012
10	Mahamadwadi	13.565	8773
11	Aruna	7.730	3172
12	Chavanwadi	0.938	475
13	Kakyewadi	0.840	336
14	Kajvi	2.798	633
15	Bamnoli	3.081	890
16	Yelendowadi	1.982	870
17	Kudup	1.641	648
18	Virdi	2.288	335
19	Golwan	1.287	514
20	Munchkundi	2.882	1234
21	Dhakmoli (Sutarwadi)	1.904	810
22	Kenjale	4.193	1862
23	Sarambala	4.305	1214
24	Bhuibavada	2.375	950
25	Belamba	1.000	405
26	Sangulwadi	13.700	4480
27	Navle	2.670	1068
28	Chinchwali	1.445	578
29	Jamda (Sutarwadi)	3.500	2060
30	Diwalvadi	9.125	3650
31	Ambelkarwadk	0.257	103
32	Adivare	0.657	263
33	Sarjulwadi	1.762	725
34	Shakale	1.641	675
35	Kasahab	1.641	650
Total of C		117.449	43932
Total of A+B+C		373.599	125400
<i>III. MINOR IRRIGATION SCHEMES—</i>			
A. Thane District (81 Nos)		18.349	8934
B. Raigad District (40 Nos.)		9.628	4450
C. Ratnagiri District (116 Nos.)		30.159	12760
Total of A- B+C (237 Nos.)		58.136	26144
Grand total of I+II+III		431.735	151544

ANNEXURE 3.6

List Of Minor Irrigation Projects

(Refer plate 7)

THANE DISTRICT

Completed

1. Karalgaon
2. Khand
3. Mohokhurd
4. Wada
5. Pali
6. Sindhipada
7. Dongaste
8. Usgaon
9. Pelhar
10. Dolkhamb
11. Musai
12. Jambhe
13. Velholi
14. Jambhivali
15. Khandpe
16. Thakurwadi
17. Bhoj

Under Construction

1. Asvali
2. Galanpada
3. Deokop

4. Masvan
5. Mahim Kelva
6. Karvel
7. Asanas
8. Hattipada
9. Ghateghar
10. Dehe
11. Khoch
12. Sasunavhar
13. Kharade
14. Ushid
15. Dhasai
16. Jamburde
17. Raitale
18. Manor
19. Adivali
20. Titwala
21. Manivali

Proposed

1. Sagaon
2. Kamare
3. Tilher

4. Kholapada
5. Shenwa
6. Moj
7. Vasalipada
8. Utawale
10. Uparle
11. Nimbapur
12. Tilas Siddheswar
13. Nampada
14. Padle
15. Antad
16. Yave
17. Dahivali
18. Vadale Pimprona
19. Dhendyanala
20. Karvelpada
21. Chandip
22. Met Bandhara
23. Manekhind
24. Gonde

 Future Schemes .. 70 Nos.

Total .. 132 Nos.

RAIGAD DISTRICT

Completed

1. Salokh
2. Morbe
3. Kalundra
4. Bammoli
5. Antore
6. Ambeghar
7. Kharsundi
8. Donvat
9. Kalote Momashe
10. Bhilavale
11. Rajanala R.B.C.
12. Palipotat
13. Rajanala L.B.C.
14. Ghotwade
15. Dhokshet
16. Kavele
17. Unhere
18. Pali
19. Kondgaon
20. Muthvali
21. Sutarwadi
22. Nizampur
23. Khoturde
24. Birwadi

25. Parle Lohare
26. Pabhare
27. Ranivali

Under Construction

1. Avasare
2. Usaran
3. Sai
4. Shirgaon
5. Varap
6. Phansad
7. Nandla
8. Kudki
9. Karle
10. Vava
11. Sanderi
12. Khindwadi
13. Varandh
14. Panhalgar

Proposed

1. Ramraj Bandara
2. Unade
3. Kharsunde
4. Jambrung

5. Tara
6. Bamanpada
7. Belvede
8. Jirne
9. Kusagaon
10. Khaire
11. Alsunde
12. Kolthan
13. Mutholi
14. Ghotwal
15. Makti
16. Gavalwadi
17. Kharsai
18. Saygaon
19. Gudvan
20. Akulwadi
21. Bhorghar
22. Notodi
23. Tudil
24. Phanswadi
25. Khadpoli
26. Mandadi

 Future Schemes .. 31 Nos.

Total .. 98 Nos.

ANNEXURE 3.6—contd.

RATNAGIRI DISTRICT

<i>Completed</i>		
1. Shirvali	5. Kodoshi	16. Rajewadi
2. Bharni	6. Kalavande	17. Abre
3. Amdas	7. Malghar	18. Asurde
4. Phanaswadi	8. Kadavai	19. Pimpar
5. Ambetkhol	9. Gavhane	20. Kumbharwadi
6. Guhagar Talav	10. Beni	21. Nive
7. Kodivare Bandhara	11. Kelamba	22. Lanja
8. Telewadi	12. Harnai	23. Gothane
9. Shiposhi	13. Kumbharwadi	24. Gopalwadi
10. Vehl	14. Ozaram	25. Talgaon
11. Ozargaon	15. Otav	26. Khalgaon
12. Varavade	16. Pulas	27. Phanasgaon
13. Lore	17. Nileli	28. Davachiwadi
14. Harkul	18. Harkul	29. Digas
15. Konde	19. Barwardi	30. Balmawadi
16. Tawadewadi		31. Insuli
17. Pavshi	<i>Proposed</i>	
18. Hateri	1. Tide	32. Banda
19. Kudal Bandhara	2. Panderi	33. Talwade
20. Poip	3. Tadil	34. Dalanwadi
21. Adeli	4. Visapur	35. Mirlok
22. Mandkol	5. Waghivne	36. Sukholi
23. Amboli	6. Ranglat	37. Vaghavane
24. Shirwal	7. Shivthar	38. Chinchghanade
25. Shirgaon	8. Kurval	39. Koyna T. E. Utilisation
	9. Talvad	40. Sakhali Bandhara
	10. Sheldi	41. Khapgaon
	11. Kondivali	42. Beni L.I.S.
	12. Kavle	43. Sutarwadi
	13. Vaderu	44. Mirukhe
	14. Vashisti Kalva	
	15. Kanhe Veher	
<i>Under Construction</i>		
1. Chincholi		
2. Sondegghar		
3. Panchnadi		
4. Tangar		
		Future Schemes .. 99 Nos.
		Total .. 187 Nos.

ANNEXURE 3.7

Annual Financial requirements of Irrigation Works

	Major	Medium	Minor	Annual Requirement
	Rs.	Rs.	Rs.	Rs.
(A) Spill-over cost of under construction projects	2945 lakhs	2945 lakhs	1044 lakhs	
Total	6481 lakhs to be completed in 5 years.			13 crores.
(B) Cost of shelf of 60 M.I. Schemes	4155.75 lakhs to be completed in 4 years			10.40 crores
(C) Shelf of 5 Nos. Medium Projects in 6 years	6482.00 lakhs to be completed in 6 years			10.80 crores
(D) Shelf of 3 major projects	18263.91 lakhs to be completed in 10 years			18.26 crores
Hence total annual requirement of funds will be (A+B+C+D) i.e.				52.20 crores

ANNEXURE 3.8

Plan requirement of the identified Hydro-power project

(Figures in Rs. crores)

	Total funds required	Funds provided	Additional funds required
A. Continuing Schemes—			
I. During 6th Five Year Plan—			
(a) Tillari	19.41	17.88	1.53
(b) Bhira Tail race	29.99	29.99	....
Total	49.40	47.87	1.53
II. During 7th Five Year Plan—			
(a) Bhira Tail race	3.86	....	....
B. New Schemes proposed/under investigation—			
I. During 6th Five Year Plan—			
Bhatsa	5.72	....	....
Vaitarna Toe of Dam	0.95	....	....
Kal/Kumbhe etc.	5.46	....	....
Total	12.13	....	....
II. During 7th Five Year Plan	51.87	....	....
III. During 8th Five Year Plan	50.00	....	....
IV. During 9th Five Year Plan	46.00	....	....
Total	160.00	....	....

ANNEXURE 3.9

Tide Heights (Metres) along Konkan Coast

	Janu- ary	Febru- ary	March	April	May	June	July	August	Septe- mber	Octo- ber	Nov- mber	Decem- ber
Highest	4.84	4.83	4.84	4.91	4.91	5.00	4.90	4.74	4.58	4.81	5.01	5.09
Lowest	+0.30	+0.59	+0.33	-0.03	-0.16	-0.12	+0.05	+0.28	+0.33	-0.03	-0.21	-0.19
	4.54	4.24	4.51	4.94	5.07	5.12	4.85	4.46	4.25	4.84	5.23	5.28

Source.—Indian Tide Tables—Part-I, 1981.

Surveyor General of India, Dehradun.

ANNEXURE 3.10

Rural Water Supply Schemes for Konkan

(Population in lakhs)

	District			Total
	Thane	Raigad	Ratnagiri	
1. (a) Number of villages	4,927
(b) Rural population	43.88
2. (a) Number of difficult villages	2,676
(b) Population of difficult villages	29.05
3. (a) Piped Water Schemes completed	50
(b) Villages covered by the Schemes	294
(c) Population covered	2.568
4. (a) Piped water schemes in progress	69
(b) Villages covered by Schemes	305
(c) Population covered	4.62
5. (a) Future identified rural water supply schemes	628
(b) Population covered	9.86
6. Population of difficult valleys to be covered by wells	3.63
7. Population of simple valleys to be covered by simple water supply schemes (wells)	12.27

ANNEXURE 4.1

SCHEMES IN AGRICULTURE

A I. Schemes

- (1) Forest plantation in the top reaches.
- (2) Horticultural, fodder and energy plantation on the moderately sloping and privately owned lands.
- (3) Terracing of easy slopes (upto 10 per cent) adjacent to the valleys for cultivation.
- (4) Construction of water harvesting structures such as check dams, nala bunds, percolation trenches.
- (5) Construction of wells (excavation part only) and fitting them with manually operated pumping equipments.
- (6) Horticultural nursery of Dapchari.
- (7) Nurseries for Alphonso mango grafts.
- (8) Fodder research for superior quality forages.

II. Area of operation

The above schemes would be operated in 50 watershed blocks (Thane 15, Raigad 10 and Ratnagiri 25) of about 20 hectares each. Total area of 50 blocks would be 1,000 hectares.

III. Period of operation

The above scheme would be operated in the duration of successive four years.

IV. Financial outlay

The average cost of full range development would be Rs. 7,000 per hectare of which Rs 4,700 would be work cost and remaining Rs. 2,300 would be for overheads. The total financial outlay for developing 1,000 hectares would be Rs. 70 lakhs. The annual financial outlay would be as follows :—

Year						Financial outlay (Rs. in lakhs)
1	..	..	..	..	..	35.00 (50 per cent)
2	..	..	..	..	..	17.50 (25 per cent)
3	..	..	..	..	..	8.75 (12.5 per cent)
4	..	..	..	..	..	8.75 (12.5 per cent)

For the schemes 6,7 and 8 the capital outlay would be Rs. 39.70 lakhs and the recurring expenditure for 5 years would be Rs. 81.50 lakhs.

V. Employment generation

The mandays required for execution of the above schemes have been estimated at 1,600 mandays per hectare per annum. It will support about two families per hectare throughout the year. These 2,000 families would be engaged fully in this work throughout the year.

VI. Implementation agency

Department of Agriculture and Konkan Krishi Vidyapeeth.

B. In addition to the above schemes the Konkan Krishi Vidyapeeth has drawn up a scheme for the extension of Khar Land Research Station at Panvel (para 4.8.23). The financial requirements are as under :—

1. Recurring and non-recurring expenditure for 5 years Rs. 30 lakhs.
2. Requirement of 1981-82 Rs. 18 lakhs.

Implementing Agency : Konkan Krishi Vidyapeeth.

C. Pilot project for horticultural growth by sprinkler irrigation from the existing storages.

Requirement of 1981-82, Rs. 2.80 lakhs.

ANNEXURE 4.2

SCHEMES IN FORESTRY

I. Schemes

- (1) Establishment of demonstration plots:
 - (a) Tree farming.
 - (b) Silvi-horticulture.
 - (c) Silvi-pastoral.
 - (d) Trench-cum-mount fencing.
- (2) Establishing handicraft training centres.
- (3) Raising casuarina plantation along coast.
- (4) Medicinal plantations.
- (5) Rubber plantations.

II. Area of operations

The probable sites are Khardi, Jawhar, Tokawada and Gokhivare ranges in Thane District, Shrivardhan and Panvel ranges in Raigad and Kudal range in Ratnagiri District. Tree farming and silvi-pastoral plantation would be taken up in a compact block to cover a mini water-shed.

III. Period of operation

Period of operation is five years.

IV. Financial outlay

The financial outlay will be as under:

- (1) Establishment of demonstration plots under tree farming, silvi-horticulture, and silvi-pastoral:

	Rs.
(a) Tree farming over an area of about 60 hectares at Rs. 1,627 per hectare ..	97,620
(b) Silvi-horticulture over an area of about 60 hectares	1,62,020
	Rs.
(i) Mango 20 ha at Rs. 5,235	1,04,700
(ii) Cashew 20 ha at Rs. 1,433	28,660
(iii) Jackfruit and kokum 20 ha at Rs. 1,433	28,660
Total	1,62,020
(c) Silvi-pastoral over an area of about 30 ha at Rs. 1,032 per ha. ..	30,960
(d) Agave along the periphery around 120 ha i.e. about 5 kms at Rs. 4,656 per km (Tree farming plus silvi-horticulture).	23,280
(2) Establishment of training centre for carpentry, tool handles and wood works, one each in Raigad and Ratnagiri Districts.	6,74,000
(3) Casuarina plantation over 25 hectares in each district at Rs. 1,627 per hectare (25 × 1627 × 3).	1,22,025
(4) Medicinal plantations on 100 hectares	16,50,000
(5) Rubber plantation on 500 hectares	87,50,000
	1,15,09,905
Say ..	1,15,10,000

ANNEXURE 4.3

*SCHEME IN SERICULTURE***I. Schemes**

(1) Establishment of mulberry plantation for sericulture.

II. Area of operation

One centre of about 0.40 hectare in each district.

III. Period of operation

The programme would be operated in a period of three years.

IV. Financial outlay

	Rs.
(a) Planting of mulberry (unit of 0.40 hectares) at Rs. 1,800 per unit ..	5,400
(b) Rearing of silk worms at Rs. 1,800 per unit ..	5,400
(c) Cost of equipment at Rs. 2,000 per unit	6,000
Total ..	16,800
Say ..	17,000

V. Implementation agency

The scheme will be operated by Konkan Krishi Vidyapeeth.

ANNEXURE 4.4

SCHEME IN FISHERIES

I. Schemes

- (1) Establishing fish seed farms.
- (2) Introducing fish culture in long seasonal tanks.
- (3) Rehabilitation of fishermen and landless labourers.
- (4) Prawn and fish culture in brackish water.
- (5) Utilization of low value fish for manufacture of food products.
- (6) Establishing one Government fish seed farm.
- (7) Mussel culture and cage culture.

II. Area of operation

The schemewise area of operation is given below:—

Scheme No.	Area of operation
1.	10 hectares per district.
2.	80 to 90 units each of 2 hectares per district.
3.	6 to 7 units per district.
4.	One unit of 10 hectares per district.
5.	One unit either at Versova or Ratnagiri.
6.	One unit of 10 ha
7.	Mussel culture 50 ha. + 1000 cages (2 × 1 × 1 m) for cage culture.

III. Period of operation

3 to 5 years.

IV. Financial outlay

Scheme No.	Details	Cost (Rs. in lakhs)
1.	10 hectares per district at Rs. 3.45 lakhs per district ..	10.35
2.	Cost of 25 lakhs seeds 1.25	1.25
	Seed bank and services 1.50	1.50
	Cost of fish culture 5.00	5.00
		7.75
		7.75
3.	Cost of rehabilitating 20 units at Rs. 10,000 each ..	2.00
4.	Cost of watching and training of staff 15.00	15.00
	Cost of bunds, feeding 10.00	10.00
	Pond construction 10.00	10.00
	Building, laboratory etc. 5.00	5.00
		40.00
	Cost of 3 units ¹ 120.00	120.00
5.	One unit 2.50	2.50
6.	One unit of 10 hectares at Government level 80.00	80.00
7.	Mussel culture 50 ha + Cage culture 1000 cages	12.00
		234.60

IV. Implementation agency

The programme would be implemented by Department of Fisheries and CIFE (ICAR).

ANNEXURE 4.5

LIVE-STOCK POPULATION OF KONKAN REGION

Serial No.	Name of District	Cattle (cows and bulis)	Buffaloes	Sheep	Goat	Horses and ponies	Poultry	Other
1	2	3	4	5	6	7	8	9
1	Thane ..	5,16,197	1,25,157	1,206	1,39,883	1,312	8,36,858	9,738
2	Raigad ..	4,15,338	1,09,711	2,324	71,565	578	8,37,633	1,436
3	Ratnagiri ..	7,07,206	1,40,987	1,680	85,562	40	12,32,334	2,519
Total ..		16,38,741	3,75,855	5,210	2,97,010	1,930	29,06,825	13,693

Source.—1972 Cattle Census Report.

ANNEXURE 4.6

*SCHEMES IN ANIMAL HUSBANDRY***I. Schemes**

- (1) Mass training of farmers.
- (2) Organising work campaigns.
- (3) Establishment of mobile veterinary clinics.
- (4) Maintenance of premium bulls at Government cost.
- (5) Providing maintenance subsidy for crossbred females.
- (6) Distribution of milch animals.
- (7) Fodder demonstration plots.
- (8) Supply of cockerels.
- (9) Artificial insemination.

II. Area of operation

The above schemes would be operated in 10 blocks per district.

III. Period of operation

The period of operation would be 3 to 4 years.

IV. Financial outlay

	Rs.
(1) Mass training of farmers : Training one unit of 30 farmers from one block at Rs. 2,500 per unit. Training farmers from 30 units (2,500 × 30).	75,000
(2) Organising work campaigns : (For offering services like treatment for diseases and cost of medicines). 42 campaigns in 3 Districts.	42,000
(3) Establishment of mobile veterinary clinics (To control epidemics and mass propaganda of the animal husbandry development and to attend emergency calls). 3 clinics per district.	10,95,624
(4) Establishment of premium bulls (for upgrading local animals), 10 bulls per district. Cost of 30 bulls.	2,73,000
(5) Providing maintenance subsidy for cross-bred females, 1,000 cows per district ..	12,00,000
(6) Distribution of milch animals : 100 cows per district at Rs. 1,500 per cow (100 × 1,500 × 3).	4,50,000
(7) 150 Fodder demonstration plots : Plots of area about 0.10 hectare per district ..	56,250
(8) Supply of cockerels : 200 cockerels per district	7,500
(9) Providing artificial insemination facilities : 20 villages in each District	9,00,000
Total ..	40,99,374
Say ..	41,00,000

V. Implementing agencies

Schemes 2 to 8 will be operated by Department of Animal Husbandry and scheme 9 will be operated by Development Corporation of Konkan Ltd., in collaboration with Department of Animal Husbandry and through training of lay inseminators from amongst the beneficiaries with veterinary guidance from qualified technicians (on performance basis). The evaluation would be done after three years.

ANNEXURE 4.7

FINANCIAL REQUIREMENT OF THE TRAINING PROGRAMMES

(Rs. in lakhs)

	Outlay for VI. F.Y. Plan	Outlay for 1981-82
(A) Establishment of Krishi Vigyan Kendras in Raigad and Ratnagiri Districts (para 4.12.2)	54.00	18.00
(B) Creating Mobile training units in Thane, Raigad and Ratnagiri Districts (2 in each District) at Rs. 5 lakhs per unit (para 4.12.10)	30.00	10.00
(C) Manpower training programme for fisheries (para 4.12.11)	.. 80.00	20.00
(D) Education in ecological consciousness (para 4.12.12)	.. 14.00	4.50
(E) Strengthening of Lab to Land Programme (paras 4.12.5 & 4.12.6)	.. 7.50	7.50
Total ..	185.50	60.00

ANNEXURE No. 4. 8

Summary statement showing schemes with Total Financial Outlay in Sixth Plan Period and in 1981-82

Serial No.	Schemes	Implementing agency	Location	No. of units	Coverage per unit	Total financial outlay in Sixth Plan (Rs. in lakhs)	Financial outlay for 1981-82 (Rs. in lakhs)	Reference	
1	2	3	4	5	6	7	8	9	
A. Agriculture									
1	Forest plantation in the top reaches	Department of Agriculture	Thane	.. 15 blocks	.. 300 hectares	70.00	35.00	Annexure 4.1	
2	Horticulture, fodder and energy plantation.		Raigad	.. 10 blocks	.. 200 hectares				
3	Terracing of easy slopes		.. Ratnagiri	.. 25 blocks	.. 500 hectares				
4	Construction of check dams, nala bunds, etc.		..	..	..	
5	Construction of wells.		Thane	.. 1 block	.. 40 hectares				
6	Horticulture nursery at Dapchhari		Konkan Vidyapeeth	Thane	.. 1 block				.. 40 hectares
7	Nurseries for Alphanso mango grafts.	KKV	Thane, Raigad	.. 30 blocks	..	66.00	25.00	para 4.8.9	
8	Fodder Research for superior quality forages.	KKV	Ratnagiri	.. 1 block	.. 60 hectares	23.00	5.00	para 4.8.17	
9	Khar Land Research station at Panvel	KKV	Thane	..	..	30.00	8.00	para 4.8.23
10	Pilot Project for horticulture by sprinkler irrigation from the existing storages.	Department of Irrigation and Department of Agriculture.	Thane	.. 4 block	.. 10 hectares	2.80	2.80	para 4.8.5	
						Total ..	224.00	83.80	
B. Forest									
1	Tree farming	Department of Forest	Khardi, Jawhar Tokawada, Ghivare ranges of Thane District, Shrivardhan and Panvel in Raigad and Kudal range	..	..	0.97	0.71	
2	Silvi-horticulture	..	..	..	..	1.62	1.16	
3	Silvi-pastoral	..	..	3	20 hectares	0.31	0.24	Annexure 4.2
4	Trench-cum-mount fencing	..	..	..	..	0.24	0.23	
5	Establishment of Training centres	..	..	..	..	6.74	3.00	
6	Raising of casuarina along coast	..	..	..	..	1.22	0.90	

7	Medicinal plantation	..	in Ratnagiri District.	100 ha	16.50	5.00	..
8	Rubber plantation	..	..	500 ha	87.50	20.00	..
				Total ..	115.10	31.24	..
C. Sericulture							
	Establishing mulberry plantation for sericulture.	Konkan Vidyapeeth.	One centre in each district.	3	0.40 hectare	0.17	Annexure 4.3
D. Fisheries							
1	Establishment of fish seed farms	Department of fisheries.	Thane, Raigad and Ratnagiri Districts	3	10 hectares	10.35	3.40
2	Introducing fish culture in long seasonal tanks.	Do.	Do.	80 to 90 per district.	2 hectares	7.75	1.60
3	Rehabilitation of fishermen and landless labourers.	Do.	Do.	6 to 7 per district.	5 families per unit.	2.00	0.40
4	Prawn and fish culture in brackish water.	Do.	Do.	3	50 fishermen per unit	120.00	40.00
5	Utilisation of low value fish for food products.	Do.	Versova/Ratnagiri	1	..	2.50	2.50
6	Establishing one Government fish seed farm.	Do.	Thane, Raigad and Ratnagiri Districts	1	10 hectares	80.00	20.00
7	Mussel culture and cage culture	Do.	Do.	..	50 hectares + 1000 cages	12.00	4.00
				Total ..	234.60	71.90	..
E. Animal Husbandry							
1	Mass training of farmers	Department of Animal Husbandry	Thane, Raigad and Ratnagiri Districts	3	30 farmers in each unit	0.75	0.50
2	Organising work campaign	Do.	Do.	3	14 campaigns	0.42	0.10
3	Establishment of mobile veterinary clinics.	Do.	Do.	3	3 clinics	10.95	4.83
4	Establishment of premium bulls	Do.	Thane Raigad and Ratnagiri Districts.	3	10 bulls	2.73	1.38
5	Providing maintenance subsidy for crossbred females.	Do.	Do.	3	1,000 cows	12.0	..
6	Distribution of milch animals	Do.	Do.	3	100 animals	4.50	0.75
7	Fodder demonstration plots	Do.	Do.	150	0.10 hectare	0.56	0.188
8	Supply of cockerel	Do.	Do.	3	200 cockerels	0.075	0.025
9	Upgradation of local animal by artificial insemination.	Development Corporation of Konkan Ltd.	Do.	3	20 villages	9.00	0.75
				Total ..	41.00	8.52	..

Annexure 4.6

ANNEXURE No. 4.8—*contd.*

1	2	3	4	5	6	7	8	9
F Integrated Programme by Voluntary agencies.				9		108.00	27.00	para 4.10.2
G Environmental Protection								
1	Survey for Biosphere Reserves	Forest Department	Matheran, Mahabaleshwar and Koyna area.	3		3.00	1.00	para 4.11.2
2	Marine National Park	National Institute of Oceanography	Malwan	1	..	25.00	10.00	para 4.11.3
						Total ..	28.00	11.00
H Training Programmes								
1	Krishi Vigyan Kendra	Agriculture Department	Raigad and Ratnagiri Districts.	2	....	54.00	18.00	Annexure 4.7
2	Mobile Training Units	Do.	Thane, Raigad and Ratnagiri Districts.	6	....	30.00	10.00	
3	Manpower training for fisheries	CIEF and Fisheries Department of Maharashtra Government.	Greater Bombay	1	....	80.00	20.00	
4	Education in Ecological Consciousness	Education Department and KKV	Thane, Raigad and Ratnagiri Districts.	....	....	14.00	4.50	
5	Strengthening of Lab to Land Programme	KKV	Do.	....	....	7.50	7.50	
						Total ..	185.50	60.00

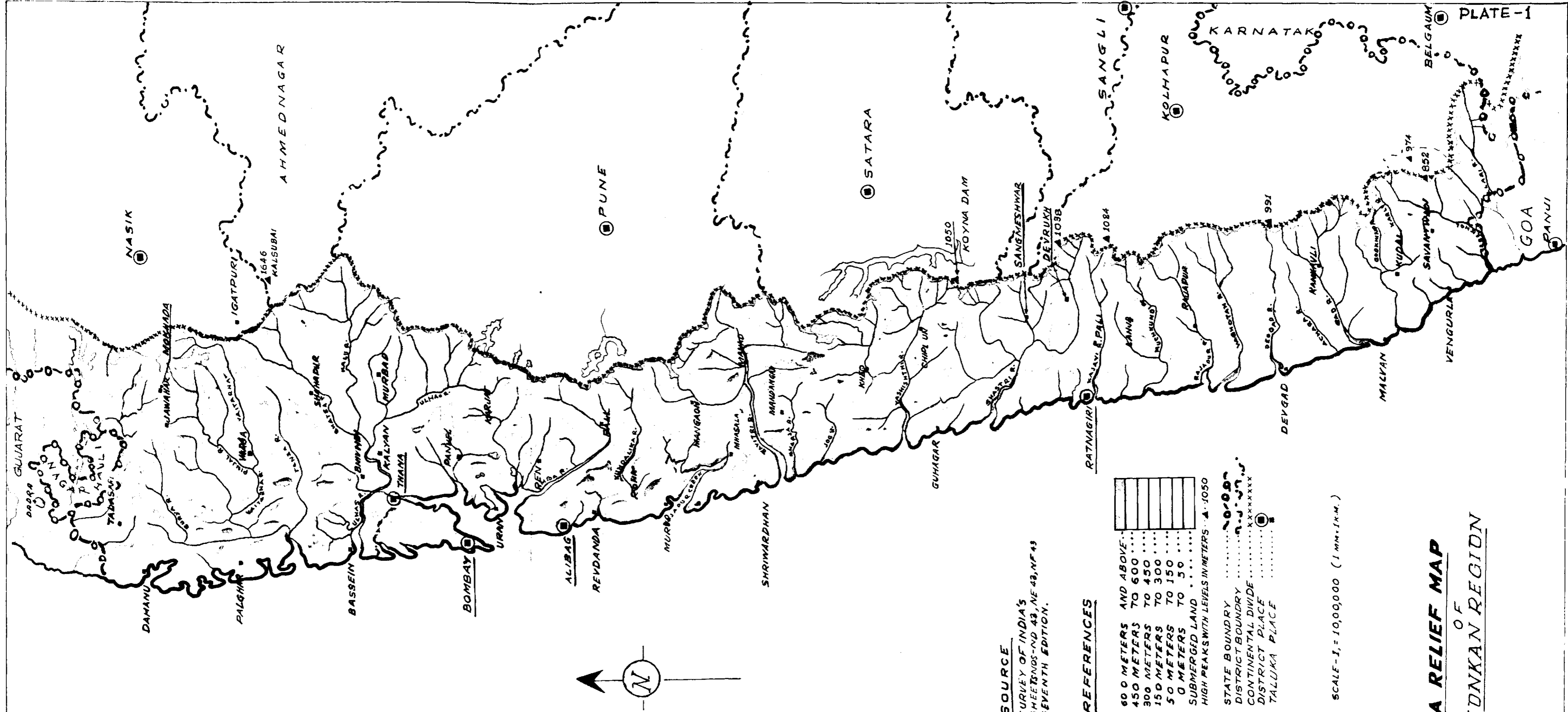
ERRATA

Page No.	Para	Line	As Printed	As required
1	2	3	4	5
2	7	3	consisted	consists
2	9	6	, at whose	, whose
3	2.2.1	5	19,00,583	19,90,583
6	2.4.1 (iii)	8	25 ml	80°
7	2.4.7	14	persued	pursued
8	2.6.1	6	1,30,400	13,04,400
9	2.7.2	8	increased	increased
9	2.7.3	2	Darying	varying
9	2.7.6	3	(Raigad, Thane	(Raigad, Thane)
10	2.7.8	3	seepage	seepage
10	2.8.1	2	crooks	creeks
10	2.8.1	3	326	311.19
10	2.8.2	7	rain off	runoff
11	2.9.6	4	perosity	porosity
11	2.9.6	5	isotop	isotope
14	2.12.2	2	Beside this	Beside this,
14	2.13.3	8	strengthened	strengthened
15	2.13.4	4	indentified	identified
15	2.14.1	1	creeks	creeks
15	2.14.1	6	145.65	149.23
15	2.14.1	7	covoring	covering
15	2.14.1	8	hactares	hectares
15	2.14.2	4	hectares	hectare
15	2.14.2	5	hectares	hectare
15	2.14.3	2	boing	being
15	2.14.3	4	additional	additional
15	2.15	1	Irrigation	Irrigation
16	2.15.2	5	disrtictwise	districtwise
16	2.15.3	2	364.54	264.54
16	2.15.3	2	project	projects
16	2.16.1	2	840 MW	860 MW
16	2.16.1	4	326.9	311.19
17	2.17.5	1	MBRDA	BMRDA
17	2.17.5	2	indicates	indicate
20	2.20.5	23	folder	fodder
24	2.20.20	1	Organisation	Organisations
25	3.1.2	6	18.28	15.28
26	3.2.3	2	51	54.54
26	3.3.2	1	principle	principal
28	3.5.2	9	persons	person
30	3.9.3	5	Project	Projects
31	3.9.8	6	a special	special
31	3.10.1	1	Maharashtra	Maharashtra,
31	3.10.1	1	Six	six
31	3.10.3	5	aracanut	arecanut
32	3.10.8	2	perview	purview
33	3.10.9 (i)	3	Seasmum	Sesame
33	3.10.10	7	conditions cropping	conditions, cropping
33	3.10.10	8	constraints	constraints,
33	3.10.11	7	as	at

ERRATA

Page No. 1	Para 2		Line 3	As Printed 4		As required 5
35	3.11.2	..	2	reaches	..	reaches :
35	3.11.3	..	5	Inglish	..	Inglis
36	3.11.4	..	last	principle	..	principal
37	3.11.8	..	2	station	..	stations
40	3.13.1	..	6	3.8	..	3.9
42	3.18.1	..	4	wall	..	well
43	3.19.2	..	2	Insustrial	..	Industrial
46	4.3.3	..	2	buffalow	..	buffalo
47	4.4.3	..	5	entegrated	..	integrated
48	4.6.1	..	9	terms	..	term
53	4.8.21	..	5	are	..	is
54	4.8.23	..	4	Vidyapeet	..	Vidyapeeth
55	4.8.28	..	1	spearate	..	separate
55	4.8.28	..	3	greately	..	greatly
56	4.11.1	..	1	Kokan	..	Konkan
57	4.11.4	..	7	fromations	..	formations
58	4.12.6	..	4-5	popularizing	..	popularising
59	4.12.11	..	6	farms	..	farms,
60	4.12.14	..	4	afforestation	..	afforestation,
62	4.14.6	..	3	peoples	..	people
63	4.16.1	..	9	blcok	..	block
63	4.16.4	..	5	easily	..	early
63	4.16.8	..	6	advice	..	advise

MAPS



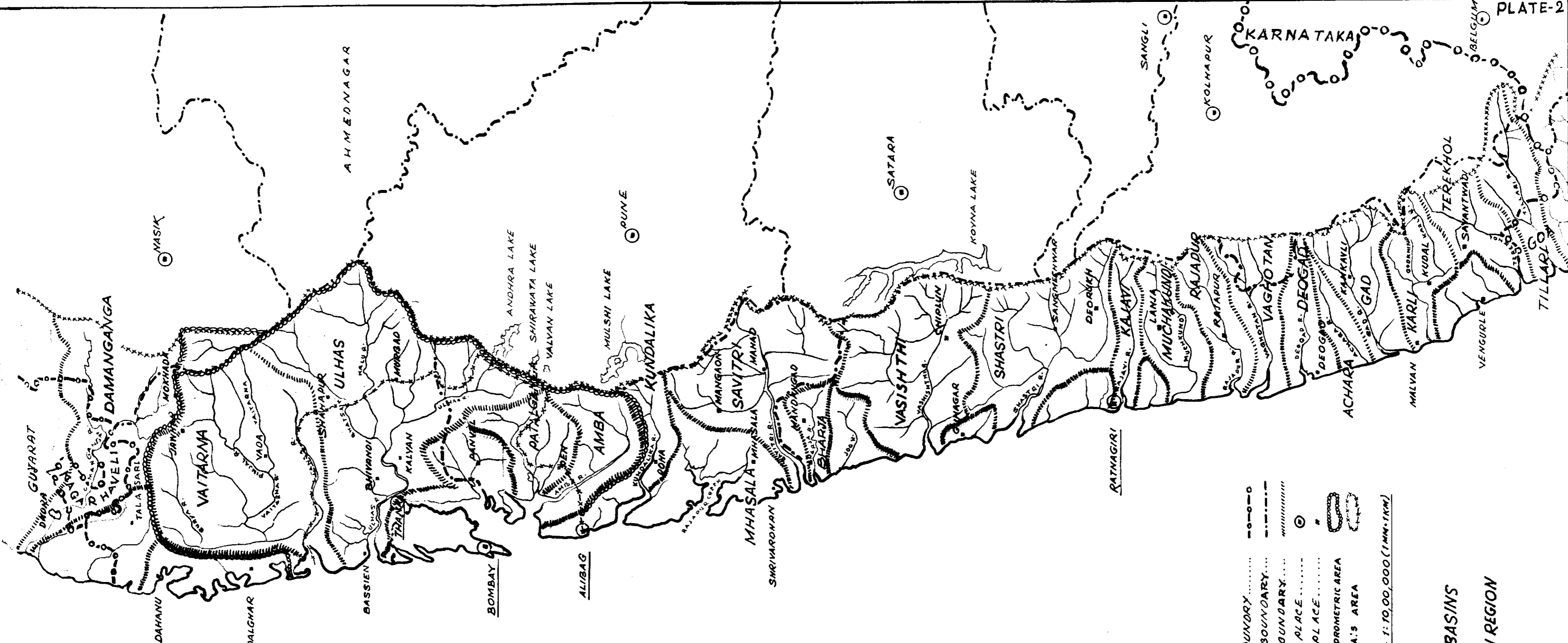
SOURCE
 SURVEY OF INDIA'S
 SHEETS NO 43, NE 43, NF 43
 SEVENTH EDITION.

REFERENCES

- 600 METERS AND ABOVE
- 450 METERS TO 600
- 300 METERS TO 450
- 150 METERS TO 300
- 50 METERS TO 150
- 0 METERS TO 50
- SUBMERGED LAND
- HIGH PEAKS WITH LEVELS IN METERS
- STATE BOUNDARY
- DISTRICT BOUNDARY
- CONTINENTAL DIVIDE
- DISTRICT PLACE
- TALUKA PLACE

SCALE - 1:10,00,000 (1 MM = 1 KM.)

**A RELIEF MAP
 OF
 KONKAN REGION**

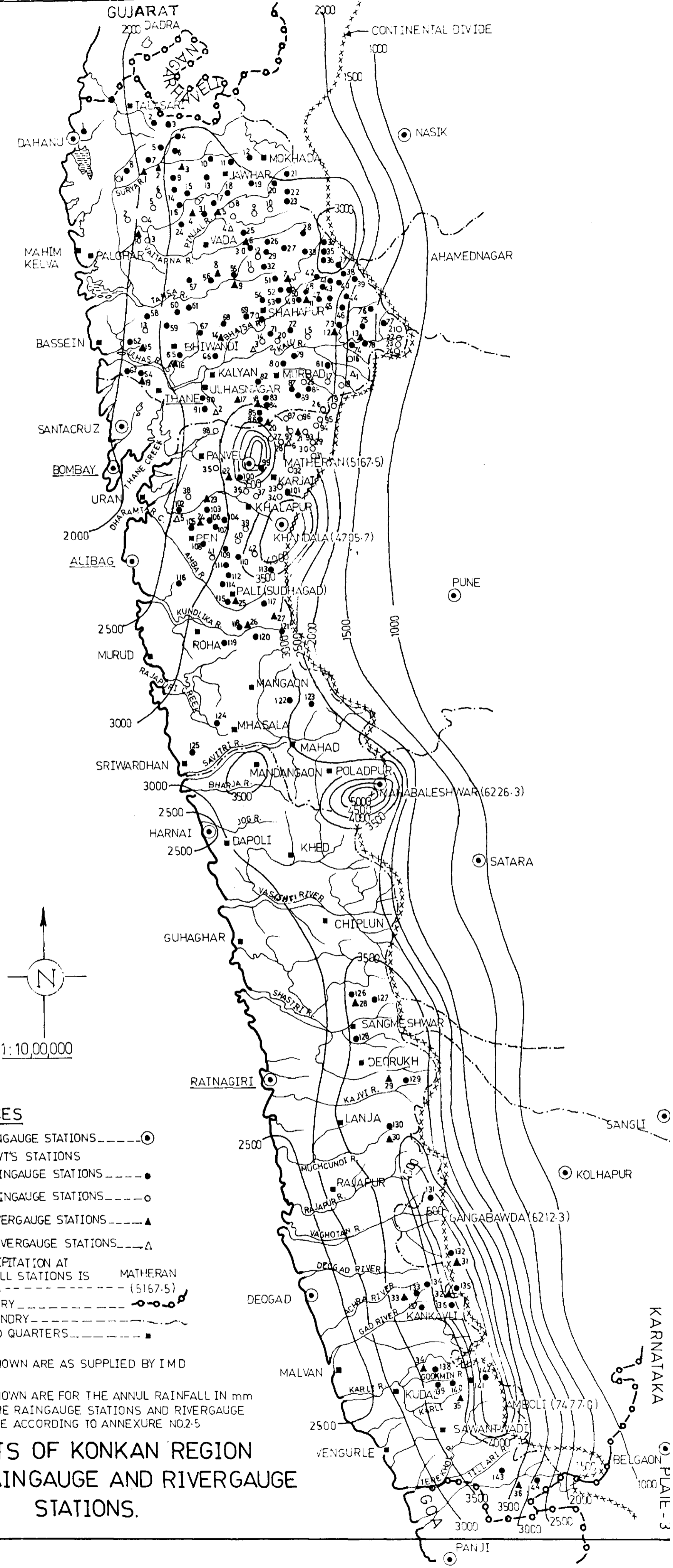


REFERENCES

- 1 STATE BOUNDARY.....
- 2 DISTRICT BOUNDARY.....
- 3 BASIN BOUNDARY.....
- 4 DISTRICT PLACE.....
- 5 TALUKA PLACE.....
- 6 BOMBAY HYDROMETRIC AREA.....
- 7. B. M. R. D. A.'S AREA.....

SCALE: 1:10,00,000 (1 CM.=10 KM.)

RIVER BASINS IN KONKAN REGION



REFERENCES

- (A) IMD RAINGAUGE STATIONS -----○
- (B) STATE GOVT'S STATIONS
EXISTING RAINGAUGE STATIONS -----●
- PROPOSED RAINGAUGE STATIONS -----○
- EXISTING RIVERGAUGE STATIONS -----▲
- PROPOSED RIVERGAUGE STATIONS -----△

ANNUL PRECIPITATION AT HIGH RAINFALL STATIONS IS MATHERAN (5167.5) SHOWN THUS -----○

STATE BOUNDRY -----○-○-○

DISTRICT BOUNDRY -----○-○-○

TALUKA HEAD QUARTERS -----■

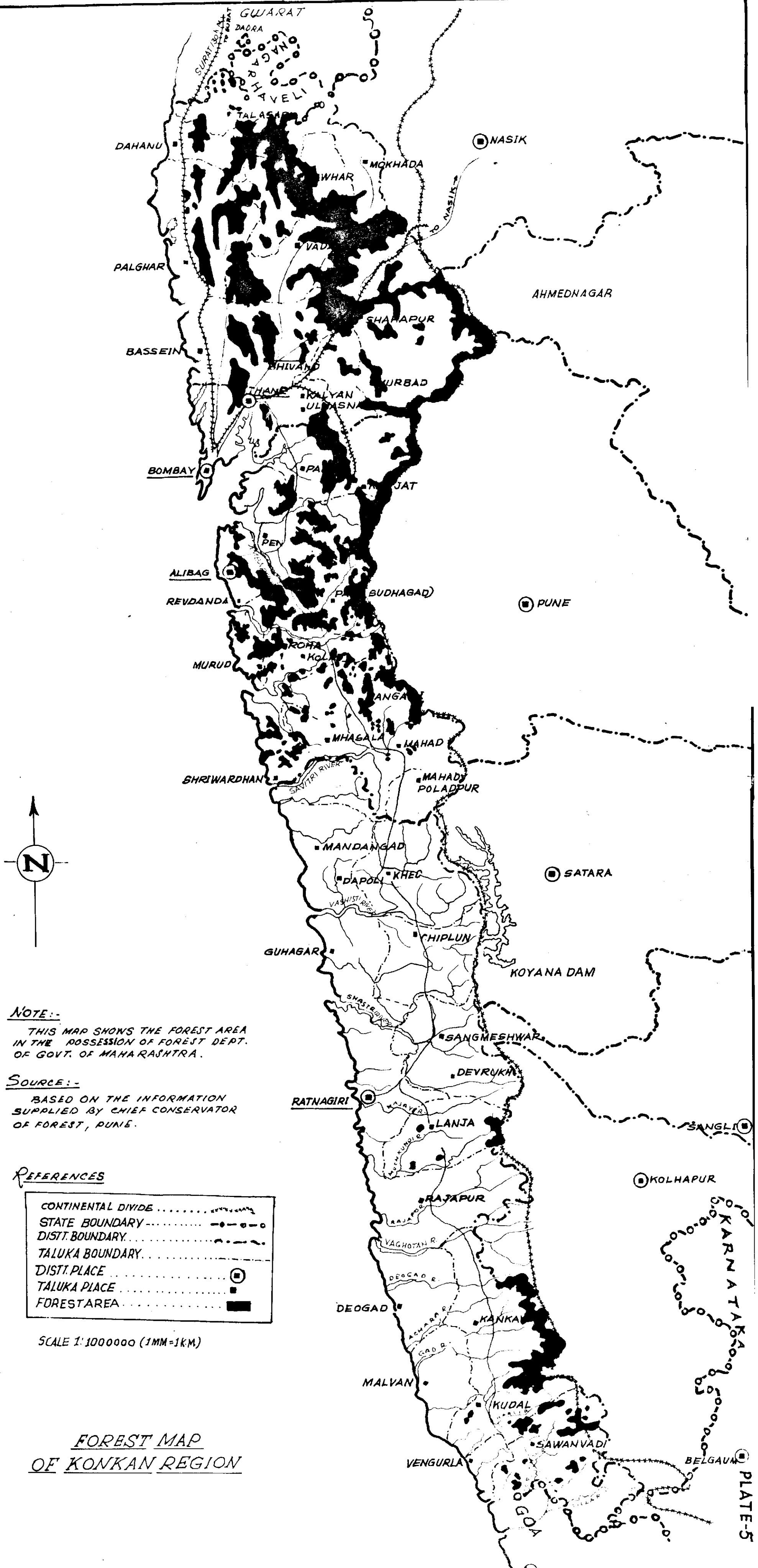
SOURCE

ISOHYETS SHOWN ARE AS SUPPLIED BY IMD

NOTES

ISOHYETS SHOWN ARE FOR THE ANNUL RAINFALL IN mm
SR.NOS. OF THE RAINGAUGE STATIONS AND RIVERGAUGE STATIONS ARE ACCORDING TO ANNEXURE NO.2-5

ISOHYETS OF KONKAN REGION WITH RAINGAUGE AND RIVERGAUGE STATIONS.



NOTE:-

THIS MAP SHOWS THE FOREST AREA IN THE POSSESSION OF FOREST DEPT. OF GOVT. OF MAHARASHTRA.

SOURCE:-

BASED ON THE INFORMATION SUPPLIED BY CHIEF CONSERVATOR OF FOREST, PUNE.

REFERENCES

CONTINENTAL DIVIDE	.....
STATE BOUNDARY	-----o-----o-----
DISTT. BOUNDARY	-----o-----o-----
TALUKA BOUNDARY	-----o-----o-----
DISTT. PLACE	□
TALUKA PLACE	■
FOREST AREA	■

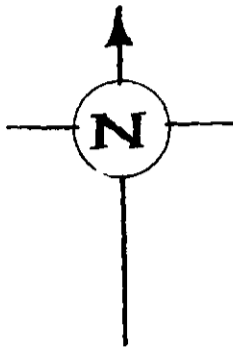
SCALE 1:1000000 (1MM=1KM)

FOREST MAP OF KONKAN REGION

LIST OF HOT SPRINGS

KOKNERE	10	VADAVLI
PODUSPODA	11	UNHARVE
HALOLI	12	KHED
SATIVALI	13	UNHARA (KHED)
VAGRESHWARI	14	ARAVALLI
GANESHPURI	15	TURAL
AKLOLI	16	RATVADI
PALI	17	SANGAMESWAR
SOV	18	MATH
	19	RAJAPUR

LOCATION OF HOT SPRING



INDEX MINERALS

- ★ ASBESTOS
- ⊙ BAUXITE
- ⊕ BARYTES
- ⊙ CHROMITE
- ⊕ CLAY
- ⊙ COPPER
- ⊕ FELSPAR
- ⊙ ILMENITE
- ⊙ IRON ORE
- ⊕ LIMESTONE
- ⊕ MANGANESE
- ⊕ MICA
- ⊙ SAND
- ⊕ STEATITE

INDEX GEOLOGICAL

- LATERITE - PLEISTOCENE
- DECCAN TRAP-UPPER CRETACEOUS TO LOWER EOCENE
- KALADGIS, PAKHAL, SULLAVAI
- GNEISS, GRANITE IN DHARWAR
- DHARWAR GROUP (SOUTH) RATNAGIRI
- PRECAMBRIAN
- ▬ DYKES

SOURCES :

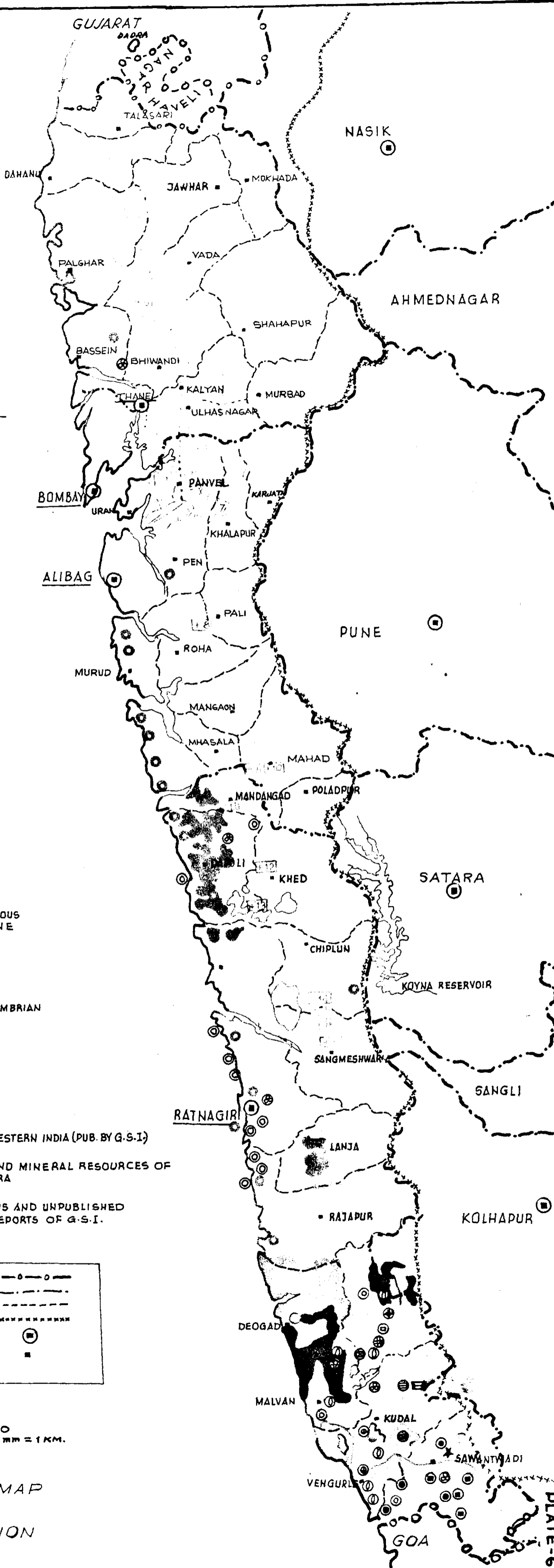
- J. B. AUDEN 1949: DYKES IN WESTERN INDIA (PUB. BY G.S.I.)
- GOVT. OF MAH. (D.G.M.) 1975: GEOLOGY AND MINERAL RESOURCES OF MAHARASHTRA
- G. S. I. : PUBLICATIONS AND UNPUBLISHED PROGRESS REPORTS OF G.S.I.

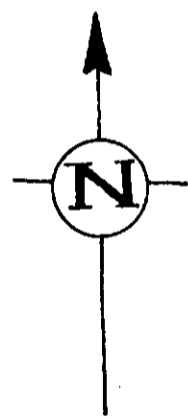
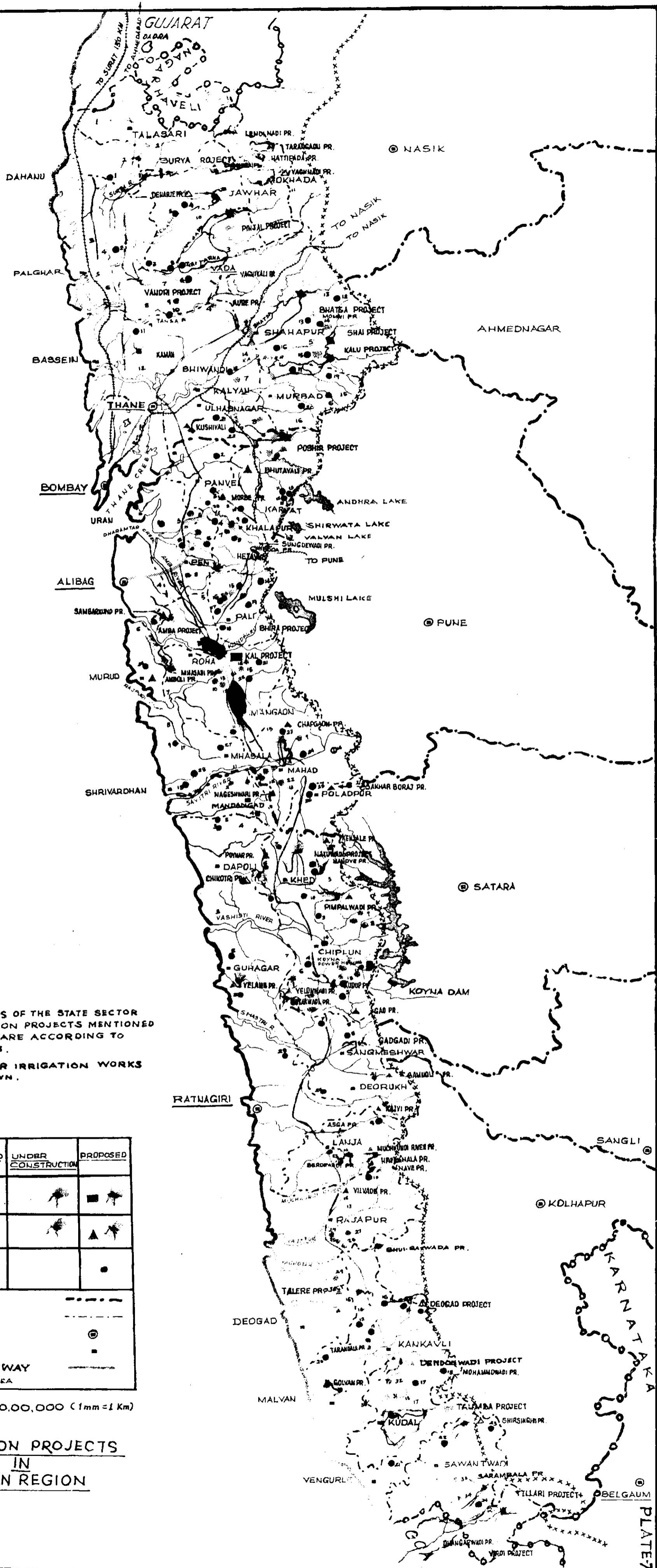
REFERENCES :

STATE BOUNDARY	.....	—o—o—
DISTRICT BOUNDARY	.....	— · — · —
TALUKA BOUNDARY	.....	— · — · —
CONTINENTAL DEVIDE	.....	*****
DISTRICT PLACE	.....	⊙
TALUKA PLACE	.....	■

SCALE : 1 : 10,00,000
OR 1 cm = 1 km.

GEOLOGICAL MAP OF KONKAN REGION





NOTE
 SERIAL NUMBERS OF THE STATE SECTOR MINOR IRRIGATION PROJECTS MENTIONED ON THIS PLATE ARE ACCORDING TO ANNEXURE No.3.
 LOCAL SECTOR IRRIGATION WORKS ARE NOT SHOWN.

REFERENCES:-

WORKS	COMPLETED	UNDER CONSTRUCTION	PROPOSED
MAJOR	■	▲	□
MEDIUM	▲	●	△
MINOR	●		●
DIST. BOUNDARY			
TALUKA BOUNDARY			
DIST. PLACE			
TALUKA PLACE			
NATIONAL HIGHWAY			
B.M.R.D.-A'S AREA			

SCALE : 1:10,00,000 (1mm=1 Km)

**IRRIGATION PROJECTS
 IN
 KONKAN REGION**

HYDRO POWER AREA	THEORETICAL FIRM POWER POTENTIAL IN MW
A	85 MW
B	35 MW
C	20 MW
	140 MW

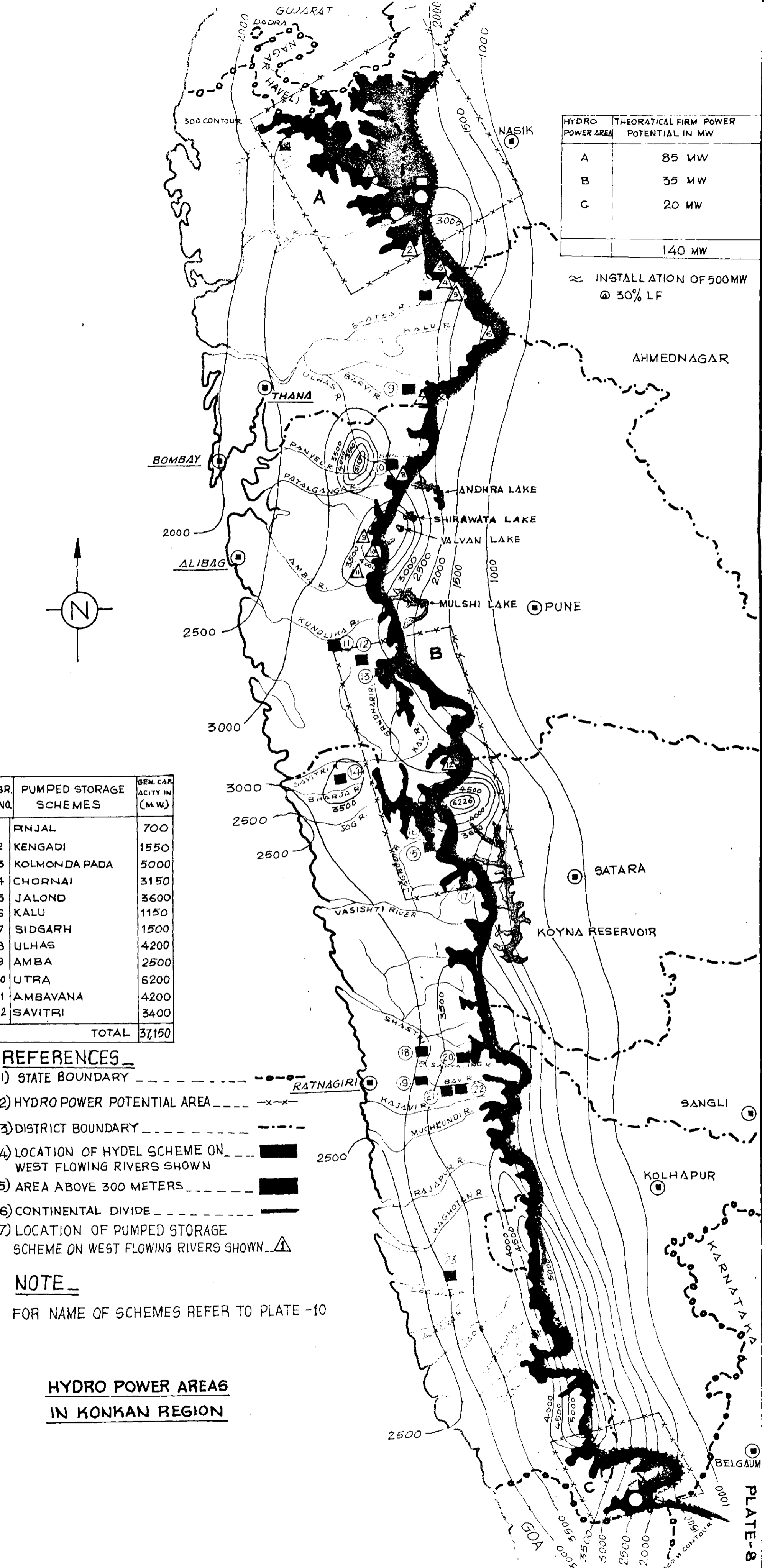
≈ INSTALLATION OF 500MW @ 30% LF

SR. NO.	PUMPED STORAGE SCHEMES	GEN. CAPACITY IN (M.W.)
1	PINJAL	700
2	KENGADI	1550
3	KOLMONDA PADA	5000
4	CHORNAI	3150
5	JALOND	3600
6	KALU	1150
7	SIDGARH	1500
8	ULHAS	4200
9	AMBA	2500
10	UTRA	6200
11	AMBAYANA	4200
12	SAVITRI	3400
TOTAL		37,150

- REFERENCES**
- 1) STATE BOUNDARY - - - - -
 - 2) HYDRO POWER POTENTIAL AREA - x-x-x-
 - 3) DISTRICT BOUNDARY - - - - -
 - 4) LOCATION OF HYDEL SCHEME ON WEST FLOWING RIVERS SHOWN - - - - -
 - 5) AREA ABOVE 300 METERS - - - - -
 - 6) CONTINENTAL DIVIDE - - - - -
 - 7) LOCATION OF PUMPED STORAGE SCHEME ON WEST FLOWING RIVERS SHOWN - Δ

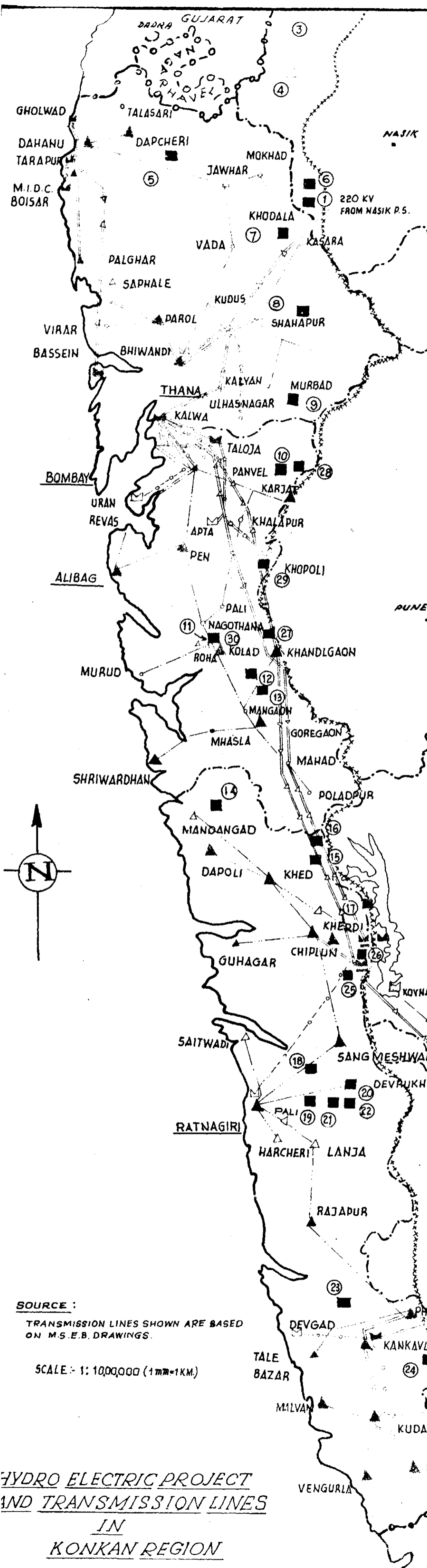
NOTE
FOR NAME OF SCHEMES REFER TO PLATE -10

HYDRO POWER AREAS IN KONKAN REGION



SCHEMES ON WEST FLOWING RIVERS

SR. NO.	NAME OF H.E. PROJECT	CAPACITY
1	VAITARNA I EXISTING ■	60 MW
	VAITARNA II SANCTIONED ■	60 MW
2	TILLARI III PROPOSED/UNDER INVESTIGATION ■	60 MW
3	PAR	18 MW*
4	DAMANGANGA	32 MW*
5	SURYA	10 MW
6	VAITARNA TOE OF THE DAM	1 MW
7	MIDDLE VAITARNA	10 MW
8	BHATSA	15 MW
9	BARVI	6 MW
10	SHILAR	4.4 MW
11	KUNDALIKA	3.6 MW
12	KUMBHE	8 MW
13	KAL	10 MW
14	BHARJA	3.5 MW
15	VASHISHTI	4 MW
16	JAGBUDI	17 MW
17	WASHISHTI	3.4 MW
18	BAV	60 MW*
19	BAV	25 MW
20	SAPTALINGI	4 MW*
21	SAPTALINGI	8 MW
22	BAV	30 MW*
23	DEVGAD	12.6 MW
24	PATGAON	33 MW
TOTAL (EXCLUDING PROJECTS MARKED *)		174.5 MW.
WEST-WARD DIVERSION SCHEMES ■		
25	KOYNA STAGE I & II	560 MW
26	KOYNA STAGE III	320 MW
27	BHIRA	141 MW
28	BHIVPURI	72 MW
29	KHOPOLI	72 MW
30	BHIRA TAIL RACE UNDER CONSTRUCTION	80 MW
TOTAL		1245 MW



SOURCE :
TRANSMISSION LINES SHOWN ARE BASED ON M.S.E.B. DRAWINGS.

SCALE : 1 : 10,00,000 (1mm=1KM.)

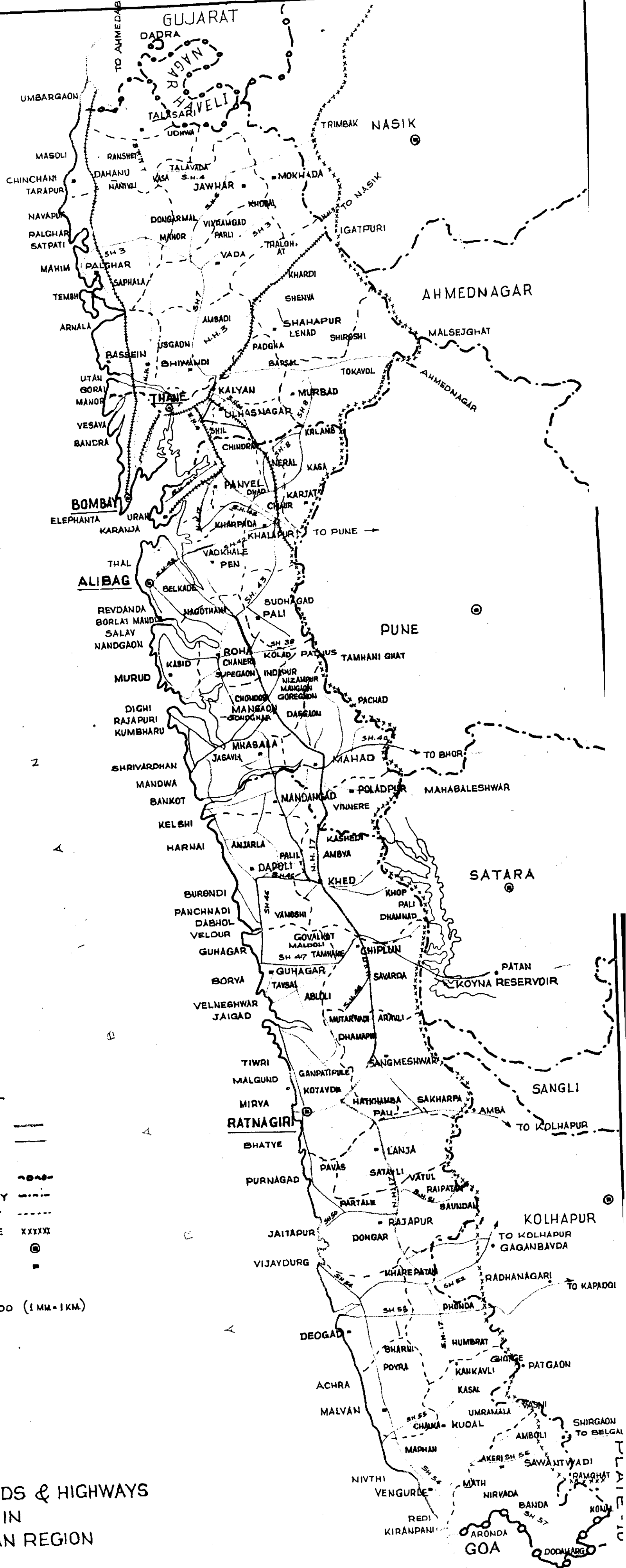
HYDRO ELECTRIC PROJECT AND TRANSMISSION LINES IN KONKAN REGION

REFERENCES

TR: LINES	EXISTING	PROPOSED
220 KV	—Δ—Δ—	---Δ---Δ---
110 KV	—○—○—	---○---○---
132 KV	—□—□—	---□---□---
66 KV	—○—○—	---○---○---
33 KV	—○—○—	---○---○---
22 KV	—○—○—	---○---○---

SUB STATIONS	EXIST.	PROP.
33 KV S/S	▲	△
ABOVE 33 KV S/S	■	□

STATE BOUNDARY	—○—○—
DISTRICT BOUNDARY	--- ---
CONTINENTAL DIVIDE	*****



REFERENCES :-

- NATIONAL HIGHWAY ———
- STATE HIGHWAY ———
- MAJOR DISTT ROAD ———
- STATE BOUNDARY - - - - -
- DISTRICT BOUNDARY - - - - -
- TALUKA BOUNDARY - - - - -
- CONTINENTAL DIVIDE XXXXX
- DISTRICT PLACE ⊙
- TALUKA PLACE ■

SCALE - 1 : 10,00,000 (1MM=1KM.)

**MAJOR ROADS & HIGHWAYS
IN
KONKAN REGION**