

ENVIRONMENTAL IMPACT ASSESSMENT OF LENDI MAJOR INTERSTATE PROJECT

PREPARED FOR:

**LENDI PROJECT DIVISION
NANDED**

Volume - I



FINAL REPORT

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INDEX

Volume – I ENVIRONEMNT IMPACT ASSESSMENT

CHAPTER NO	CONTENTS	PAGE NO
	EXECUTIVE SUMMARY	
CHAPTER 1	INTRODUCTION	
1.1	Introduction	01
1.2	About the Project	02
1.3	Necessity of the Project	03
1.4	Selection of Sites	04
1.5	The Present Proposal	04
1.6	Administrative Approval	05
1.7	Approaches to the Dam	07
1.8	Work Progress Update	08
1.9	Salient Features of the Project	11
1.10	Catchment Area	15
1.11	Submergence Area	16
1.12	Command Area Details	17
1.13	Cropping Pattern for Maharashtra & Andhra Pradesh	18
1.14	Physiography and Relief	21
1.15	Organization of the Study	31
CHAPTER 2	SCOPE AND METHODOLOGY	
2.1	Scope of the EIA Study	35
2.2	Detailed Scope and Methodology	36
2.3	Identification of Existing Direct Impacts	39
2.4	Identification of Potential / Future Impacts	40
2.5	Identification of Indirect Impacts	41
2.6	Identification of Adverse Impacts	41
2.7	Environmental Management Plan (EMP)	42
2.8	Responses from MoEF	44
CHAPTER 3	BASELINE DATA : LAND USE AND LAND COVER STUDY	
3.1	Introduction	53
3.2	Land Use Pattern	53
3.3	Land Use Classification	55
CHAPTER 4	METEOROLOGY	
4.1	Introduction	63
4.2	Analysis of the Data Recorded at IMD	63
4.3	Analysis of Data Available from other Secondary Sources	70
CHAPTER 5	SOIL QUALITY	
5.1	Introduction	79
5.2	Secondary Data Analysis	79
5.3	Primary Studies on the Soil Quality	87
5.4	Soil Quality study – Maharashtra	88
5.5	Conclusion – Maharashtra	99

5.6	Soil Quality study - Andhra Pradesh	101
5.7	Conclusion – Andhra Pradesh	115
CHAPTER 6	NOISE AND AIR QUALITY	
6.1	Noise quality Study	116
6.2	Ambient Air Quality Study	119
CHAPTER 7	GEOLOGY AND SEISMOLOGY	
7.1	Introduction	122
7.2	Geographical Profile of Maharashtra	122
7.3	Geology of Deccan Plateau	123
7.4	Geology of Nanded District	124
7.5	Geology of Andhra Pradesh State	127
7.6	Seismic History in Maharashtra	128
CHAPTER 8	HYDROLOGY AND WATER PLANNING	
8.1	Introduction	131
8.2	Hydrology	131
8.3	Water Availability and Planning	131
8.4	Water Quality	150
8.5	Conclusion	168
CHAPTER 9	ECOLOGICAL STUDIES	
9.1	Introduction	169
9.2	Vegetation Study	170
9.3	Aquatic Ecology	215
9.4	Faunal Study	218
CHAPTER 10	SOCIO - ECONOMIC STUDY	
10.1	General Introduction and Scope	243
10.2	Methodology	245
10.3	Part – I: Socio - Economic Studies (Census Study)	247
10.4	Health Status	256
10.5	Health Management Plan	260
CHAPTER 11	SOCIAL IMPACT ASSESSMENT (SIA)	
11.1	Introduction	263
11.2	Description of the Project	263
11.3	Methodology	264
11.4	Social Impact Assessment	264
11.5	Baseline condition of the Project Affected Families	267
11.6	Anticipated Impacts	287
11.7	Mitigation Measures	292
CHAPTER 12	ENVIRONMENTAL IMPACT ASSESSMENT	
12.1	Introduction	301
12.2	Impacts During Construction And Operational Phase	301
12.3	Impact on Physical Resources	303
12.4	Impact on Environmental Resources	305
12.5	Impact on Ecological Resources	317
12.6	Impact on Human Use Values	321
12.7	Impact on Quality Of Life	323

TABLES

Table No	Details	Page No
1.1	Alternative Sites	04
1.2	Details of the cost of construction works	06
1.3	The detail salient features of the project	11
1.4	Gross Demand Table (Combined) At Canal Head	14
1.5	State wise Utilization of Water of Lendi Project	15
1.6	Water utilization (conjunctive use of water)	16
1.7	Submergence area	17
1.8	Command Area Details	18
1.9	Taluka wise Command Area	18
1.10	Existing Cropping Pattern for the command area in Maharashtra	19
1.11	Proposed Cropping Pattern for the command area in Maharashtra	20
1.12	The existing & Proposed cropping pattern for command area in Andhra Pradesh	20
1.13	Yield of Lendi Major Project (From 1949 to 2004)	23
1.14	Storage (existing and planning) upstream of proposed Lendi Dam	25
1.15	Existing utilization in catchments area of Lendi Project	26
1.16	Summary of the yield versus utilisation	27
1.17	Calculated crop water requirement	29
1.18	Abstract Of Demands In M.Cum.	30
3.1	Land use Classification of catchment area	59
3.2	Land use Classification of submergence area	61
4.1	Statement Showing Tahsil wise Rainfall in Maharashtra (in mm)- Source-IMD	65
4.2	Statement Showing the Mandal wise Rainfall in Nizamabad District (in mm)	68
4.3	The Mean Surface Relative Humidity percentages Observed at Parbhani Station at 8.30 LMT and 17.30 LMT for the entire year	70
4.4	Climatological Table 1961-1990 – Nanded	71
4.4	Climatological Table 1961-1990 – Nizamabad	75
5.1	Distribution of Command Area in Different Depth Classes	80
5.2	Medium Soils from command area	81
5.3	Deep Soils from command area	81
5.4	Area suitable for irrigation	81
5.5	Infiltration Rate for Major Soil Groups	81
5.6	Tehsil wise Fertility Index for the Nanded District	82
5.7	Textural classes of the soils from the command area	82

Table No	Details	Page No
5.8	Statement showing the hectares under different irrigability classes under the command area	86
5.9	List of Sampling Stations for Soil Quality – Maharashtra	88
5.10	Parameters for Soil Quality Assessment	90
5.11	Physical/ Mechanical Analysis of the Soil	90
5.12	Chemical Analysis of Soil for Post Monsoon Season	92
5.13	Results of soil analysis for Pre Monsoon Season	93
5.14	Results of soil analysis for Winter Season	95
5.15	Uses of soil based on their quality	96
5.16	The Standard methods adopted for soil analysis	101
5.17	The soil sampling stations – Andhra Pradesh	102
5.18	Physical/ Mechanical Analysis of the Soil	104
5.19	Results of Chemical Analysis of Soil for Winter Season	106
5.20	Results of Chemical Analysis of soil for Post Monsoon Season	108
5.21	Results of Chemical Analysis of soil for Pre Monsoon	110
5.22	Standard Soil Classification	112
6.1	Ambient Noise Standards	116
6.2	Noise Quality at and around the dam site	117
6.3	Ambient Air quality at and around the Dam site	119
8.1	Yield of Lendi Major Project (From 1949 to 2004)	132
8.2	Storage (existing and planning) upstream of proposed Lendi Dam	134
8.3	Existing utilization in catchments area of Lendi Project	135
8.4	Summary of the yield versus utilization	136
8.5	Crop Water Requirement	138
8.6	Ground Water Level Data Report at Rajura Bk	140
8.7	Ground Water Level Data Report at Narangal Bk	140
8.8	Ground Water Level Data Report at Tadkhel	141
8.9	Ground Water table in command area (year 2006 to 2010)	141
8.10	The number of wells and area irrigated across sub areas	145
8.11	List of existing and proposed K T Weirs on the downstream of the proposed dam site	146
8.12	Results of pH and Electrical Conductivity of Water Samples from Lendi and Manar river	150
8.13	Table depicting observed number of Wells / village	151
8.14	Status of Ground Water Table in Command Area	151
8.15	List of Sampling Stations for Ground Water Quality	155
8.16	List of Sampling Stations for Surface Water Quality	156
8.17	Parameters for Surface and Ground Water Quality Assessment	158

Table No	Details	Page No
8.18	Ground Water Analysis Report of Post monsoon season	159
8.19	Ground Water Analysis Report of summer season	160
8.20	Water Quality Standards in India (Source IS 2296:1992)	161
8.21	FAO Guidelines for Evaluating the Quality of Water for Irrigation	162
8.22	Results of surface water quality in post monsoon season	166
8.23	Results of surface water quality in summer season	167
9.1	Characteristics of Sampling Stations for Terrestrial Ecology	170
9.2	Phytosociological Study of the Submergence	171
9.3	Phytosociological Study of the Command MH- Halni	173
9.4	Phytosociological Study of the Command MH – Unhali- Khanapur	174
9.5	Phytosociological Study of the Catchment MH - Dabka Raja	175
9.6	Phytosociological Study of the Catchment MH – Hatral	176
9.7	Phytosociological Study of the Command AP – Marapalli	176
9.8	Phytosociological Study of the Command AP – Madnoor	177
9.9	List of species recorded in the study area during the Study	180
9.10	List of Cultivated Species in Study Area (based on actual survey)	207
9.11	Ethno botanical Information	209
9.12	List of plant species with their number recorded from the Submergence zone	211
9.13	Status of the Species recorded in the project area	214
9.14	Sampling Stations for Aquatic Ecology	216
9.15	Diversity and Distribution of Aquatic Ecological Elements in the Water Bodies	216
9.16	Checklist of Prominent Mammals in the Study Area	219
9.17	Check List of Birds Observed in the Study Area	223
9.18	Checklist of Prominent Reptiles in the Study Area	234
9.19	The checklist of the prominent aquatic species	237
9.20	Insects recorded in the study area during the study	240
9.21	Conservation status of the Faunal Species	241
10.1	Demographic and Socio-economic Information of Study Villages in command area of Maharashtra & Andhra Pradesh	248
10.2	Demographic and Socio-economic Information of Study Villages in Submergence area	254
11.1	Population Distribution of Project Affected Villages	267
11.2	Age distribution among the project affected persons	268
11.3	Caste Distribution	269
11.4	House-Roof characteristics of project affected families	270
11.5	House-all characteristics of project affected families	270
11.6	Assets possessed by the PAF's	271

Table No	Details	Page No
11.7	Major sources of livelihood	272
11.8	Sources of secondary livelihood	273
11.9	Village wise agricultural land	274
11.10	Income classes and population representing the class	275
11.11	Expenditure on Household items and families representing the class	276
11.12	Expenditure on Education	277
11.13	Annual Expenditure on Health	277
11.14	Annual Expenditure on Agriculture	278
11.15	Live Stock	279
11.16	Migration	280
11.17	Irrigation Facilities	281
11.18	Trees in the Project Affected Villages	282
11.19	Loan	283
11.20	Market Facilities	284
11.21	Presence of Social organizations and NGOs	285
11.22	Education Facilities in Villages	285
11.23	Health Facilities	286
11.24	Availability of Electricity	287
11.25	Details of land acquisition	289
11.26	land use classification of submergence area	289
11.27	Affected villages, area submerged and number of families affected	290
11.28	Valuation of Properties held by PAPs (Rs. in lakhs)	292
11.29	Statement Showing The Details of Award of Land Payments	293
11.30	Compensation For Houses	294
11.31	Update on the rehabilitation activities	295
11.32	Statement showing the present position of work of civic amenities in the new locations/ gaothans	300
12.1	Environmental Impacts of the Project	325

FIGURES

FIGURE NO	DETAILS	PAGE NO
1.1	Location Map	09
1.2	Project Scheme	10
3.1	Classified Land use map of the Catchment area	57
3.2	False Color Composite (FCC) Of the Project Area	58
3.3	Classified Land use Pattern for Catchment	59
3.4	Classified Land use pattern submergence area	61
3.5	Classified land use map of the submergence area	62
4.1	Wind rose data: IMD – Nanded (0830 Hrs)	73
4.2	Wind rose data: IMD – Nanded (1730 Hrs)	74
4.3	Wind rose data: IMD – Nizamabad (0830 Hrs)	77
4.4	Wind rose data: IMD – Nizamabad (1730 Hrs)	78
5.1	Map showing Soil Sampling Stations	103
6.1	Sampling Stations for Noise Quality Study	118
6.2	Sampling Stations for Ambient Air Quality Study	121
7.1	Seismic Zoning Map-100 yrs Exposure	130
8.1	Details of existing and proposed K T Weirs on the downstream of the proposed dam site	147
8.2	Sampling Stations of Surface and Ground Water Quality	157
10.1	Demography of Project Villages	251
10.2	Distributions of SC and ST Communities	252
10.3	Literacy Status	252
10.4	Working and Dependent Class of Population	253
10.5	Main and Marginal Workers	253
11.1	Graphical representation of progress of Rehabilitation and Resettlement	299

APPENDIX

NO	DETAILS	PAGE NO
1	Public Consultation – Maharashtra	
2	Public Consultation – Andhra Pradesh	

EXECUTIVE SUMMARY

Executive Summary

1.0 Preamble:

Lendi is a major Inter-State Project between Maharashtra and Andhra Pradesh with a location on Lendi River upstream of village Gonegaon, Taluka – Mukhed, District- Nanded. (Latitude: 18° 32' 00" Longitude: 77° 26' 00"). The project envisages construction of an earthen dam and masonry weir across the Lendi River, upstream of village Gonegaon, Taluka Mukhed in Nanded District for irrigating the land of both the States i.e. Mukhed and Degloor talukas of Nanded district of Maharashtra and Madnoor and Bichkunda mandal / Tehsils of Nizamabad district of Andhra Pradesh.

The project is administratively approved by Government of Maharashtra for amounting to Rs. 4551.71 Lacks vide Government resolution No. LND/1085(248/85) WRI dated 29-8-1986. Second Revised Administrative approval to the project is accorded by Government of Maharashtra for Rs.357.88 Crores vide Govt. Res. No. GMIDC/IIInd RAA/Ts-3/ Lendi Project /M.P/31 dated 28-11-2005. Total cost of the project including cost of Andhra Pradesh canal is Rs. 432.20 Crores (357.88+74.32 Crores). The revised estimated cost of the project is Rs. 554.54 crore (29-12-2007).

Salient features of the project

1. Name of the Project	: Lendi Major Irrigation Project Taluka Mukhed Dist. Nanded.
2. Location	
a. River	: Lendi (A tributary of Manjara River)
b. Taluka & Dist.	: Taluka Mukhed Dist. Nanded
c. Co-ordinates	
Latitude	: 18° 32' 00"
Longitude	: 77° 26' 00"
3. Hydrology	
a. Total Catchment area at the Proposed site	: 1594 Sq km
b. Average annual rainfall	: 838 mm
c. 75% Dependable annual rainfall	: 617 mm

- d. Maximum monsoon rainfall : 1434 mm
- e. Yield at 75% dependability : 9.687TMC
- f. Net 75% dependable annual yield : 8.65TMC
- Deducting existing & proposed
U/s utilization

4. Reservoir

- a. Full Reservoir Level (FRL) : 396.00 m
- b. Top of Dam (Reservoir) : 401.00 m
- c. High Flood Level (HFL) : 398.50 m
- d. Irrigation Sluice (I.C.P.O.) : 388.00 m
- e. M.D.D.L. : 389.50 m
- f. Gross Storage. : 145.15 M Cum
- g. Dead Storage. : 26.83 M Cum
- h. Live Storage. : 118.32 M Cum
- i. Annual utilization : 180.11 M Cum

5. Dam

- a. Type : Earthen Dam with Masonry Spill Way
- b. Length : 1651.40 m
- c. Top of dam : RL 401.00 m
- d. Top width : 6.5 m
- e. Maximum height : 27.83 m
- f. Free Board : 2.5 m

6. Spill Way

- a. Type : "Ogee" with 14 gates of size 12 x 8 M
- b. Length of weir : 328.60 m
- c. Location : RD 1208 m to 1536.60 m
- d. Crest Level : 388.00 m
- e. Maximum design discharge : 11660 m³/sec

7. Head Regulator

- a. Number : 1 No. @ RD 315 M. on Left Flank
- b. Sill Level : 388.00 m
- c. Canals
 - i. Length of Common carrier : 19.00 km
 - ii. Length of Left canal of Maharashtra : 28.50 km

iii. Right bank canal of Andhra Pradesh : 35.00 km

iv. Off take point of A.P. Canal : 18.98 km

8. Capacity of Canals

a. Common carrier : 13.260 cumecs

b. Left bank canal of Maharashtra : 6.541 cumecs

c. Right bank canal of A.P. : 6.485 cumecs

9. Submergence

a. Area under submergence : 2338.06 ha

b. Acquisition of land : FRL + 0.50 m

c. Total population affected : 30680 individuals

d. Number of villages affected : 19 villages (Fully submerged 12 & only Land affected 7)

e. Submergence Ratio. : 0.12

Area under submergence x 100 = $2338.06 \times 100 / (11000+8907) = 11.74 \% \text{ I.C.A.}$

10. Unit Cost

a. Cost of the project : Rs. 55454.51 lakh

b. Cost per 1000 cum of Gross Storage : Rs. 35586 / per TMC

c. B.C. ratio : 1.58

d. E.R.R. : 13

Command Area: The total project has 32410 ha as a gross command area (G.C.A.), 28286 ha as a culturable command area (C.C.A.) and 26924 ha as an irrigable command area (I.C.A.) including conjunctive use of ground water for both the State

Submergence area: The total 2338.06 ha agricultural and Gaothan land will be submerged due to the proposed project. The total 19 villages will be affected. Out of the total 19 villages, 12 villages are fully affected and only land affected villages are seven. The total 5880 families will be affected from 19 affected villages.

2.0 Baseline Environment:

The Lendi River with its two main tributaries Tiru and Kundrala originates at an altitude 650 m near Udgir in Latur district. The entire Catchment and Command area experiences tropical climate.

Geology & Seismicity: The only geological formation in Nanded area is the Cretaceous to Eocene Deccan trap flows with Intertrappean and Infratrappean beds. In the seismic zoning map of India as per 1893 – 1984, the Lendi project falls in Zone II, however post Killari earthquake (1993), the design was planned for next higher zone i.e. Zone III, for which the basic seismic co-efficient is 0.03 and the same is adopted during the dam design.

Andhra Pradesh (AP), by virtue of its location in peninsular India embodying defined, tectonic elements, contains fairly good record of the Achaean, the Middle–Upper, Proterozoic and the Gondwana strata.

Soil Environment: Soils of the command area of Lendi Project is medium to deep, fine textured and moderately drained. Since soil is medium to deep.

Water Environment: The pH of all ground water samples is normal and water is found to be potable after adequate disinfection measures. The levels of Sodium and Fe observed to be higher, indicating anthropogenic activities.

Air Environment: The air sampled at the 12 sites depict that the ambient air quality is in the prescribed limit and no need for alarm.

Land Use Pattern: This revealed that agriculture (standing and harvested) land is the most predominant land use followed by wasteland, scrub lands, barren land, water body and Settlement.

Ecology: Project area, including the catchment and command of both the States, highly degraded vegetation. The vegetation is predominantly dry deciduous scrub, with a few xerophytic elements. Total 23 species belonging to schedule I & II of the wild life protection act 1972 (As amended up to 2006) have been reported from the project area. Out of these, twelve species belong to class Mammalia; four species belong to class Aves while remaining seven species belong to class Reptilia.

Socio-Economic Environment: Agriculture is the main source of livelihood of the region, supporting 34% of the PAFs directly and 52.4% indirectly as agricultural labour. The beneficiaries of the project include the small and marginal farmers.

3.0 Environmental Impact Assessment

Biological Resources: Due to inception of the present project, water will be available for almost round the year and would enhance the existing vegetation cover.

Human Use Values: Bringing water to this area would increase the land under irrigation and shall improve the vegetation cover. Thus many areas which at present are fallow will be put to agricultural use.

Quality of life

- **Impact on social and community structure:** Creation of reservoir may attract various agro-based industries services in the area and creating new avenues for jobs and entrepreneurships.
- **Impact on civic amenities:** The impact of economic development on civic amenities will be substantial. The adequate civic amenities will also be extended to the resettled villages to enhance their livelihood. The overall impacts will be positive and beneficial.
- **Impact on public health and nutrition:** Comparison of water scarce with water sufficient areas has revealed that irrigation project proves beneficial for socioeconomic progress of the communities in the area. The health problems associated with scarcity of water will be mostly eliminated.
- **Impact on Aesthetic value:** Creation of the reservoir and surrounding it by plantation would enhance the aesthetic value of the site. This may attract water birds and create pleasing atmosphere. All this is likely to attract tourists from various places.

Impact on Topography: During construction of the dam and related activities such as excavation for casing and hearting material and quarrying for rubble, an impact on physical environment is inevitable.

Impact on Agriculture Productivity: Water availability to the command area will enhance the agriculture productivity of the command area substantially.

Impact on air quality: The impact on the ambient air quality will be localized, temporary and reversible in nature.

Impact on noise levels: Noise produced during the construction will have a significant impact on the existing ambient noise level surrounding the construction site. The impact of construction activities on local communities will be minimal.

Impact on ground water and soil: This project will be useful for bringing dry-lands under cultivation by providing irrigation facility. This will help increase groundwater levels in the area and vicinity.

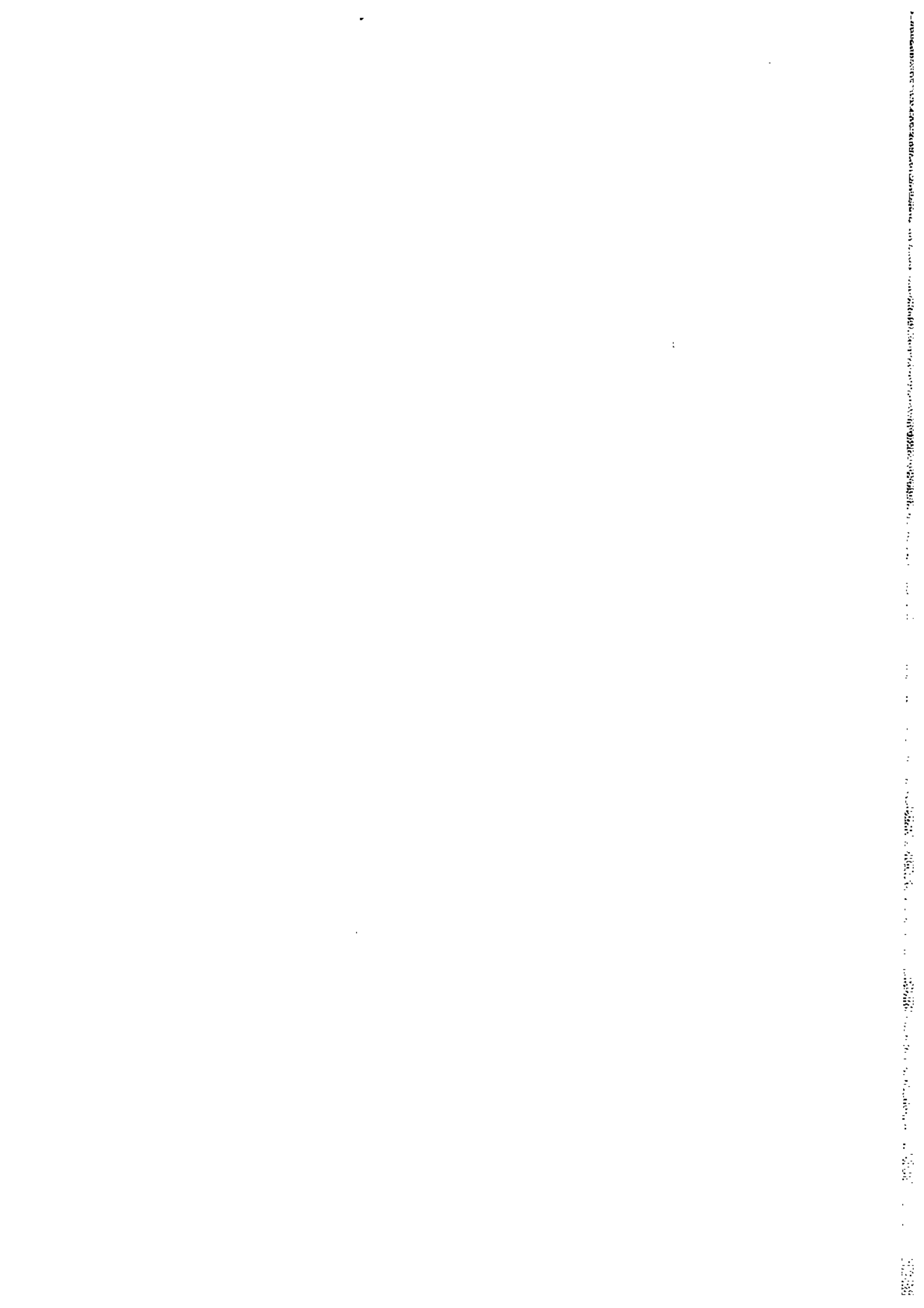
4.0 Environment Management Plan

- Provision of Rs 4038.0 lakh; have been made in the estimate for the Command Area Development Plan. There is a separate division for the CAD work.
- The initial cost for the green belt development at head works, colonies and other areas will be Rs. 157.00 lakh.
- Provision of Rs 8718.0 lakh; have been made in the estimate for the Rehabilitation and Resettlement plan.
- The sound implementation of the CATP through various disciplines involves total cost Rs. 5800.00 Lakhs.
- The disaster management plan has been made. Emergency action plan is prepared. The provision for the Disaster Management Plan is Rs. 150.00 Lakh

5.0 Environmental Monitoring Programme

The detail monitoring Schedule for Environmental Parameters & Budgetary Cost Estimates has been papered and included in EMP .Provision has been made for environment monitoring of Rs. 260.00 lakh.

EXECUTIVE SUMMARY



TOR

No.	Heading	Chapter & Page
A	Compliance to the Queries with reference to Information /clarifications sought from the Project Proponent by the Expert Appraisal Committee (EAC) during the scoping (No. J-12011/57/2007-IA.I dated 1.10.2007).	
1	The reply to item 2.2 has not considered the downstream water users of the river if the dam were not there. Water impoundment in the reservoir may drastically reduce the natural river flow and hence, may affect adversely the current users of the river water. This issue is to be looked into and appropriate information may be given.	Chapter No. 8 Page 146-149
2	With respect to the item 3.5 the type of compensation (monsoon only or new land or lost agricultural land etc) may be mentioned in the EIA-EMP.	Chapter 14 Page 38
3	The TOR has identified the soil and water parameters to be collected, interpreted, and reported in the EIA study. Groundwater table depth changes during the last 5-10 years may be reported and chances of water table rise due to low efficiency of surface irrigation system (including conveyance and application), vis-à-vis the water transmission characteristics of the soil may also be included in the EIA study report.	Chapter No. 08 Page 140 -145
4	While conducting EIA and as a component of EMP, the feasibility of conjunctive water use and adoption of water use efficient methods of irrigation may be examined and suitably dealt in these documents.	Chapter No. 01 Page No. 15-16; Chapter No. 08 Page No. 153; & Chapter No. 16 Page No. 98-100
5	The erosion status of the catchment would have to be studied using the SYI method and components of CAT with their time frame of anticipated progress may be reported in the EIA and EMP respectively.	Chapter No. 17 Page No. 140
6	It may be clarified if there is a drinking water provision from the water impounded in the reservoir. This is an important requirement for a water resources development project.	Chapter No. 08 Page No. 154
7	It may be clarified as to what mechanisms exists in Maharashtra and Andhra Pradesh to train the cultivators on scientific water use for irrigation, as they may not be used to handle large quantities of water under the present rain fed condition.	Chapter No. 16 Page No. 123
8	The EIA Report is to be prepared based on three season (pre-monsoon, monsoon and post-monsoon) data on hydrology and all relevant soil and water parameters.	Chapter No. 5 & Chapter No. 8

No.	Heading	Chapter & Page
9	The public hearing is to be conducted in both the states after supplying the EIA-EMP documents to the PAPs and the beneficiaries.	Volume 1 Appendix 1 & 2
10	The PFR reports very high vales of conveyance efficiency, distribution efficiency and application efficiency. Such high efficiencies may be achievable when respectively the conveyance system is lined, fields are developed to a uniform slope and water application is highly scientific (not necessarily by the pressurised irrigation methods). To claim such a high efficiencies, the PA must supply actually field measured data from some of the existing irrigation commands on both the states. Please note that the overall efficiency, which has been taken as 65.52 percent, actually is between 40 to 50 percent in many command areas in the country. This factor is directly linked with sustainable irrigation and efficient use of water available in the reservoir.	Chapter No. 08 Page No. 137
11	The committee also desired that next time, representative of Andhra Pradesh Irrigation Department should also attend the meeting.	Yes
B	Compliance to the Queries with reference to the clarifications sought from the Project Proponent by the Expert Appraisal Committee (EAC) thirty fifth (35th) meeting of Expert Appraisal Committee for River Valley and Hydroelectric Projects, of Ministry of Environment and Forests, New Delhi. The meeting was held on 18th & 19th February, 2010. (No. J-12011/57/07-IA.I dated 10.03.2010).	
1	The project proponent has not supplied a compliance report to know how the earlier observations of EAC have been addressed. The present EIA on pages 9 and 10 says that the major suggestions have been complied with and least them (7 numbers). Comparing with the earlier EAC minutes the following important items are not found in the list: i. Downstream water user's interest. ii. Water table rise due to low efficiency of surface irrigation system. iii. Feasibility of conjunctive water use. iv. Adoption of efficient methods of irrigation. v. Supporting data for adopting very high values of conveyance efficiency, distribution efficiency and application efficiency. These issues may be satisfactorily clarified.	Chapter No. 8 Page 146-149 Page 151 Page 115 Page 137
2	Since, the existing cropping pattern is given for the command area; the proposed cropping pattern of the command area has to be given and not for the whole state of Maharashtra (Page 20, 21).	Chapter No.01 Page No. 18

No.	Heading	Chapter & Page
3	Under Identification of Adverse Impacts (Page 40, 41), the impact on soil health and groundwater table due to continued in efficient flow irrigation has been totally ignored which is a serious lacuna. A supplementary EIA document containing this aspect and a supplementary EMP giving the corresponding mitigation measures, with action plan, activity schedule and budget should be given.	Chapter No.08 and 13 page no 8
4	The data of Table 5.5 and Table 5.7 (Pages 80, 81, read in conjunction with Table 5.11 in Page 90) are not compatible. An area with more than 80% of sandy clay and finer soils cannot have infiltration rate between 7.5 and 21 cm/h. With such high values, the soils are not moderately drained, as written in Page 101, but they are excessively drained. Such data are to be re-checked, tests may be re-conducted in-situ using double ring cylinder infiltrometer (WALMI), Aurangabad's help may be taken for this) and correct values may be reported. The implication of excessive seepage of the applied irrigation water on fast groundwater table rise is well known.	Chapter No. 05 Page 81
5	The statement: It is rather difficult to locate the areas where drainage would be necessary unless irrigation starts and damages make appearance (Page 83) is not acceptable by the committee. With the vast experience of irrigation and its consequences in India and particularly in Maharashtra, identifying such areas based on soil texture, soil-water properties, local topography, water table, climate, crop-wise delta, etc., is possible and even without using any modelling software. It has to be a part of EIA. One does not have to depend on what USBR might have said, as the reference to the context has not been established. To wait till the problem appears is a waste of time. Intervention of surface drainage is always difficult after irrigation continues for several years. The PA must be aware that in any surface irrigation project there has to be a study to identify areas that are waterlogged and or prone to be waterlogged and there should also be a drainage plan for the cultivated lands, in addition to improving the natural drains. The plan may be worked out and submitted as a supplementary document to the present EIA and EMP.	Chapter No. 16 Page 103
6	Summarising, the Project Authority is to address the following: (i) Submit a point-wise Compliance Report on the EACs observations on the project during its presentation on 20th September 2007. (ii) Re-check infiltration rate values, re-conduct the tests as	Chapter 5 and Chapter 16

No.	Heading	Chapter & Page
	suggested in one of the earlier paragraphs and submit the revised data. (iii) Address the joint adverse impacts of continued flow irrigation in fine textured soils in a harsh climate where the summer temperature rises to 45°C in terms of soil salinization and water-logging by drawing up a surface drainage plan of the command area, in addition to improving the natural drains, as suggested. The plan along with schedule of activities and the corresponding budget may be submitted as a supplementary document to the EIA/EMP.	
7	Additional Compliance Sought by EAC a) Land Use Pattern of the Submergence Area b) Additional Soil Quality Examination for Andhra Pradesh	Chapter No. 03 Page No. 60 & Chapter No. 05 Page No. 101
C	Compliance to the Queries with reference to the clarifications sought from the Project Proponent by the Expert Appraisal Committee (EAC) fifth (53rd) meeting of Expert Appraisal Committee for River Valley and Hydroelectric Projects, of Ministry of Environment and Forests, New Delhi. The meeting was held on 11th & 12th November, 2011. (No. J-12011/57/07-IA.I dated 05.12.2011)	
1	Since 200 Persons are displaced and 4643 families of ten villages are affected, a separate Social Impact Assessment should be submitted	Chapter No. 11
2	Dam Break Analysis may be carried out again as there are so many inconsistencies observed. Some of these are as follows	Chapter No 18
I	The erosion intensity categorization at page 425 of EIA report should also include the values of W_i and D_i assumed for each watershed	Chapter No. 17 Page 142
II	The input data given under the head Reservoir And Breach Description at page 469 in chapter 17 for Dam Break Analysis in the EIA report has the following technical inconsistencies	
a)	The dam has an ogee spillway with 14 gates of 12 X 8 m size as stated on the page no. 468. However, input data does not include it in the analysis	Chapter No. 18 Page No. 188
b)	It is also not clear whether the dam failed by overtopping or by piping. It needs to be mentioned	Chapter No.18 Page No.204
c)	The initial water surface elevation was considered at 398.50 m which is higher than the dam top (at 388.00 m) by 10.5 m compared to the dam height, it is an excessively high value, and therefore, is quite unrealistic for farming a critical condition.	Chapter No. 18
d)	It is not clear as to how a value of CDO equal to 600 was	Chapter No. 18

No.	Heading	Chapter & Page
	arrived at.	
e)	The assumed breach width of 140m at page 477 of the EIA report is actually not available at dam site X – section given at page 494. Similarly, the assumed initial flow of 20419 cumecs at page 478 is excessively high compared to the maximum (dam break) flow of 27607 cumecs. It is not clear why the cross sections at pages 491 -494 of the report include levees (or vertical walls) on both the banks of the river downstream. These cross sections should actually include maximum water levels.	Chapter No. 18
f)	On pages 493, 495-498, the analysis shows only stage hydrographs including the dam break flood hydrograph.	Chapter No. 18
3	In view of the above technical reasons, the dam break analysis needs to be carried out using realistic data and chapter should be re-written	Yes, Chapter is revised accordingly
4	The list of avifauna is deficient and need to be arranged according to the accepted classification. The wintering species are conspicuous by their absence. Blackbuck, the most important mammalian species of the study area is a WPA Schedule – 1 species and not a Schedule – III species as given in the EIA report. Specific suggestions for the conservation of RET species may be included in the EMP.	Chapter No. 09 Page No. 223 & 219 Chapter No. 13 Page No. 11
5	Fishery Management Plan has not been submitted. The same may be submitted with details of aquatic fauna available in the river.	Chapter No. 19 Page No. 249
6	Clear indication of environmental flow with supporting hydrology along the 10 daily discharge table may be provided	Chapter No 13 Page No. 22
7	Command Area Development (CAD) Plan needs to be submitted	Chapter No.17
8	Details of LADA and EMP activities with allocated budget may also be submitted.	Chapter No. 17 Chapter No.20 Page No. 265-266
9	Since the information on the project has now changed drastically, a revised executive summery including all information should be submitted	Revised Executive Summery
10	List of flora and fauna is deficient and should be reclassified as per the approved classification. A number of migratory bird's species are missing from the list.	Chapter No. 09 Page No. 180
11	Lower group of plants have not been included in the EIA Report, these may be included	Chapter No. 09 Page No. 213
12	You are requested to kindly submit the above mentioned information. The proposal shall be reconsidered after the submission of the same.	Resubmitted EIA – EMP report

CHAPTER – 1

INTRODUCTION

CHAPTER 1.0 INTRODUCTION

1.1 Introduction

There are great variations in the average amount of rainfall received by the various regions-from too to never enough in Rajasthan. Season-to-season variations in rainfall are also high. The consequence is bumper harvests in some areas while crop-searing drought in others. Since the Indian economy is agriculture based, water availability is the key element governing economy. This clearly emphasises the importance of irrigation in terms of assured water. Though, present India is self sufficient in food grain production, we need to plan ahead for the future food demand. Since, the scope for bringing additional area under agriculture is limited there is no alternative except for the extending irrigation facilities.

In irrigation sector, water demand is region specific, depending upon the types of soil, cropping patterns/practices, climatic conditions, etc. Irrigation water demand also depends upon the type of crops, conveyance system, water application technique etc. Thus, there arises a need for immediate attention for the improvement in efficiency of irrigation sector with the slogan of 'more crop per drop of water' as rightly coined by international agencies such as Food and Agriculture Organization (FAO) and International Water Management Institute (IWMI). Benchmarking of irrigation



projects may provide an effective tool for measurement of relative performance of irrigation projects and suggest ameliorative measures for performance improvement. Ministry of Water Resources, Government of India has constituted a 'Core Group' under the Chairmanship of Member (Water Planning and Projects), Central Water Commission with members from Ministry of Water Resources, Indian National Committee on Irrigation and Drainage and Central Water Commission. The 'Core Group' has been constituted with the view of promoting benchmarking of irrigation projects in the states and union territories of India by way of providing guidance, developing methodology, evolving work programme, coordinating activities and extending assistance in other related aspects of benchmarking.

Apart from the apparent economic benefits, dams are also known to have social fronts. One major beneficial impact upstream of the dam is the added biomass, enhanced water availability, income and ecological security, and restored micro-climatic conditions for local communities from the restoration of degraded catchments. The reservoirs created by large dams often become tourist attractions. As per the data available, there are at least 50 reservoirs that have also been declared National Parks or Sanctuaries and, consequently, not only contribute to Wildlife Conservation but also serve as tourist resorts.

Though the profile of fisheries might change because of the creation of a reservoir, efforts to stock commercially valuable fish in these reservoirs has often led to an increase in fisheries (catch and income) in the reservoir area. This has been a benefit to the fisher folk who have access to reservoir fisheries.

In this scenario dam play very important role. Water demand for irrigation as well as for drinking purpose were the twin problems faced in the proposed project area spread across drier regions of Maharashtra and Andhra Pradesh states. These conditions have resulted in proposal of formulation of Lendi – Major interstate project.

1.2 About the Project

Major and medium irrigation projects are playing pivotal role in making green revolution in India a success with the certainty of water supply to cultivable lands.

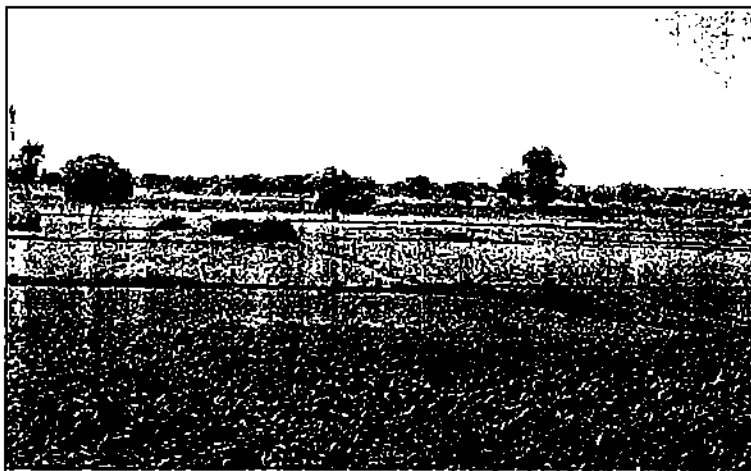
Lendi is a major Inter-State Project between Maharashtra and Andhra Pradesh with a location on Lendi River upstream of village Gonegaon, Taluka – Mukhed, District - Nanded. (Latitude: $18^{\circ} 32' 00''$ Longitude: $77^{\circ} 26' 00''$).

Dams, by intent or otherwise, sometimes play the role of regulating floods. In areas that are water deficient, the provision of surface water and the enhancement of groundwater because of seepage from canals can significantly improve water availability.

Godavari Marathwada Irrigation Development Corporation (GMIDC), a Govt. of Maharashtra Enterprise, is setting up Lendi – a major interstate project, at village Gonegaon of District Nanded, Maharashtra on the Lendi River. The major source of water for this dam is river Tiru which is a tributary of the river Lendi. The site was investigated and approved by Govt. of Maharashtra vide resolution number LND/1085(248/85) WRI dated 29-8-1986.

1.3 Necessity of the Project

The areas of Mukhed and Degloor Taluka in Nanded District of Maharashtra State and those of Madnoor and Bichkunda Tehsils / Mandals in Nizamabad District of Andhra



Pradesh are devoid of major irrigation facilities. Therefore, Irregular and insufficient rainfall always results in failure of Kharif and Rabi crops, which can be avoided by extending irrigation facilities in this drought-prone area.

The other consideration that would demand special attention is that the area falls under backward region of Maharashtra and Andhra Pradesh. The proposed project is expected to facilitate the process of social, economic and infrastructure development of the region. Since the economy here is agriculture based, it was decided that irrigation facilities would be appropriate for the upliftment of the region.

1.4 Selection of Site:

The six alternative sites between village Thana and Marajwadi have been investigated. Out of six sites, site no 5 which is upstream site of village Gonegaon was found to be suitable and economical. The detailed survey and investigation was carried out and project report is prepared. This sites passes along the ridge and across the contours at right angles.

Table 1.1 Alternative Sites

Sr. No.	Name of Site	Remark
1	D/S of Sangvi Bhalde Village	The Length of the Dam is 3600 mtrs
2	D/S of Itgayal Village	The Length of the Dam is 2940 mtrs
3	U/S of Gonegaon Village	The Length of the Dam is 2700 mtrs
4	U/S of Gonegaon Village	The Length of the Dam is 3000 mtrs
5	Upstream site of village Gonegaon*	The length of the dam on this alignment is minimum i.e. 2140 mtrs and site affords suitable location for surpassing the flood. Here basalt granite compact drop down to R.L. +356.0 mtrs & thickness & massive basalt over granite ranges from 12.50 to 20.00 mtrs which is thicker than at other alignment. This site has therefore been finally adopted for the present report.
6	U/S of Village Bhatapur	The length of the dam is 3480 mtrs

* Lendi Project Report, Volume – 1, Irrigation Projects Circle, Aurangabad, 1985 (Page no. 6, 7)

1.5 The Present Proposal

The Lendi Major Irrigation project is a joint venture of Governments of Maharashtra and Andhra Pradesh States. The project was administratively approved by the Government of Maharashtra in the year 1986.

The project envisages construction of an earthen dam and masonry weir across the Lendi River, upstream of village Gonegaon, Taluka Mukhed in Nanded District for irrigating the land of both the States i.e. Mukhed and Degloor talukas of Nanded

district of Maharashtra and Madnoor and Bichkunda mandal / Tehsils of Nizamabad district of Andhra Pradesh.

It is proposed to construct 1651.40 m long earth dam with a maximum height of 27.83m and 328.60 m long non over flow portion and gated spillway with 14 no. of gates of size 12m x 8m located in the natural stream on the right side of the existing main river. It will have a live storage capacity of 118.32 M cum (4.17TMC). There is only one canal on the left side, which takes off at RD 315m on dam line having discharging capacity of 13.26 cumecs. An outlet is proposed for regulating the discharge and as irrigation cum power outlet.

The total length of left bank canal is 47.50 km in which 19.00 km is common carrier with a discharging capacity of 13.26 cumecs. It is as per new modification, which fulfils the need of both the States. In the beginning, for about 4-5km, canal runs in hard rock cutting and, thereafter, actual command area starts. The remaining left bank canal is 28.50 km long with a discharging capacity of 6.541 cumecs to fulfil the need for Maharashtra State, beyond the common carrier of 19.00 km.

Right bank canal takes off at 18.98 km on left bank canal with discharging capacity of 6.485 cumecs to exclusively meet the need of Andhra Pradesh. Initially right bank canal runs in Maharashtra State for about 9.43 km and crosses the main river Lendi at 3.70 km from its take off point. Thereafter it runs for a distance of 34.50 km in Andhra Pradesh.

1.6 Administrative Approval

The project is administratively approved by Government of Maharashtra for amounting to Rs. 4551.71 Lacks vide Government resolution No. LND/1085(248/85) WRI dated 29-8-1986. Total cost of the project, including cost of Andhra Pradesh canal was Rs. 5455.71 Lacks (R.S.R. 1984-85).

Second Revised Administrative approval to the project is accorded by Government of Maharashtra for Rs.357.88 Crores vide Govt. Res. No. GMIDC/IIInd RAA/Ts-3/ Lendi Project /M.P/31 dated 28-11-2005. Total cost of the project including cost of Andhra Pradesh canal is Rs. 432.20 Crores (357.88+74.32 Crores). The revised estimated cost

of the project is Rs. 554.54 crore (29-12-2007). The breakup of the total project cost is as below.

a. Head works	Rs. 308.47 Crores
b. Common carrier	Rs. 57.57 Crores
c. Main canal & branches	Rs. 98.28 Crores
d. A.P. Canal Cost	Rs. 90.22 Crores
Grand Total	Rs. 554.54 Crores

1.6.1 C.W.C's Clearance: Since 1984, the compliance of C.W.C's comments, raised by various directorates is in progress. Out of the 15 directorates, clearance of 9 directorates is received and among 6 directorates comments of 4 directorates are in progress. Compliance of 2 directorates has been submitted by this office.

1.6.2 Inter State Agreement: The Inter State Agreement of Lendi Project has been signed at Hyderabad on dated 18-11-2003 by Hon. Chief Secretary, Maharashtra State and Hon. Chief Secretary, Andhra Pradesh State in the presence of Hon. Mr. Sushilkumar Shinde, the then Chief Minister of Maharashtra and Hon. Mr. N. Chandra Babu Naidu, the then Chief Minister of Andhra Pradesh.

As per the stipulation quoted in agreement, state wise sharing of cost of the project is as shown in table 1.2 below.

Table 1.2 Details of the cost of construction works

Sr. No.	Details	Proportion of cost of sharing		Total (Rs. in Crores)
		Maharashtra (Rs. In Crores)	Andhra Pradesh (Rs. in Crores)	
1	Dam And Head works (i.e. common proportion of works)	191.25 (62%)	117.22 (38%)	308.47
2	Canal and Branches	28.91 (50.22%)	28.66 (49.78%)	57.57
3	A.P. Canal cost	--	90.22	90.22
4	Main canal cost	98.28	--	98.28
	Total	318.44	236.10	554.54

Source: Third revised estimate of the Lendi Project 2006-07 (Page no. 64-65)

The main features of Inter-State-Agreement are as below:

- a. Here after Andhra Pradesh Government will pay to Maharashtra as per its share (38%) towards expenditure incurred on common portion of works on Lendi Project at the beginning of every 6 months.
- b. The operation and maintenance of common portion of works will be done by Maharashtra State and the expenditure incurred on this will be shared between Maharashtra and Andhra Pradesh States in the ratio of 62:38.
- c. For coordinating the construction of Lendi Project and its operation and maintenance after completion, a standing Committee shall be constituted. The Chief Engineer (Irrigation Department) Government of Maharashtra, Aurangabad will be Chairman and the Chief Engineer (Irrigation Department), Govt. of Andhra Pradesh will be a Co-Chairman. Other concerned officers will be the Member and the Executive Engineer in charge of Lendi Project; Government of Maharashtra will be Member Secretary.
- d. For the overall supervision and control over planning and construction of Lendi Project and maintenance of Lendi Project after its completion, the Control Board comprising of Ministers and officers of the two State Governments shall be constituted. The Minister (Irrigation) of government of Maharashtra will be the Chairman and the Minister (Irrigation) of Andhra Pradesh will be a Co-Chairman.
- e. If a dispute arises regarding the clause/clauses of this Agreement, this shall be referred to the Chief Minister of Government of Maharashtra and Chief Minister of Government of Andhra Pradesh for resolution. In the event of non-resolution by the Chief Minister the same will be referred to adjudication.

1.7 Approaches to the Dam Site

The Dam is being constructed at Gonegaon village of Mukhed tehsil. The dam site is 20 km away from the Degloor town, which is also a tehsil / taluka place in Nanded district of Maharashtra. The site is 40 km away from Udgir - another tehsil of Latur district of Maharashtra; both these towns are linked with the State Highway. Udgir town is an important & the nearest railway station on Hyderabad – Parli Vaijnath broad gauge railway line. The Degloor town is 87 km from Nanded, on Nanded – Hyderabad State Highway.

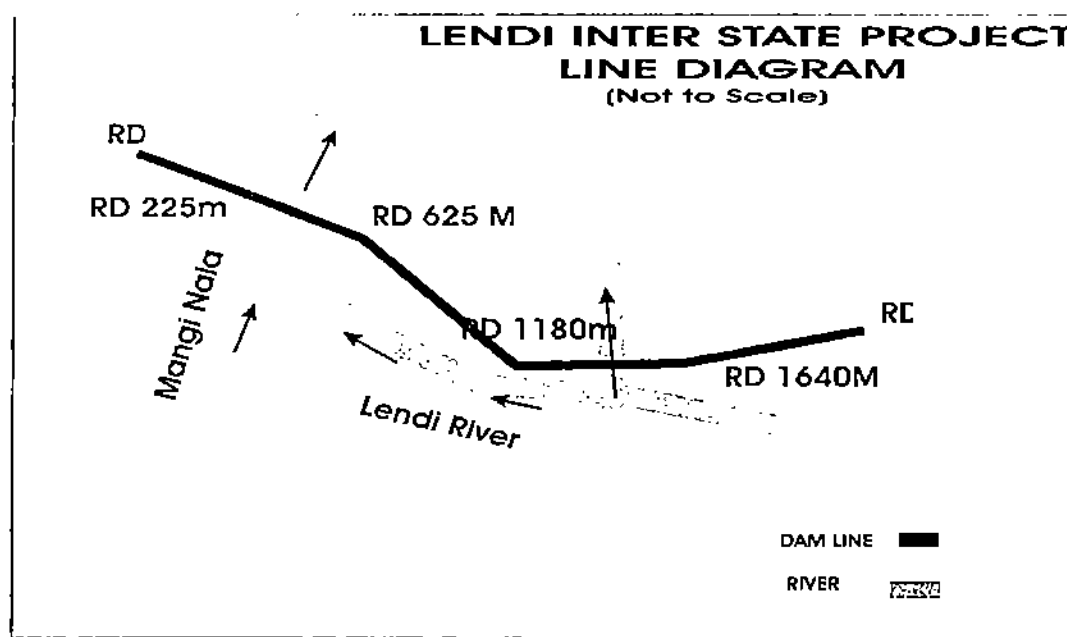
The dam site is approachable from Nanded district head quarter through Nanded – Hyderabad State Highway approach road, taking off at village Khanapur which is at about 81km from Nanded and on route through the villages Khanapur, Tadkhel, Undri, Rajura (BK), Ambulga and Itgyal. Moreover, this road is of the ODR standard having a length of 25 km from Khanapur village.

The site is also approachable from Mukhed in Nanded District by MDR standard road to Degloor, via the villages Hokarna, Bhagnur, Pala, Jahur, Ambulga and Itgyal; is 35 km from Mukhed. The nearest railway station is Udgir, which is 40 km away. The other railway stations are Nanded and Dharmabad of Nanded district, which are 87 km and 122 km away respectively from the dam site.

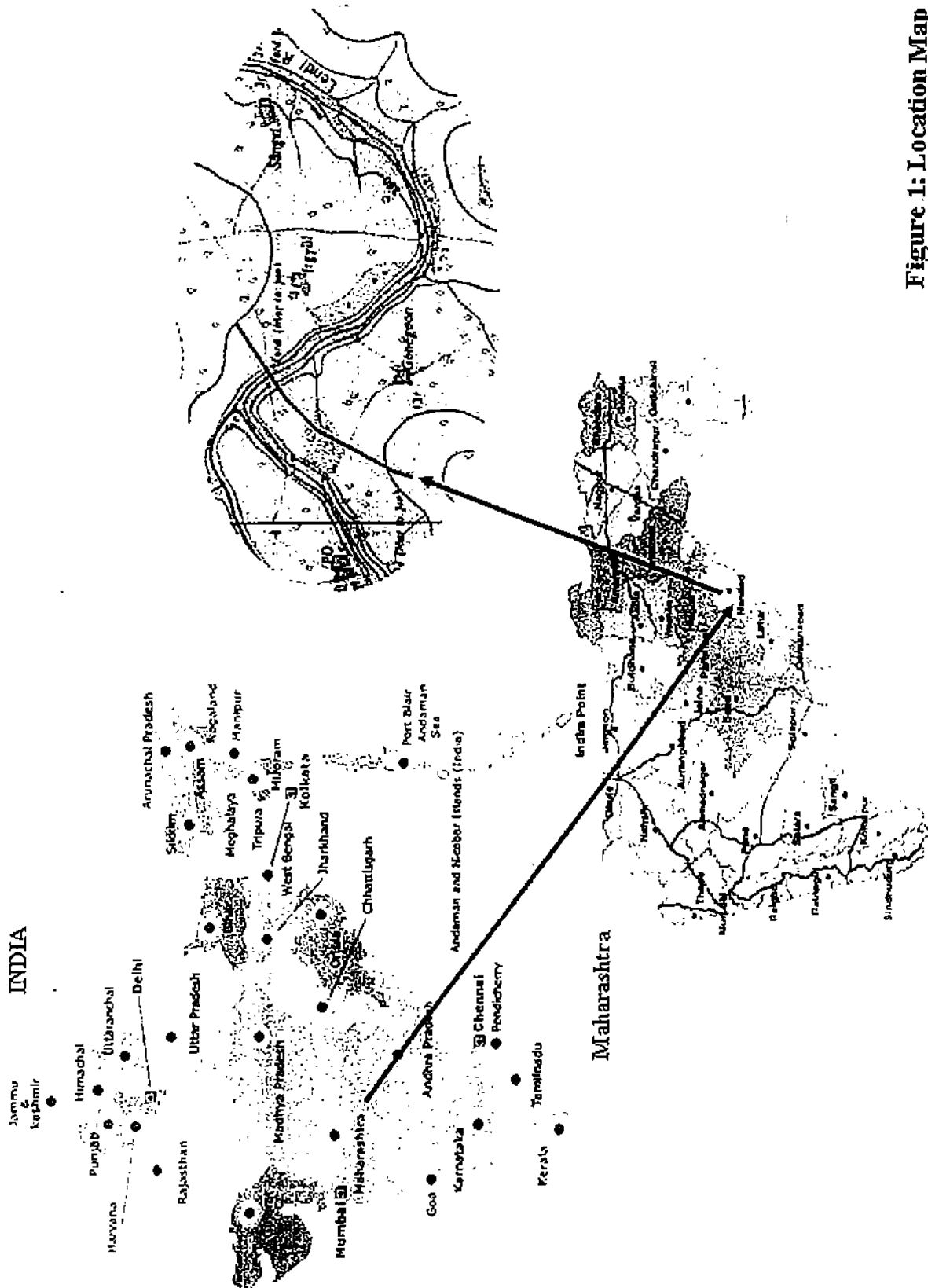
1.8 Work Progress Update

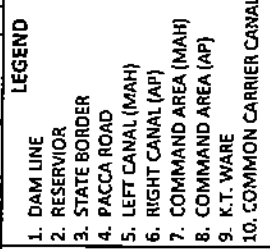
a. Construction of Dam: The total planned 3537 cubic metres of earthen construction is planned. The work towards survey and land acquisition is complete. The earthen as well as masonry work has been initiated and the 75 % work is completed till date. (Excluding gauge portion)

b. Canals: The total length of common canal is 19.00 km. The length of Maharashtra Canal is 28.46 km while the length of Andhra Pradesh Canal is 35 km the survey and delineation work of the common canal has been completed.



Source: Meeting updates Presentation 02.03.2011





GENERAL NOTES		CATCHMENT AREA 1594 Sq Km.	
COMMAND AREA IN b. MAHARASHTRA STATE	ANDHRA PRADESH	TOTAL	CANAL
11,000 Ha	8,907 Ha	19,907 Ha	a. MAHARASHTRA 30.84 KM(LI)
4,710 Ha	2,307 Ha	7,017 Ha	b. ANDHRA PRADESH 34.57 KM (R)
			COMMON CARRIER 0 TO 18.98 KM
			TOPO SHEET
			56 F/NE
15,710 Ha	11,214 Ha	26,924 Ha	56 F/SW
TOTAL			



1.9 Salient Features of the Project

The Lendi River with its two main tributaries Tiru and Kundrala originates at an altitude 650 m near Udgir in Latur district. Lendi flows 85 km in the eastern direction, and joins Manjra River at an altitude of 362 m below the Nizamsagar Project.

In the initial reaches, the Lendi river flows through hilly area with an average bed fall of 11m/ km for about 15 km from its origin. There after it flows with an average bed fall of 4 m/ km for about 21km up to the confluence of Tiru River – the tributary of Lendi. Finally it joins to Manjra River by flowing through plain country with a bed fall of 1 m/ km for remaining length of 49 km and thus the overall bed slope is 3.11m/ km

The total length of the river is 78.89 km up to the dam site upstream of Gonegaon village. The basin up to this site is an undulating plane having predominantly medium black soil derived from the Deccan trap.

The available water from the Lendi river basin has not been fully utilized except for some minor irrigation schemes and two medium irrigation projects; one each on Tiru and Kundrala tributary. Hence, it is proposed to have a storage reservoir by constructing a dam across this river at Gonegaon.

Lendi project is included in the Krishna- Godavari master plan at Sr. No. 37, page 35 for water utilization of 209.51 mm² (7.40 TMC). According to this water reservation, detailed investigation for this project was carried out and submitted to the Central Water Commission (CWC) for clearance by Govt. of Maharashtra in 1967 under letter no. PIM/6067/71894/IP (I) dt; 24.08.1967. The CWC has raised remarks during Oct. 1968, Sept. 1969 and Aug. 1971 and replies to these remarks were submitted in Feb.1969, June 1970 and July 1973 respectively.

Table 1.3 The detail salient features of the project

1. Name of the Project	: Lendi Major Irrigation Project Taluka Mukhed Dist. Nanded.
2. Location	
a. River	: Lendi (A tributary of Manjara River)
b. Taluka & Dist.	: Taluka Mukhed Dist. Nanded
c. Co-ordinates	

Latitude	: 18° 32'
Longitude	: 77° 26'

3. Hydrology

a. Total Catchment area at the Proposed site	: 1594 Sq km
b. Average annual rainfall	: 838 mm
c. 75% Dependable annual rainfall	: 617 mm
d. Maximum monsoon rainfall	: 1434 mm
e. Yield at 75% dependability	: 9.687TMC
f. Net 75% dependable annual yield Deducting existing & proposed U/s utilization	: 8.65TMC

4. Reservoir

a. Full Reservoir Level (FRL)	: 396.00 m
b. Top of Dam (Reservoir)	: 401.00 m
c. High Flood Level (HFL)	: 398.50 m
d. Irrigation Sluice (I.C.P.O.)	: 388.00 m
e. M.D.D.L.	: 389.50 m
f. Gross Storage.	: 145.15 M Cum
g. Dead Storage.	: 26.83 M Cum
h. Live Storage.	: 118.32 M Cum
i. Annual utilization	: 180.11 M Cum

5. Dam

a. Type	: Earthen Dam with Masonry Spill Way
b. Length	: 1651.40 m
c. Top of dam	: RL 401.00 m
d. Top width	: 6.5 m
e. Maximum height	: 27.83 m
f. Free Board	: 2.5 m

6. Spill Way

a. Type	: "Ogee" with 14 gates of size 12 x 8 M
b. Length of weir	: 328.60 m
c. Location	: RD 1208 m to 1536.60 m
d. Crest Level	: 388.00 m
e. Maximum design discharge	: 11660 m ³ /sec

7. Head Regulator

a. Number	: 1 No. @ RD 315 M. on Left Flank

- b. Sill Level : 388.00 m
- c. Canals
 - i. Length of Common carrier : 19.00 km
 - ii. Length of Left canal of Maharashtra : 28.50 km
 - iii. Right bank canal of Andhra Pradesh : 35.00 km
 - iv. Off take point of A.P. Canal : 18.98 km

8. Capacity of Canals

- a. Common carrier : 13.260 cumecs
- b. Left bank canal of Maharashtra : 6.541 cumecs
- c. Right bank canal of A.P. : 6.485 cumecs

9. Submergence

- a. Area under submergence : 2338.06 ha
- b. Acquisition of land : FRL + 0.50 m
- c. Total population affected : 30680 individuals
- d. Number of villages affected : 19 villages (Fully submerged 12 & only Land affected 7)
- e. Submergence Ratio. : 0.12

Area under submergence $\times 100 = 2338.06 \times 100 / (11000+8907) = 11.74 \% \text{ I.C.A.}$

10. Unit Cost

- a. Cost of the project : Rs. 55454.51 lakh
- b. Cost per 1000 cum of Gross Storage : Rs. 35586 / per TMC
- c. B.C. ratio : 1.58
- d. E.R.R. : 13

According to Inter State meeting on 6/10/1975 between the States of Maharashtra and Andhra Pradesh and subsequent meeting on 19/12/1975 by three States viz. Karnataka, Maharashtra and Andhra Pradesh for Godavari basin, the States of Maharashtra and Andhra Pradesh have decided to take up the Lendi project as a joint venture with agreed water utilization as per Govt. letter No. ISW- 176/722-A6/ dated 24.05.1976. Further according to final award of Krishna Godavari Water Dispute Tribunal (KGWDT), the State of Maharashtra is free to utilize 1698.75 Mm^3 (60 TMC) of water for new projects in the Godavari basin below Jayakwadi dam, below Siddeshwar on Purna and below Nizamsagar on Manjara but above Pochampad project. This project is now planned out of above reservation of water to utilize 180.06 Mm^3 (6.36 TMC).

Drinking Water Provision:

In the planning, 1.5 mcum drinking water has been allocated for Udgir Taluka of Latur District of Maharashtra while, for Andhra Pradesh around 6.80 mcum water is reserved for the drinking water. Additionally once the project is operational, many small water supply schemes will be undertaken for the villages in the periphery of the reservoir.

The detailed breakup of the drinking water requirement is as provided in the table 1.4.

Table No. 1.4 Gross Demand Table (Combined) at Canal Head

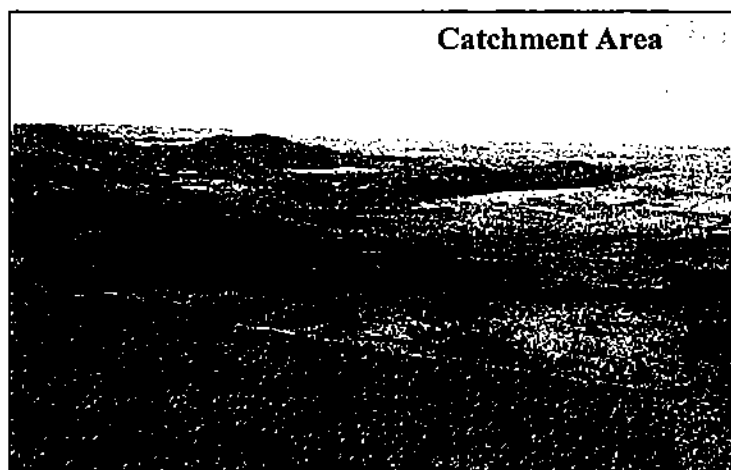
Sr. No	Month wise water requirement in M.m ³							Gross total Col: (4+8)
	Months	Maharashtra			Andhra Pradesh.			
		Irrigation	Drinking Water	Total	Irrigation	Drinking Water	Total.	
1	2	3	4	5	6	7	8	9
1	June	4.884	0.125	5.009	3.2499	0.5664	3.8163	8.8253
2	July	2.200	0.125	2.325	5.9620	0.5664	6.5284	8.8534
3	August	3.330	0.125	3.455	7.5905	0.5664	8.1569	11.6118
4	September	5.554	0.125	5.679	8.8694	0.5664	9.4358	15.1145
5	October	14.480	0.125	14.605	14.3556	0.5664	14.922	29.5274
6	November	11.640	0.125	11.765	2.9500	0.5664	3.5164	15.2816
7	December	13.208	0.125	13.333	2.5722	0.5664	3.1386	16.4720
8	January	13.915	0.125	14.040	3.3000	0.5664	3.8664	17.9060
9	February	6.681	0.125	6.806	1.0000	0.5664	1.5664	8.3724
10	March	2.735	0.125	2.860	0	0.5664	0.5664	3.4269
11	April	3.924	0.125	4.049	0	0.5664	0.5664	4.6158
12	May	7.303	0.125	7.428	0	0.5664	0.5664	7.9945
	Total M.m ³	89.8550	1.5000	91.355	49.8496	6.7968	56.646	148.0014

	Maharashtra	Andhra Pradesh	G. Total
Irrigation	89.8550	49.8496	
Drinking water	1.5000	6.7968	
Evaporation.	19.836	12.157	
	111.1910	68.8034	
SAY.	3.93	2.43	6.36
	TMC	TMC	TMC

Source: Third revised estimate of the Lendi Project 2006-07 (Page no. 07) & Interstate Agreement Para 2.3 A dt; 18.11.2003

1.10 Catchment Area

The total catchment area of this site is 1594 sq.km. from where total yield 341.93 mm³ (12.077 TMC) is available and it lies in the state of Maharashtra. Total water utilization of the project including



evaporation losses is 6.36 TMC, out of which, Maharashtra share is 3.93 TMC (62%) and Andhra Pradesh share is 2.43 TMC. The total irrigation potential of the project is 26924 ha, out of which 15710 ha potential is in Maharashtra and 11214 ha is in Andhra Pradesh.

Table 1.5 State wise Utilization of Water of Lendi Project

Sr. No.	State	Utilization in TMC		
		Net	Evaporation	Total
1	Maharashtra	3.23	0.70	3.93 (62%)
2	Andhra Pradesh	2.00	0.43	2.43 (38%)
	Total	5.23	1.13	6.36 (100%)

Source: Interstate Agreement Para 2.3 A dt; 18.11.2003

Maximum height of the earthen dam is 27.83 m. Length of the earthen dam is 1651m. Masonry spillway is of ogee shape having length of 214.80 m. with (14) radial gates of size 12m x 8 m are proposed. One I.C.P.O. is proposed at R.D. 315m (1x350 kw). General layout of the scheme is received from C.D.O. Nasik and work of I.C.P.O. is in progress.

Total irrigation proposed is 26924 ha out of which 15710 ha will be in Maharashtra State and the balance 11214 ha in Andhra Pradesh. The State-wise conjunctive use of both surface and ground water as indicated below:

Conjunctive use of water: This concept was introduced by the C.W.C. in planning of irrigation projects, which states that the percolation losses and direct precipitation in the command during monsoon, results into the rise of water table in wells of the

command area. This recharge should be used conjunctively with surface irrigation. The requisite data was supplied to ground Water Development Authority (GSDA) and on this basis they have communicated that about 38.52 mm³ (1.36 TMC) of utilisable recharge is available in the command of Lendi project.

The 1.36 TMC of the recharge if harnessed would bring an area of 4710 ha of command under irrigation for the State of Maharashtra. Similarly for Andhra Pradesh command 0.780 TMC of recharge will be available from wells and this meet an additional area of 2307 ha. This additional recharge has been considered while finalizing the gross demand. The water utilization section of hydrology chapter has provided details on the conjunctive water use. The summary of quantification of conjunctive water use planned is provided in table 1.6.

Table 1.6 Water utilization (conjunctive use of water)

State	G.C.A. ha	C.C.A. ha	Total I.C.A.	G.W. use ha	I.C.A. (Surface)
Maharashtra	19050	16950	15710 (surface 11000, Ground 4710)	4710	11000
Andhra Pradesh	13360	11336	11214 (surface 8907, Ground 2307)	2307	8907
Total	32410	28286	26924	7017	19907

Source: Third revised estimate of the Lendi Project 2006-07 (Page no. 07)

1.11 Submergence Area

The total 2338.06 ha agricultural and Gaothan land will be submerged due to the proposed project. The total 19 villages will be affected. Out of the total 19 villages, 12 villages are fully affected and only land affected villages are seven. The total 5880 families will be affected from 19 affected villages.

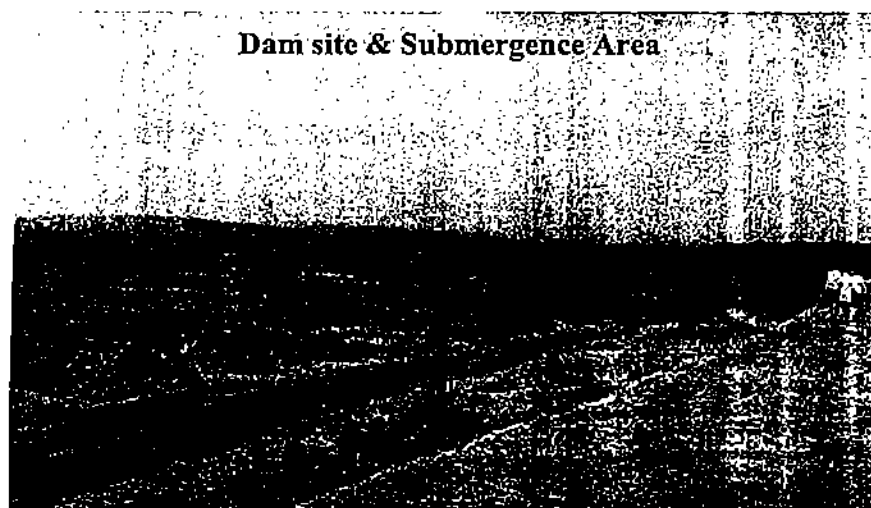


Table 1.7 Submergence area

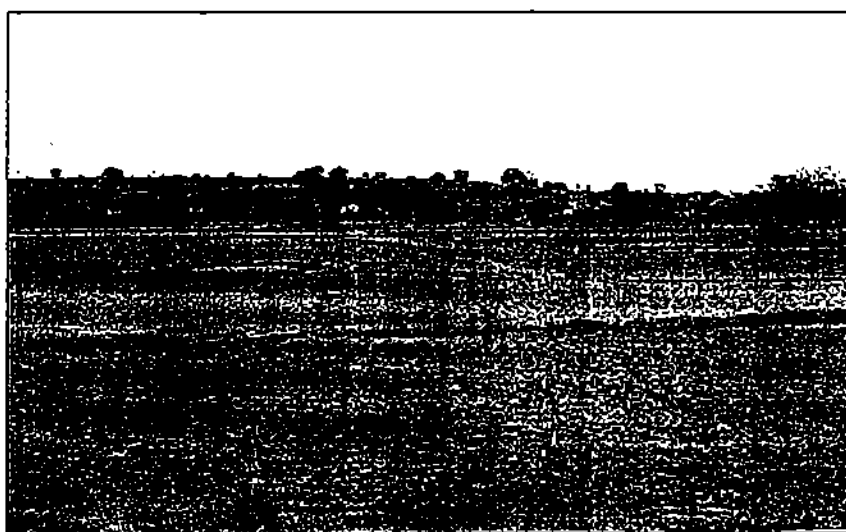
Sr. No	Affected villages	No	Submerged Area in ha	Families
1	Fully	12	2228.5	5731
2	Partially (Only land affected)	7	109.56	149
	Total	19	2338.06	5880

1.12 Command Area Details

The total project has 32410 ha as a gross command area (G.C.A.), 28286 ha as a culturable command area (C.C.A.) and 26924 ha as an irrigable command area (I.C.A.) including

conjunctive use of ground water for both the States.

The break – up of the command is as given in the table covering the area of Mukhed -



Degloor talukas in Nanded district of Maharashtra and the area of Madnoor and Bichkunda talukas / mandals in Nizamabad district of Andhra Pradesh.

The soils of the district are black and fertile. The best black soils, which are deep and clayey are found in a narrow strip of land on the banks of the Godavari River and its tributaries. Soils have light grey, brown to grey brown colour on the surface. They exhibit clayey texture and black colour.

In Kandhar and western parts of Mukhed talukas the soils though black are stony and thin. As a consequence only Kharif crop is grown. Nearby Mukhed tehsil, Deglur tehsil is considered to possess the best soil in the whole of the district. The soils attain greater depth and are more fertile in the western parts of Deglur and Biloli tehsils. Hence, in addition to the Kharif crops, Rabi crops are also grown. The rich soils on

either bank of the Godavari River are used for intensive cultivation of rice, plantains and chillies.

Table 1.8 Command Area Details

No.	Name of Taluka	State	G.C.A. (ha)	C.C.A. (ha)	I.C.A. (ha)
1	Mukhed	Maharashtra	440.74	392.15	363.47
2	Degloor	Maharashtra	18609.26	16557.85	15346.53
3	Madnoor	Andhra Pradesh	3803.00	3227.00	3192.00
4	Bichkunda	Andhra Pradesh	9557.00	8109.00	8022.00
	Total		32410	28286	26924

1.13 Cropping Pattern for Maharashtra and Andhra Pradesh

The existing cropping pattern in the project command area is as follows:



Table 1.10 Existing Cropping Pattern for the command area in Maharashtra

Sr. No.	Name of Crops	Percentage
1	L.S. Cotton	13
2	Chillies	2.9
3	Oil Seeds	4.5
4	Other Perennials	0.6
5	Paddy	2
6	Jowar (Kh)	18
7	Groundnuts	4
8	Pulses	17
9	Wheat	6
10	Jawar (Rabi)	30
11	Gram	2
	Total	100%

(Source: Revised Estimate of Lendi Project, Abstract, Volume I, 1999-2000)

The proposed cropping pattern for the Maharashtra state is as follows

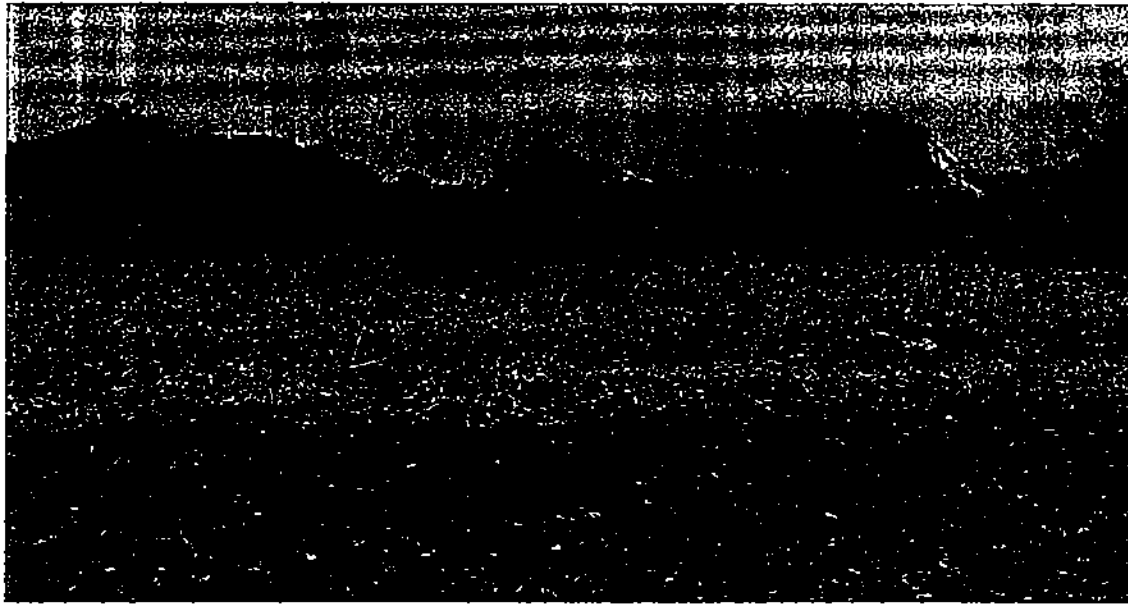


Table 1.11 Proposed Cropping Pattern for the command area in Maharashtra

Sr. No.	Name of Crops	Percentage
1	Perennials	
	a. Sugarcane	4
2	Two Seasonal	
	a. Chillies	10
	b. L.S. Cotton (Short Duration June Showing)	20
3	Kharif Seasonal	
	a. Paddy	10
	b. Kh. Hy. Jowar	10
	c. Kh. Hy. Maize	15
	d. Green Manure Pulses etc. (Un irrigated)	31
		100
4	Follow on Crops	
	a. Rabi Jowar Maldandi	15
	b. Wheat High Yielding	25
	c. Gram	10
	d. H.W. Groundnut	5
		55
	Total	155
	Irrigation Intensity	124%

(Source: Director of Agriculture, Pune vide Lr. No. IRP/77/Lendi/Dt./30.3.83)

Cropping pattern for command area in Maharashtra is considered, as approved by Director of Agriculture, Pune vide Lr. No. IRP/77/Lendi/Dt./30.3.83. The cropping pattern is prepared on the basis of average percentage of existing crops in the

command of Maharashtra with due consideration of soil situation, existing trend and marketing demands.

Table 1.12 The existing & proposed cropping pattern for command area in Andhra Pradesh

A. Existing cropping pattern			B. Proposed cropping pattern		
Sr. No.	Name of crop	% Age	Sr. No.	Name of crop	% Age
1	2	3	1	2	3
Kharif	Paddy	5.00	Kharif	Paddy	10.00
	Soyabean	15.00		Soyabean	15.00
	Cotton	15.00		Cotton	20.00
	Black gram	5.00		Red gram	10.00
	Green gram	5.00	Rabi	Paddy	25.00
	Red gram	5.00		Ground nut	10.00
Rabi	Paddy	5.00		Sun Flower	10.00
	Ground nut	5.00		Sugar Cane	4.00
	Sun Flower	15.00		Gram	10.00
	Bengal gram	25.00		Chillies	10.00
	Total	100.00			124.00

(Source: Andhra Pradesh Government, agricultural authorities vide Lr. No. TPD/DB-14/284/92 dt. 14-9-92)

Planned Irrigation Intensity is 124 %. Total area proposed to be irrigated by flow irrigation is 11075 ha considering 124 % irrigation intensity; annual irrigation comes to 13733 ha. Cropping pattern taken by Andhra Pradesh Government for this project is decided by their agricultural authorities vide Lr. No. TPD/DB-14/284/92 dt. 14-9-92.



1.14 Physiography and Relief

In Nanded district, the main trend of the hills is from northwest to south-east in parallel ranges.

The first of the ranges from north is known as Satmala range, which enters the district after the gap, cut by the



Penganga just West of Mahur. The hill range, which forms the water divide between the Penganga and the Godavari enters the district from a northwest direction. To the south of the Satmala range, are the Nirmala ranges running parallel to Satmala range. The hill range, which forms the water divide between the Penganga and the Godavari, enters the district from a northwesterly direction and stretches south-eastwards. The hills to the south of the Godavari are generally of lower elevation. The area shows severe erosion along the nala, riverbanks and few other patches. This area would require shaping and stabilizing for irrigation. The entire command area is slightly undulating plane having predominantly medium black soil derived from the Deccan trap.

1.14.1 Climate : The entire Catchment area is subjected to tropical climate. The temperature shows large variation. The annual temperature ranges from 5°C in winter to 45°C during summer season. The drainage area lies in the normal annual rainfall range of 900 mm (38 inch) to 1000 mm (39 inch) and the weighted average annual rainfall is about 960 mm. It receives most of its precipitation from southwest monsoon during the period from June to September. The area (Catchment and command) lies directly in the path of cyclonic storms originating from the Bay of Bengal due to which it receives rains as stated above and therefore it is generally called as an area of moderate rainfall zone. Due to erratic nature of monsoon the area experiences some dry spells in August and September.

1.14.2 Geology: The entire command area lies in between the latitude from 18° 30' to 18° 40' North and the longitude from 77° 25' to 77° 45' East. The area is an undulating plane occupied by Deccan trap. Mainly two types of geological formations are noticed in the district with patches of local alluvium along the major rivers. About more than two third portion of the district is covered by Deccan trap formation of Cretaceous Eocene age and the rest is occupied by igneous rocks of Archaean age and local alluvium of recent to sub recent age. Very small portion of the district is covered under clayey and alluvium soil. Exposures are scanty except along the river course. Most of the soils under the command area are grid soil developed from the basaltic Deccan trap. The soils on the ridge portion are shallow and formed *in situ*. At the proposed dam site it is found that the thickness of massive trap ranges from 12.80m to 20.00m.

1.14.3 Hydrology and Water Management: The most important river of the Nanded district is Godavari River. It enters the district from the west and flows eastwards through the central part of the district. It controls almost the entire drainage system of the district. Other rivers are the Manjra, Manar, Saraswati, Penganga, Ashna, Sita and Lendi. The largest tributary of the Godavari is Manjra, which flows from south to north forming the boundary between the district and Andhra Pradesh. Manar flows through Kandhar tehsil from west to east and forms the natural boundary between Mukhed, Deglur and Biloli tehsils. Saraswati takes its course in Wakhad hill, flows from north to south through the eastern portion of the district and finally meets the Godavari.

Lendi flows from west to east in Deglur tehsil with its tributary -Tiru. Tiru, after the confluence with Lendi, referred as Lendi and forms as one of the major tributary of Manjra. Ashna flows in the eastern direction and falls into Godavari on the left bank about two miles from Nanded town. Sita comes from North and meets Godavari. The Penganga forms the northern boundary of the district throughout its long sinuous course. It flows in an easterly direction. At two places, namely Jamsa village and near Islampur, the Penganga changes its direction and continues the course of its tributaries viz. Tamsa nala and Khat River. It falls into Wardha River in Yavatmal district.

1.14.4 Water Availability: The river Lendi with its two main tributaries Tiru and Kundrala originates at an altitude of 650m, near Udgir in the Latur district of Maharashtra State. It flows 85 kms in the eastern direction and joins Manjara River at an altitude of 362m. The river flows through hilly area with an average bed fall of 11m per km initially for the 15km from its origin. Thereafter it flows with an average bed fall of 4 m per km for about 21 km up to the confluence with Tiru river tributary. Finally it joins the Manjra river with a bed fall of 1m per km for the remaining length of 49km. thus the overall bed slope of the Lendi river is 3.11m per km from the origin to the dam site the river length counts to be 78.89km

The rainfall series 1914 to 1965 of Ahmedpur, Kandhar, Degloor & Udgir rain gauge stations in the influence of Lendi Catchment area were considered in the report. The yield on the project was worked out to be 210.164 Mm³ (7.423 TMC). While working out this yield post monsoon flow was restricted to 5% as per the C.W.C. suggestions given in September 1969. The 75% dependable design year was 1964. The yield was exclusive of upstream reservations 68.714 Mm³ (2.427 TMC) intercepted by Tiru, Kundral medium projects and some M.I. schemes

The 75% dependable yield at project site is 314.28 Mm³. Considering upstream utilization of 68.714 Mm³ (2.427 TMC) and 28.31 Mm³ (1 TMC) reservation for Udgir tehsil, the net yield thus available for this project is 244.90 Mm³ (8.65 TMC) as against the requirement of 180.11 Mm³ (6.36 TMC).

Table 1.13 Yield of Lendi Major Project (From 1949 to 2004)

Statement showing Monsoon Yield at Lendi Project from 1949 to 2004.							
			75 % dep monsoon virgin yield			314.28	Mcum.
Sr. No	Total Virgin Monsoon yield at Lendi Project site						
	Year	June	July	August	Sept	Oct	Total
		Runoff in MCM					
1	1949	44.18	105.22	33.83	108.16	35.06	326.46
2	1950	62.16	155.09	62.96	169.84	29.09	479.14
3	1951	50.64	124.08	37.68	136.35	26.01	374.76
4	1952	76.60	195.85	90.51	210.11	30.99	604.06
5	1953	40.20	104.83	75.50	235.59	52.82	508.94
6	1954	98.75	80.96	76.14	242.57	141.78	640.21
7	1955	79.46	129.62	343.55	228.74	42.94	824.30
8	1956	56.77	341.80	28.69	104.57	68.70	600.53

9	1957	37.21	149.94	227.89	112.88	46.75	574.68
10	1958	10.54	48.24	85.38	33.33	15.05	192.54
11	1959	54.10	92.57	136.61	124.73	56.14	464.15
12	1960	66.68	76.84	0.00	158.64	10.59	312.76
13	1961	52.09	153.00	87.41	54.48	142.93	489.91
14	1962	21.40	46.51	145.17	301.53	54.64	569.24
15	1963	81.53	60.90	231.89	35.51	124.18	534.01
16	1964	20.08	102.12	70.89	189.57	26.95	409.62
17	1965	51.70	113.12	87.53	103.84	0.00	356.19
18	1966	21.94	61.63	29.98	149.25	0.00	262.79
19	1967	19.31	69.75	17.55	76.47	2.83	185.91
20	1968	15.39	92.04	1.71	177.99	26.24	313.37
21	1969	12.92	118.12	78.12	190.16	4.61	403.94
22	1970	49.64	64.12	291.76	235.42	0.00	640.93
23	1971	26.50	0.00	81.70	43.83	86.29	238.32
24	1972	17.70	0.00	27.45	5.62	3.12	53.89
25	1973	32.25	61.35	215.10	89.06	119.71	517.47
26	1974	48.88	53.95	106.62	144.67	168.15	522.28
27	1975	11.13	192.18	159.99	225.60	125.99	714.89
28	1976	21.53	114.08	103.59	56.63	0.00	295.83
29	1977	23.36	94.59	73.36	56.98	33.23	281.52
30	1978	55.82	157.52	78.23	84.62	50.55	426.74
31	1979	47.50	45.05	25.08	237.82	0.00	355.46
32	1980	45.75	29.52	190.91	141.24	0.00	407.42
33	1981	20.72	55.34	72.42	247.72	45.09	441.29
34	1982	15.31	116.83	35.51	145.96	28.83	342.44
35	1983	9.15	139.78	282.05	358.84	213.84	1003.65
36	1984	34.80	77.37	11.61	120.56	69.94	314.28
37	1985	52.44	105.14	29.81	93.50	75.85	356.74
38	1986	26.72	47.40	106.04	21.62	0.00	201.78
39	1987	37.57	59.92	115.52	4.34	52.59	269.96
40	1988	38.51	154.47	247.57	450.77	7.31	898.62
41	1989	62.71	231.96	141.12	141.74	23.35	600.88
42	1990	61.41	30.18	225.85	39.36	174.37	531.17
43	1991	40.05	148.06	18.94	0.00	0.00	207.05
44	1992	42.02	0.00	110.83	71.82	42.21	266.88
45	1993	20.87	91.96	97.12	66.79	87.38	364.12
46	1994	17.26	37.19	92.80	26.77	69.07	243.08
47	1995	49.66	109.07	75.32	42.04	197.70	473.78
48	1996	3.15	107.96	154.92	235.41	129.27	630.70
49	1997	9.53	50.60	99.52	91.06	84.16	334.87
50	1998	36.33	160.70	154.71	243.33	112.49	707.56
51	1999	17.33	74.43	105.61	138.62	84.59	420.58
52	2000	51.28	90.15	277.53	30.32	14.48	463.76
53	2001	65.46	0.00	183.80	30.37	150.17	429.80
54	2002	34.94	17.66	153.44	114.42	32.25	352.71

55	2003	31.90	180.49	108.73	74.12	17.22	412.46
56	2004	33.41	160.63	36.57	187.71	54.55	472.87
Average		38.68	97.89	111.43	132.91	58.79	439.70

Table 1.14 Storage (existing and planning) upstream of proposed Lendi Dam

Name of Project	Taluka	District	U/S Gross Storage in M Cum.	U/S Storage up to Project M cum.
COMPLETED PROJECT				
Major Project.			0	0
Medium Project			0	0
Minor Project				
Nedgir	Udgir	Latur.	1.78	1.78
Haldwatona	Jalkoot	Latur.	3.68	3.68
Degaon	Mukhed	Nanded	1.98	1.98
Hunmanhipperga	Degloor	Nanded	0.99	0.00
Nideben	Udgir	Latur.	1.36	1.36
Dhonwadi	Jalkoot	Latur.	1.05	1.05
Gudsor	Udgir	Latur.	1.93	1.93
Downhipperga	Udgir	Latur.	4.05	4.05
Gupti	Jalkoot	Latur.	3.09	3.09
Sonada	Jalkoot	Latur.	5.49	5.49
wejegphd	Udgir	Latur.	1.10	1.10
Hanihipperga	Udgir	Latur.	0.96	0.96
Bagentakdi	Degloor	Nanded	0.91	0.00
		Total	28.37	26.47
PROJECT IN PROGRESS				
Major Project.			0.00	0.00
Medium Project			0.00	0.00
Minor Project				
Khrebwadi	Ahmedpur	Latur	2.57	2.57
Rohini	Chakur	Latur	1.08	1.08
Mandorki		Latur	1.33	1.33
Kodli		Latur	1.72	1.72
Dongergaon		Latur	4.17	4.17
Gotti -II		Latur	1.41	1.41
Rawenkoda		Latur	1.27	1.27
Dapkaraja	Mukhed	Nanded	1.84	1.84
Undrimangri	Mukhed	Nanded	1.65	1.65
Increase hight of Tiru Project	Udgir	Latur	4.50	4.50
Chandegaon		Latur	4.53	4.53
Tondchir		Latur	1.33	1.33
Madhipperga		Latur	4.08	4.08

Mangri		Latur	2.73	2.73
		Total	34.21	34.21
PROJECT UNDER EXPLORATION				
Major Project.			0.00	0.00
Medium Project			0.00	0.00
Minor Project				
Bamajichiwadi		Latur	1.14	1.14
Dongerkonali		Latur	4.13	4.13
Awelkonda		Latur	2.23	2.23
Dhongitanda		Latur	1.17	1.17
Shirnade			1.65	1.65
Wazer	Degloor	Nanded	1.62	0.00
Sherngi	Degloor	Nanded	2.03	0.00
Tumberphadi	Degloor	Nanded	2.10	0.00
Loonitanda	Degloor	Nanded	1.15	0.00
		Total	17.22	10.32

Table 1.15 Existing utilization in catchments area of Lendi Project

Sr. No.	Name of Project	Taluka	District	U/S Gross utilisation up to Gauging Site in Mcft.	U/S Storage up to Project Mcft.
COMPLETED PROJECT					
A)	Major Project.			0	0
B)	Medium Project				
1)	Tiru Project	Udgir	Latur.	938.0	938.0
2)	Kerdkhed Project	Degloor	Nanded	600.0	0.0
3)	Kundrala Project	Mukhed	Nanded	657.0	657.0
			Total	2195.0	1595.0
C)	Minor Irrigation (S.S.) (A)				
1)	Pimpri	Udgir	Latur	130.000	130.000
2)	Kallur	Udgir	Latur	51.000	51.000
3)	Ekurka.	Udgir	Latur	68.000	68.000
4)	Nagatgaon	Udgir	Latur	66.000	66.000
5)	Wasur	Mukhed	Nanded	43.000	43.000
6)	Dhorsangvi	Ahmedpur	Latur	93.000	93.000
7)	Degloor	Degloor	Nanded	47.000	0.000
8)	Ambutga	Degloor	Nanded	96.000	0.000
9)	Hanegaon	Degloor	Nanded	59.000	0.000
10)	Hanegaon II	Degloor	Nanded	42.000	0.000
				695.000	451.000
D)	Minor Irrigation (S.S.) (A)				
1)	Janapur	Udgir	Latur	26.000	26.000
2)	walkonda	Udgir	Latur	26.000	26.000

3)	Dongarshelki	Udgir	Latur	26.000	26.000
4)	Jamb (Bk)	Mukhed	Nanded	23.000	23.000
5)	Bapethwadi	Mukhed	Nanded	19.000	19.000
6)	Gojegaon	Mukhed	Nanded	14.000	14.000
7)	Kamjatga	Mukhed	Nanded	9.000	9.000
8)	Konali	Udgir	Latur	18.000	18.000
9)	Dawangiri	Udgir	Latur	14.000	14.000
				175.000	175.000
E)	Lift Irrigation Scheme				
1)	Hanuman Hipparga	Degloor	Nanded.	167.000	0.000
2)	Mujalga	Degloor	Nanded.	62.000	0.000
3)	Temlur	Degloor	Nanded.	58.000	0.000
4)	Penar Scheme	Dgloor	Nanded	0.000	0.000
				287.000	0.000
F)	LARGE MINOR				
1)	Rechannwadi	Udgir	Latur	180.000	180.000
2)	Sangamawadi	Udgir	Latur	269.000	269.000
3)	Gurdghal	Udgir	Latur	141.000	141.000
				590.000	590.000
G)	M.I.S.S.				
1)	Keskrwadi	Udgir	Latur	66.000	66.000
2)	Jagamwadi	Udgir	Latur	39.000	39.000
3)	Hawarga	Ahmedpur	Latur	62.000	62.000
4)	Bothi	Udgir	Latur	72.000	72.000
5)	Deogaon	Mukhed	Nanded	55.000	55.000
				294.000	294.000
			G. Total	4236.000	3020.000
				119.949	85.516

Table 1.16 Summary of the yield versus utilisation

LENDI MAJOR PROJECT					
Statement showing monthly U/S Utilisation of Medium and Minor projects.					
75 % Virgin Monsoon yield at the project site =		314.28	MCM		
Total Upstream utilization =					
Utilization	Utilization up to Gauging site.	MCM	Utilization up to Project site.		
Completed					
Medium	119.949		85.516		
Minor	28.37		26.47		
Under construction					
Medium	0		0		

Minor	34.21	34.21
Administrative approved		
Medium	0	0
Minor	17.22	10.32
Total	119.749	156.516
PM flow 3%		
Monsoon	193.76	151.82
Regeneration	10%	
In MCM	19.975	15.652

Crop water Requirement: In the administratively approved report the crop water requirement is calculated by considering the following points:

i)	Methodology adopted	Charisitansons's method.
ii)	Climatological data	Nizamabad station
iii)	Overall efficiency	65.52%
	a) Conveyance efficiency	90%
	b) Distribution system efficiency.	91%
	c) Field application efficiency.	80%
iv)	Lining up to 5/8 hector block	
v)	Chance of rain fall occurrence	80%

However, as per the CWC Directorate Guidelines (CWC Booklet T5 series), the system efficiencies suggested are as below:

a) Conveyance efficiency: Lining of main canal and distribution up to 5 to 8 ha block (as in case of the Lendi Project)	75%
b) Field application efficiency (field canal to root zone of crop)	65%
c) Pre sowing water depth for all crops	75 mm
d) Occurrence of effective rainfall	80%
Overall efficiency = Conveyance efficiency *field application efficiency *100	48.75% say 50 %

Considering all factors mentioned in the above table, a fresh crop-water requirements for various crops to be harvested in Maharashtra and Andhra Pradesh are worked out, which are also prepared duly applying the modified penman method. Thus the overall efficiency considered for design of the Canal System of the Lendi project is 50%.

Table No 1.17 The crop water requirement calculated accordingly is presented below:

Water requirement per 1000 Ha. (Maharashtra portion as per Modified Pan men method)

As per T - 5 series (in M. Cum.)

Sr. No.	Crops.	%	Area in Ha.	Kharif				Rabi.				Hot. Weather.							
				Jul	Aug	Sep	Oct	Total.	Oct	Nov.	Dec	Jan	Feb	Total.	Mar.	Apr	May	Jun	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	Perennials.																		
1	Sugarcane.	4	40	0.020	0.017	0.019	0.022	0.078	0.022	0.044	0.039	0.063	0.041	0.209	0.054	0.071	0.094	0.050	0.269
	Over lap 30% Kh., 40% Rab., HW. 10%.			0.006	0.005	0.006	0.007	0.024	0.008	0.018	0.016	0.025	0.016	0.083	0.005	0.007	0.009	0.005	0.026
				0.026	0.022	0.024	0.029	0.101	0.030	0.062	0.055	0.088	0.058	0.292	0.060	0.078	0.103	0.055	0.295
2	Two Seasonal.																		
1	Chillies.	10	100	0.015	0.020	0.032	0.094	0.161	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.080	0.080
2	L.S. Cotton.	20	200	0.038	0.070	0.096	0.104	0.308	0.102	0.186	0.000	0.000	0.000	0.289	0.000	0.000	0.184	0.028	0.212
	Kharif.																		
	Hy. Jawar	15	150	0.003	0.009	0.033	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030
	Maize.	10	100	0.007	0.012	0.025	0.016	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.016
	Paddy.	10	100	0.011	0.018	0.042	0.053	0.124	0.053	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.000	0.013	0.013
	Rabi.																		
	Jawar.	15	150	0.000	0.000	0.000	0.000	0.000	0.071	0.111	0.174	0.086	0.000	0.441	0.000	0.000	0.000	0.000	0.000
	Gram.	10	100	0.000	0.000	0.000	0.000	0.000	0.035	0.023	0.089	0.115	0.000	0.262	0.000	0.000	0.000	0.000	0.000
	Wheat.	25	250	0.000	0.000	0.000	0.000	0.000	0.073	0.148	0.283	0.300	0.225	1.029	0.000	0.000	0.000	0.000	0.000
	Hot. Weather.																		
	Ground Nut.	5	50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.021	0.065	0.067	0.101	0.045	0.000	0.213
								0.901						2.723					1.153
	50% Efficiency							1.802						5.446					2.306

Source: Approved Water Planning Booklet Vide CE Letter No. T.S.5/File 21/2610 dt; 20.03.2009

Table 1.18 Lendi Major Project R.B. Canal, Madhur Taluka, Nizamabad District.

Sr. No.	Month.	Khariff Season.					Rabi Season		From canal water for irrigation M.Cum.	Canal water for Drinking water M.Cum.	Total canal water requirement M.Cum.	From wells ground water M.Cum.	Total requirement in M.Cum.	Remarks.
		G. Nut. 5000 Ac.	Chillies 2000 Ac.	Paddy 4000 Ac.	Cotton 9000 Ac.	Pulses 2000 Ac.	Pulses 4000 Ac.	Jawar 1700 Ac.						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	June	0.6395	0	0.5084	2.3022	0.7998	0	0	3.2499	0	3.2499	1.0000	4.2499	14.3556+
2	July	0.8215	0	5.1600	1.4787	0.5018	0	0	5.9620	0	5.9620	2.0000	7.9620	1.4355=15.7911
3	August	1.2205	0	3.4860	3.996	0.888	0	0	7.5905	0	7.5905	2.0000	9.5905	for rush irrigation
4	September	1.3275	0.1328	3.2400	5.8437	0.3254	0	0	8.8694	0	8.8694	2.0000	10.8694	=577.66 Mcft. =
5	October	0	1.3722	5.3984	9.585	0	0	0	14.3556	0	14.3556	2.0000	16.3556	208.20 Cusecs.
6	November	0	1.9900	0	0	0	2.0916	0.8889	2.9500	1.2960	4.2460	2.0205	6.2665	Say 5.90 Cumces.
7	December	0	1.6654	0	0	0	3.2636	1.3464	2.5722	1.5000	4.0722	3.7024	7.7746	
8	January	0	0	0	0	0	4.6428	1.8809	3.3000	2.0000	5.3000	3.2237	8.5237	
9	February	0	0	0	0	0	3.4416	1.6896	1.0000	2.0000	3.0000	4.1312	7.1312	
	Total.	4.0090	5.1604	17.7928	23.2056	2.5150	13.4396	5.8058	49.8496	6.7960	56.6436	22.0786	78.7242	

1.15 Organization of the Study

The EIA Report is based on field data generated at site and data collected from secondary sources of all seasons. The present final report is divided into chapters as presented below:

VOLUME – I ENVIRONEMNT IMPACT ASSESSMENT

Chapter 1 Introduction This chapter provides background information of the project, site description, Salient features of the project, overview of legislation, and organization of the report.

Chapter 2 Scope and Methodology of EIA: This chapter deals with the scope and methodology of the project. This includes approved Terms of Reference (TOR), detailed methodology use for collection and analysis of data, identification of impacts and preparation of management plan to mitigate the impacts.

Chapter 3 Baseline Environmental Status - Land Use and Land Cover: This chapter presents the procurement of National Remote Sensing Agency (NRSA), Hyderabad was downloaded into the system and a land-use map was prepared. Such data is crucial for obtaining and visualizing the information pertaining to the existing field conditions, assessment of the accessibility of the area, pattern and distribution of vegetation and its composition.

Chapter 4 Baseline Environmental Status – Meteorology: This chapter represents the meteorological data of the study area recorded by Indian Meteorological Department (IMD). It provides information on the prevailing meteorological conditions of the study area. This chapter describes regional surface meteorological data viz., temperature, relative humidity, wind speed and direction, station level pressure and rainfall.

Chapter 5 Baseline Environmental Status – Soil Quality: This chapter deals with various aspects of the soil in the command area of Maharashtra and Andhra Pradesh from structure to texture to depth, drainage, irrigability, nutrient status, suitability for cultivation of crops etc.

Chapter 6 Baseline Environmental Status – Noise and Air Quality: This chapter deals with ambient noise and air quality monitoring undertaken for the project area.

Chapter 7 Baseline Environmental Status – Geology and Seismology: This chapter gives the geological and seismological profile of the area. The geological profile of the area and the chemical and physical properties observed helps us to take proper regulatory measures before and during irrigation and decide the cropping pattern for the command area based on the suitability and outcome.

Chapter 8 Baselines Environmental Status – Hydrology and Water Planning: This chapter deals with water availability and its proposed utilization. Information on the existing water storage structures on the upstream of the project and yield at the proposed dam site was also reported. Data is also made available on yield versus utilization. The information from the command area of the project such as number of wells, area irrigated using well water, ground water table, trends in ground water fluctuation over the years, existing downstream users, existing water conservation structures in the downstream, quality of water etc The chapter also examines surface and ground water quality in order to evaluate its suitability for irrigation and drinking.

Chapter 9 Baseline Environmental Status – Ecological Studies: This section covers the baseline terrestrial and aquatic ecological status of the area. The floral and faunal studies conducted for the entire command, catchment and submergence zone.

Chapter 10 Baseline Socioeconomic Studies: This chapter provides information on demographic structure, existing infrastructure facilities (education, water supply sanitation, roads, electricity, school, post office, bank, village panchayat, police station, approach road etc.) and occupational structure of the project area. The study covers both the secondary data from the Census and primary data collected using questionnaire surveys to bring out the existing socioeconomic status of the project area.

Chapter 11 Social Impact Assessment: This Chapter presents identification and appraisal of various impacts from the project on society. This covers the prediction of impact during construction and operation of the project.

Chapter 12 Environmental Impact Assessment: This chapter presents identification and appraisal of various impacts from the project and estimates the cumulative impact of different project activities on each of the environmental attributes. This covers prediction of possible impacts during the construction and operation of project activities

and categorised as impacts of physical resources, environment, ecological resources, human use values and quality of life. The summary of impacts are provided as an impact matrix.

VOLUME – II ENVIRONMENT MANAGEMENT PLAN

Chapter 13 Environmental Management Plan and Environment Flow: This chapter includes environmental plan and environmental improvement strategies. It provides recommendation for environmental management plan aimed at minimizing the negative environmental impacts of the project. Environmental planning includes a system of plans, programme and measures for planning use/protection of natural resources and incorporation of environmental/ ecological objectives into the Master Plan. Environmental monitoring requirements for effective implementation of mitigation measures during construction as well as operation of the project have also been delineated. Also it includes the management of environment flow of water to maintain aquatic ecosystem.

Chapter 14 Rehabilitation and Resettlement Plan: This chapter covers various legal aspects related to the rehabilitation and resettlement of the project affected families, primary and secondary data on the project affected families, and Rehabilitation and resettlement plan by the project authorities inclusive of provisions by the project authorities. The chapter provides information on number of villages, population and properties under the proposed submergence zone, valuation of properties, compensation details and update on the status of rehabilitation and resettlement plan.

Chapter 15 Green Belt Development Plan: This chapter includes approach of Green belt development along the canal, periphery of dam site in the project area.

Chapter 16 Command Area Development Plan: This chapter includes the comprehensive and inclusive land slopes, soil erosivity, requirement of land development for efficient irrigation and the irrigation department responsible for undertaking such activities, water allocation, distribution pattern, lining of open on farm conveyance system after water will be discharged from the close conduit and conjunctive use of surface and ground water from the context of water use efficient irrigation system.

Chapter 17 Catchment Area Treatment Plan: In this chapter the erosion status of the catchment has been studied using the SYI method. The SYI is calculated for the entire catchment of the Lendi Project. Status of existing watershed development in the catchment area of proposed Lendi Project also been investigated and details are provided as a part of CAT Plan.

Chapter 18 Dam Break Analysis: Some of recent disasters have focused attention on the requirement of conducting needful analysis of such cases, however remote they may be, in order to assess probable damage due to dam break, it is necessary to predict not only the possibility and mode of dam failures, but also the flood hydrograph of discharge from the dam break and the propagation of the flood waves. Thus this chapter includes inundated area, flood depth, flow velocity and travel time of the flood waves etc

Chapter 19 Fish Management Plan: In this chapter the details of fish management plan has been give.

Chapter 20 Environmental Monitoring: Environmental monitoring requirement is highlighted in this chapter. Monitoring Schedule for Environmental Parameters & Budgetary cost towards the environment management is also estimated and presented.

CHAPTER – 2

SCOPE AND

METHODOLOGY OF EIA

CHAPTER 2.0 SCOPE AND METHODOLOGY

2.1 Scope of EIA Studies

The EIA requires to be carried out as per guidelines/notifications issued by The Ministry of Environment and Forest (MoEF). Base-line data for two season, on environmental components viz. Water, air, noise, Meteorology, Land, Geology, Hydrology, Hydrogeology, Soil, Socio-economic aspects, rehabilitation and resettlement, Ecology (Terrestrial and Aquatic), Catchment Area Treatment Plan and Command Area Development Plan are usually collected as appropriate considering the present project status. The aim of any EIA should be to facilitate sustainable development.

An Environmental Impact Assessment will be prepared after identifying and quantifying the impacts on all environmental components, which will be based on the studies, mentioned above. A key output of the EIA should be an action plan to be followed during implementation and after implementation during the monitoring phase.

Environmental Management Plan (EMP) will be based on the impacts identified during the environmental impact assessment. This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation. This will suggest mitigating measures to minimize the adverse impacts on all environmental components. EMP also highlights the positive impacts generated by the project. One of the more straightforward and effective measures is to set-up a monitoring programme with clear identification of agencies responsible for data collection, collation, interpretation and implementation of management measures. Cost required for the post project monitoring is another important part of environmental management plan. The purpose of monitoring is to compare the predicted and actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be very accurately predicted. The results of monitoring can be used to manage the environment, particularly to highlight problems early so that action can

be taken. The range of parameters requiring monitoring may be broad or narrow and will be dictated by the 'prediction and mitigation' stage of the EIA.

2.2 Detailed Scope and Methodology

i) **Hydrology:** Hydrology is study of the availability of water at the resource, and its estimated status after implementing the project command area. The EIA report addresses the likely effects of the project, based on a comparison of available pre-project information and identifies potential effects associated with project operation and construction. The EMP covers the recommendations to ameliorate any identified negative impacts and enhance beneficial impacts of the project on hydrological conditions and water users. The water quality will be tested for different chemical parameters so as to relate its effect to its use in the command area and suggest mitigation measures if the impact is negative.

ii) **Water logging:** A brief analysis of the drainage and water-logging scenario in the pre-project situation as well as post-project phases will be undertaken as a part of Command Area Development Plan (CADP). The analysis will cover the surface and sub-surface drainage problems of the command area vis-à-vis excessive rainfall, flooding, induced seepage, over irrigation, deficiencies in farm drains etc.

iii) **Water Quality:** Sampling at adequate number of sampling stations for both ground and surface water quality will be carried out from the pre-determined sampling locations in the command area. Samples collected during the study will be analyzed for the parameters as per IS: 2296 for surface water (Irrigation purpose) and IS: 10500 for ground water. Groundwater table for the past 5-10 years will be reported and chances of water table rise due to low efficiency of surface irrigation system vis-à-vis the water transmission characteristics of the soil may also be included in the EIA study.

While conducting EIA and as a component of EMP, the feasibility of conjunctive water use and adoption of water use efficient methods of irrigation will be examined and suitability will be dealt in these documents.

iv) **Geology and Soils:** Brief geological history of the area will be brought out from the available secondary data which is verified during field visits undertaken from time to

time. Various stratigraphic formations, rock types, structural features and weathering characteristics like porosity, permeability, existing water table level and impact on the same, geophysical aspects of the study area will be studied.

The soil profile will also establish for their physical and chemical parameters. The soil will be analyzed during the study. In addition to the primary surveys the data will also be collected from various agencies/departments working in the areas of Geology and Soil. This data will be interpreted with its correlation to the chemical properties of water and its relation to the other physical and biological components of the project area to concretize the impacts and the strategies in the EMP.

v) **Land Use:** Land use of the command area will be studied based on the 'Satellite Image', secondary data and field studies. This data will be used to quantify the land use pattern in the catchment area and thus suggest changes so as to adapt the present usage to post project conditions and bring in maximum benefits to the area.

vi) **Meteorology:** Meteorological factors such as precipitation and evapo-transpiration are important determinants of water availability, cropping patterns, irrigation and drainage patterns. In order to address these issues, meteorological data of past decade from the nearest observatory will be obtained and wind rose diagrams will be prepared. For ascertaining the frequency of occurrence of hurricane, tornadoes, and cyclones, data will be collected from the nearest meteorological station. The rainfall data available with concerned Government /Research authorities will also be collected and analyzed.

vii) **Terrestrial Ecology:** The bio-geographical region in which the project and its various activities are located will be identified and general information on characteristic flora and fauna will be obtained. Specific data on endemic, rare, endangered, resident, migratory species and on sensitive or protected habitats will be collected. The assessment of status of flora and fauna *vis a vis* Red Data Book of Plants and Animals and Wildlife Protection Act will be carried out.

The forest cover and vegetation pattern will be assessed based on the field survey and secondary data available. The vegetation pattern will be based on sampling of vegetation for density, diversity, frequency, relative abundance, etc. at adequate

locations to cover all phytosociological variations. In addition, presence of wild animals and birds will enlist. Threatened species (both plants and animals) will be identified and their local status will be assessed. The nearest protected area (biosphere reserve/national park/wild life sanctuaries) if any, is identified and location is indicated on a map.

The survey of flora and fauna will include endangered species, forest resource evaluation, study of pattern of plant distribution, bio-diversity indices, cropping pattern, mammals, avifauna, reptiles, rare and endangered plant species. Any wildlife habitat breeding/feeding/nesting/roosting areas will also be surveyed. The survey will be carried out mostly in command area of the project.

Plans for re-establishment of wildlife, where appropriate, are an integral part of project planning. This is to compensate for wildlife loss. Therefore depiction of presence of designated wildlife conservation areas such as national parks; bird sanctuaries and biosphere reserves are carried out if present in the vicinity of the project area.

viii) Aquatic Ecology: Ecology of the proposed site and its command area will be thoroughly studied. This effort includes search and review of the existing literature and study of adequate locations depending on the site details. A list of flora and fauna including plankton will be prepared based on actual studies and secondary data. Study of the impact on bird migration if visiting within the project affected zone will be carried out. Impact due to operation and construction, establishment of canal network on the aquatic ecosystem will be assessed. The impact of habitat alteration on aquatic and associated fauna and flora too will also be studied.

ix) Socio-Economic, Health and Cultural Aspects: The principal objective of any development project is to improve the quality of life of the population in a specific area or region. Only in absence of secondary data, a detailed survey to determine the socio-economic characteristics of the Project Affected Persons (PAPs) will be carried out to review the impacts on the communities of the region.

Study of Demographic structure, existing infrastructure facilities like education, water supply sanitation, roads, electricity, school, post office, bank, village Panchayat, police

station approach road, occupational structure etc will be carried out in the affected villages and for the remaining adjoining villages.

The health status in terms of the presence and prevalence of diseases and conditions with reference to present interventions will be studied using secondary information as well as focused group interviews.

x) Rehabilitation and Resettlement Plan: Often the most significant social issue arising from irrigation development is the resettlement of people displaced by the flooding of land and homes or the construction of canals or other works. This can be particularly disruptive to communities when insensitive project development causes avoidable problems by a lack of consultation at the planning stage and inadequate compensation of the affected population. Community re-establishment often includes, for example, pilot farms, extension services and credit schemes etc.

Existing Rehabilitation plan for the Project Affected Persons (PAPs) will be reviewed. Also fresh survey of all the project affected families will be carried out and detailed Rehabilitation & Resettlement plan will be discussed. Overall the guidelines of the Government of Maharashtra will be followed. Study of historical, archeological sites and cultural aspects shall also be addressed. Identification of impacts due to operation of the project and remedial measures for the same shall be brought out. Occupation pattern, population, number of villages and population to be displaced, size of the affected village, affected families in each village and occupation of the same, monuments, site of cultural, historical, religious, archeological importance shall be studied.

xi) Future Industries/Developments: During the study, a conscious effort will be taken to enlist probable industries / polluting units that are likely to come up in the areas in the next 10 years as a consequence of the present intervention. The likely impacts of these units and other development projects and anticipatory planning to tackle these issues form an integral part of the environmental management plan.

2.3 Identification of Existing Direct Impacts

In accordance with the various statutory guidelines the EIA will be focused on, but not limited, to the following:

- ❖ An assessment of the positive and negative, direct and indirect impacts which have occurred as a result of the construction of reservoir.
- ❖ An assessment of the environmental and social impacts, which may arise in the future through the operation of the project.
- ❖ The assessment of impacts will include both positive and negative impacts associated with construction and operation of the project. Each impact shall be discussed in terms of the following aspects:
 - ✓ Nature of the issues
 - ✓ Description of the impact (short term, long term)
 - ✓ Classification of the impact (reversibility, longevity etc)
 - ✓ Whether the impact is likely to take place in the future
 - ✓ Whether the impact is capable of mitigation and, if so the level of mitigation that is possible
- ❖ The likely impacts associated with the irrigation project which need to be addressed includes:
 - ✓ Impact due to the source, use and disposal of construction materials
 - ✓ Direct damage or disturbance to wildlife and wildlife habitats (population isolation, fragmentation, endangerment, etc.)
 - ✓ Direct disturbance to fisheries and other resources, if any
 - ✓ Loss of productive land and forests (due to canals, colonies etc.)
 - ✓ Direct impact on health
 - ✓ Quality/quantity of water for downstream users
 - ✓ Direct loss of cultural amenity/monuments

The focus of the study is based on the significance of impacts and on the identification of probable impacts.

2.4 Identification of Potential / Future Impacts

From the analysis of the impacts studied in the previous tasks, the probable future impacts will be highlighted and described, which may result from the operation of current project through changes in the physical or socio-economic environment. The principle aim of this task is to identify future impacts for which suitable

environmental mitigation measures may be implemented. In addition, analysis may provide opportunities to increase the longevity of the project and reduction in the environmental risk.

The assessment of future impacts includes an analysis of the likely impacts of future developments within the command including increase in industrialization, resettlement, and agricultural encroachment etc.

2.5 Identification of Indirect Impacts

Indirect impacts resulting from the sub-project developments may be seen largely as a product of the wider socio-economic implications of dam and irrigation project. In particular, the positive impacts shall reflect the increased resources brought to the area through the provision of a reliable year round water supply, increased opportunities for the agricultural sector etc. In short, the positive indirect impacts that may occur and need to be addressed are listed below:

- Improved ground water level and availability
- Employment generation and redistribution of income
- Agriculture and livestock development (including higher yields)
- Forestry development
- Fisheries development (lacustrine fisheries potential)
- Recreation and tourism potential

2.6 Identification of Adverse Impacts

In addition to the positive impacts described above, there may be adverse impacts, which may include:

- Water quality impacts and effects on the hydrological balance;
- Industrial water pollution;
- Agro-chemical pollution associated with intensified agriculture;
- Overgrazing;
- Reduction in downstream (fisheries etc.);
- Increased water-borne diseases and unwanted interactions between migrant workers and permanent population; and
- Direct damage or disturbance to wildlife and wildlife habitats.

Throughout the EIA, a special consideration is provided to 'how the local population perceives and reacts to indirect negative impacts such as the loss of land, forest, cultural resources and other services provided by the physical and social environment and overall intervention of coming up of the dam and irrigation project.

2.7 Environmental Management Plan (EMP)

The results of EIA form the basis of the EMP incorporating a series of measures and procedures for the long-term management of the projects. The main objective of the EMP is to ensure that the future management of natural resources is sustainable. For this the project authority need to make adequate and appropriate provision in terms of realization, mitigation and compensation measures. Moreover, the EMP addresses measures needed to strengthen institutional capacity of the project proponent in environmental monitoring.

The EMP comprises of the following:

- An introduction to purpose and aim of the EMP
- A summary of a short and long-term mitigation measures of adverse impacts
- Recommendations for the enhancement of positive impacts
- Environmental monitoring of parameters
- Institutional responsibilities for mitigation, monitoring and management
- Recommended program for further environmental training

2.7.1 Identification of Mitigation Measures

For preparation of EMP, appropriate mitigation measures are identified to cover the existing, negative impacts, potential negative impacts and impacts of sub basin activities (land use changes). For each mitigation measure, attempt will be made to identify the agency or individual responsible for implementation and the necessary parameters that need to be considered for environmental monitoring.

2.7.2 Enhancement of Positive Impacts

In addition to the mitigation of adverse impacts, the EMP will present recommendations for the enhancement of the positive impacts. These recommendations cover the following;

- ❖ Potential for increased employment opportunities associated with project related activities (transport, maintenance, service facilities etc.)
- ❖ Potential for lacustrine fisheries development
- ❖ Potential of agriculture and livestock development within the project area
- ❖ Potential for the development of eco-tourism based on the creation of additional wetlands and wildlife habitats

2.7.3 Identification of Environmental Monitoring Parameters

Environmental monitoring is essential to ensure that the mitigation measures function effectively during the entire period of project. Moreover, external changes to the project may at any future stage endanger environmental conditions rendering the existing mitigation measures inadequate. As the EIA is basically an evaluation of future events, it is necessary to continue monitoring certain parameters identified as critical by relevant authorities under an Environmental Monitoring Plan. Hence all environmental parameters (positive or negative impacts) which need regular monitoring will be addressed in the EIA/EMP report.

2.7.4 Analysis of Agency Monitoring Capabilities

The assessment of monitoring capabilities shall form the overall assessment of the institutional strength of the project authorities. In order to focus this exercise, monitoring capability is judged against the suitability of environmental parameters under EIA.



भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

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F. No. J-12011/57/2007-IA-I

Date: 5th December, 2011

To

Executive Engineer
Lendi Project Division
Godawari Marathwada Irrigation Development Corporation
Nanded - 431 605
Maharashtra
Email - lpddegr@gmail.com

Subject: Lendi Major Irrigation (Interstate) Project on Lendi River in Nanded District of Maharashtra and Nizamabad District of Andhra Pradesh by M/s Lendi Project Division, Godavari Marathwada Irrigation Development Corporation, Government of Maharashtra- Environmental Clearance regarding.

Sir,

This is with reference to your communication No. LPD/Ts 1/CWC/1623 dated 25th July, 2011 on the above mentioned subject.

2. The above mentioned project proposal was considered by the Expert Appraisal Committee (EAC) for River Valley and Hydro-Electric Power Projects (RV&HEP) in its 53rd meeting held on 11th-12th November, 2011 at New Delhi. The detailed observations of the Committee may be seen in the minutes of the meeting which are available on the web-site of this Ministry. The Committee desired certain additional information for approval of EC for the Project, which are as follows:

- (i) Since 200 persons are displaced and 4643 families of ten villages are affected, a separate social impact assessment should be submitted.
- (ii) Dam brake analysis may be carried out again as there are so many inconsistencies observed. Some of these are as follows-
- (A) The Erosion Intensity categorization table at page 425 of EIA report should also include the values of WI and DI assumed for each watershed.

एवं है पर्यावरण।
वहाँ है वृक्षवासी।

पर्यावरण भवन, सी.जी.ओ. कॉम्प्लेक्स, लोदी रोड, नई दिल्ली - 110 003
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI - 110 003.
Website : envfor.nic.in

(B) The input data given under the head 'RESERVOIR AND BREACH DESCRIPTION' at page 469 in Chapter 17 for Dam Break Analysis in the EIA report has the following technical inconsistencies: ✓

421

- a) The dam has an Ogee spillway with 14 gates of 12m x 8m size as stated on page no. 468. However, input data does not include it in the analysis.
- b) It is also not clear whether the dam failed by overtopping or by piping. It needs to be mentioned.
- c) The initial water surface elevation was considered at 398.50 m, which is higher than the dam top (at 388.00 m) by 10.5 m. Compared to the dam height, it is an excessively high value, and therefore, is quite unrealistic for framing a critical condition.
- d) It is not clear as to how a value of CDO equal to 600 was arrived at.
- e) The assumed breach width of 140 m at page 477 of the EIA Report is actually not available at dam site x-section given at page 494. Similarly, the assumed initial flow of 20419 cumecs at page 478 is excessively high compared to the maximum (dam break) flow of 27607 cumecs. It is not clear why the cross-sections at pages 491-494 of the report include levees (or vertical walls) on both the banks of the river downstream. These cross-sections should actually include maximum water levels.
- f) On pages 493, 495-498, the analysis shows only stage hydrographs. It is imperative to include all the discharge hydrographs including the dam break flood hydrograph.

(iii) In view of the above technical reasons, the dam break analysis needs to be carried out using realistic data, and chapter should be re-written.

(iv) The list of avifauna is deficient and needs to be arranged according to the accepted classification. The wintering species are conspicuous by their absence. Blackbuck, the most important mammalian species of the study area is a WPA Schedule I species and not a Schedule III species as given in the EIA report. Specific suggestions for the conservation of RET species may be included in the EMP. ✓

(v) Fishery Management Plan has not been submitted. The same may be submitted with details of aquatic fauna available in the river. ✓

→ (vi) Clear indication of environmental flow with supporting hydrology along with 10 daily discharge table may be provided.

→ (vii) Command Area Development (CAD) Plan needs to be submitted.

(viii) Details of LADA and EMP activities with allocated budget may also be submitted.

- DEC 12 2012 10:00 AM PAGES 11
- (ix) Since the information on the project has now changed drastically, a revised executive summary including all information should be submitted.
 - (x) List of flora and fauna is deficient and should be reclassified as per the approved classification. A number of migratory birds species are missing from the list.
 - (xi) Lower group of plants have not been included in the EIA Report, these may be included.

3. You are requested to kindly submit the above mentioned information. The Proposal shall be reconsidered after submission of the same.

Yours faithfully,



(Sanchita Jindal)
Director

BY SPEED POST

No. J-12011/57/07-IA.I
Government of India
Ministry of Environment and Forests

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi -110 003

Telefax: 2436 2827

Dated:10.3.2010

The Executive Engineer
Lendi Project Division
Nanded -431 605
Maharashtra

Subject: Lendi Major Irrigation (Interstate) Project in Maharashtra & Andhra Pradesh for Environmental Clearance - regarding.

Sir,

This proposal was considered by the Expert Appraisal Committee at its meeting held on 20th September, 2007 for scoping. The project authority was advised to include some additional TORs proposed by the Committee and report back. However the project proponent did not resubmit the revised TOR. They had gone ahead with the preparation of EIA report and public hearing. This was reviewed in the Ministry, as the additional TORs were incorporated for preparation of EIA report, The Ministry decided to put up the proposal before the EAC for considering the project for environmental clearance.

लेंडी प्रकल्प विभाग, बेलागाँव
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शाखा
आवक क्र 1247
दिनांक 25/3/2010

The Committee noted that the Lendi Major Irrigation Project on the river Lendi is a joint venture of Maharashtra and Andhra Pradesh States. The entire catchment area of the project (1594 km²) falls in Maharashtra. The total area to be irrigated is about 59,000 ha of which 27,000ha lies in Maharashtra and 22,000 ha in the Andhra Pradesh. The project envisages construction of an earthen dam and masonry weir across upstream of river Lendi at village Ganeagaon in the district of Nanded, Maharashtra for irrigating lands in the Nanded district, Maharashtra and Nizamabad district, Andhra Pradesh. The height of the dam is 27.83 meter and the total submergence area is 3025 ha. The expenditure share for head works, land acquisition and rehabilitation and resettlement of the project will be shared as per water utilization percentage i.e. Maharashtra share 62% and Andhra Pradesh share 38%.

This project was considered by the Expert Appraisal Committee at its meeting held on 18.02.2010. The representatives of both the States attended the meeting and gave a detailed presentation on the salient features of the project. The Committee noted that construction of this project initiated during

1986 and earth work for construction of dam has been completed. No forest area is involved and submergence area is in Maharashtra only. In Andhra Pradesh only 34.50 kilometer length of canals will be constructed for irrigating 11,336 ha. After critically examining this was pointed out that during the EAC meeting on 20th September, 2007 certain queries were raised by the members. The project proponent has not supplied a compliance report to know how the earlier observations of EAC have been addressed. The present EIA on pages 9 and 10 says that the major suggestions have been complied with and least them (7 numbers). Comparing with the earlier EAC minutes the following important items are not found in the list:

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- i. Downstream water users' interest.
 - ii. Water table rise due to low efficiency of surface irrigation system.
 - iii. Feasibility of conjunctive water use.
 - iv. Adoption of efficient methods of irrigation.
 - v. Supporting data for adopting very high values of conveyance efficiency, distribution efficiency and application efficiency.

These issues may be satisfactorily clarified.

Since, the existing cropping pattern is given for the command area; the proposed cropping pattern of the command area has to be given and not for the whole state of Maharashtra (Page 20, 21).

page 23
chapter 1

Under "Identification of Adverse Impacts" (Page 40, 41), the impact on soil health and groundwater table due to continued inefficient flow irrigation has been totally ignored which is a serious lacuna. A supplementary EIA document containing this aspect and a supplementary EMP giving the corresponding mitigation measures, with action plan, activity schedule and budget should be given.

EMP

The data of Table 5.5 and Table 5.7 (Pages 80, 81, read in conjunction with Table 5.11 in Page 90) are not compatible. An area with more than 80% of sandy clay and finer soils cannot have infiltration rate between 7.5 and 21 cm/h. With such high values, the soils are not 'moderately drained', as written in Page 101, but they are 'excessively drained'. Such data are to be re-checked, tests may be re-conducted *in-situ* using double ring cylinder infiltrometer (WALMI, Aurangabad's help may be taken for this) and correct values may be reported. The implication of excessive seepage of the applied irrigation water on fast groundwater table rise is well known.

soil
chap-5
para-85

The statement: "It is rather difficult to locate the areas where drainage would be necessary unless irrigation starts and damages make appearance." (Page 83) is not acceptable by the committee. With the vast experience of irrigation and its consequences in India and particularly in Maharashtra, identifying such areas based on soil texture, soil-water properties, local topography, water table, climate, crop-wise delta, etc., is possible and even without using any modelling software. It has to be a part of EIA. One does not have to depend on what USBR might have said, as the reference to the context has not been established. To wait till the problem appears is a waste of time.

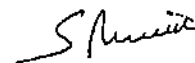
Intervention of surface drainage is always difficult after irrigation continues for several years. The PA must be aware that in any surface irrigation project there has to be a study to identify areas that are waterlogged and/or prone to be waterlogged and there should also be a drainage plan for the cultivated lands, in addition to improving the natural drains. The plan may be worked out and submitted as a supplementary document to the present EIA and EMP.

Summarising, the Project Authority is to address the following:

- (i) Submit a point-wise 'Compliance Report' on the EAC's observations on the project during its presentation on 20th September 2007.
- (ii) Re-check infiltration rate values, re-conduct the tests as suggested in one of the earlier paragraphs and submit the revised data.
- (iii) Address the joint adverse impacts of continued flow irrigation in fine textured soils in a harsh climate where the summer temperature rises to 45°C in terms of soil salinization and water-logging by drawing up a surface drainage plan of the command area, in addition to improving the natural drains, as suggested. The plan along with schedule of activities and the corresponding budget may be submitted as a supplementary document to the EIA/EMP.

The clarifications/ information on the above issues may please be submitted at the earliest for further consideration by the committee.

Yours faithfully,



(Dr. S. Bhowmik)
Additional Director

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पर्यावरण एवं वन मंत्रालय

GOVERNMENT OF INDIA

MINISTRY OF ENVIRONMENT & FORESTS

पर्यावरण भवन, सी. जी. ओ. कॉम्प्लेक्स

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No.J-12011 /57/2007-(A.1)

01.10.2007

Shri B. V. K. Watikar
Executive Engineer
Lendi Project Division
Nanded - 431605
Maharashtra

Subject - Lendi Major Irrigation Project in Maharashtra & Andhra Pradesh. -
Scoping regarding.

Sir,

The above mentioned project was considered by the Expert Appraisal Committee on 20th September 2007. The committee noted that the Lendi major irrigation project is a joint venture of Maharashtra and Andhra Pradesh states. The project envisages construction of an earthen dam and masonry weir across upstream of river Lendi at village Gonegaon in the District of Nanded, Maharashtra for irrigating lands in the Nanded district, Maharashtra & Nizamabad district, Andhra Pradesh. The length of the dam is 1651.40 m with a maximum height of 27.80 m including 214.60 m long gated spillway with 14 nos. of gates of size 12 m x 8 m. with live storage capacity of 118.32 m³. The total catchment area at the site is 1594 Sq. km with total yield of 341.93 m³ is available. The total command area on this project is 32410 ha. as gross command area with 28286 ha. as cultural command area & 26924 ha. as irrigable command area out of these 13360 ha GCA, 11336 ha CCA & 11,214 ha ICA is in Andhra Pradesh. The total land requirement is about 2621.42 ha. The area under submergence is 3052 ha. The total cost of the project is about Rs. 432.26 Crores

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The committee noted that construction of this project initiated during 1986 and earth work for construction of dam has been completed. No forest area is involved and submergence area is in Maharashtra only. Only canals of 34.50 km length will be constructed in Andhra Pradesh for irrigating 11,336 ha(CCA).

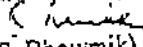
After carefully examining all the environmental issues, the committee suggested in addition to the proposed TORs the following TORs should also be included in EIA study and report:

- Since, there are activities reported for Items 1.17 and 1.18, the response 'NA' may be changed to 'Yes'.
- The reply to item 2.2 has not considered the downstream water users of the river if the dam were not there. Water impoundment in the reservoir may drastically reduce the natural river flow and hence, may affect adversely the current users of the river water. This issue is to be looked into and appropriate information may be given.
- With respect to the reply of Item 3.5, the type of compensation (monitory only, or new land for lost agricultural land, etc.) may be mentioned in the EIA/EMP.
- Responses to items 4.2, 4.6 and 7.2 have not considered the sewage generated from the labour camps and staff colony.
- The TOR has identified the soil and water parameters to be collected, interpreted and reported in the EIA study. Groundwater table depth changes during the last 5 to 10 years may be reported and chances of water table rise due to low efficiency of surface irrigation system (including conveyance and application), vis-à-vis the water transmission characteristics of the soil may also be included in the EIA study and report.
- While conducting EIA and as a component of EMP, the feasibility of conjunctive water use and adoption of water use efficient methods of irrigation may be examined and suitably dealt in these documents.
- The erosion status of the catchment would have to be studied using the SYI method and components of CAT with their time frame of anticipated progress may be reported in the EIA and EMP, respectively.
- It may be clarified if there is a drinking water provision from the water impounded in the reservoir. This is an important requirement for a water resources development project.
- It may be clarified as to what mechanisms exist in Maharashtra and Andhra Pradesh to train the cultivators on scientific water use

for irrigation, as they may not be used to handle large quantities of water under the present rainfed condition.

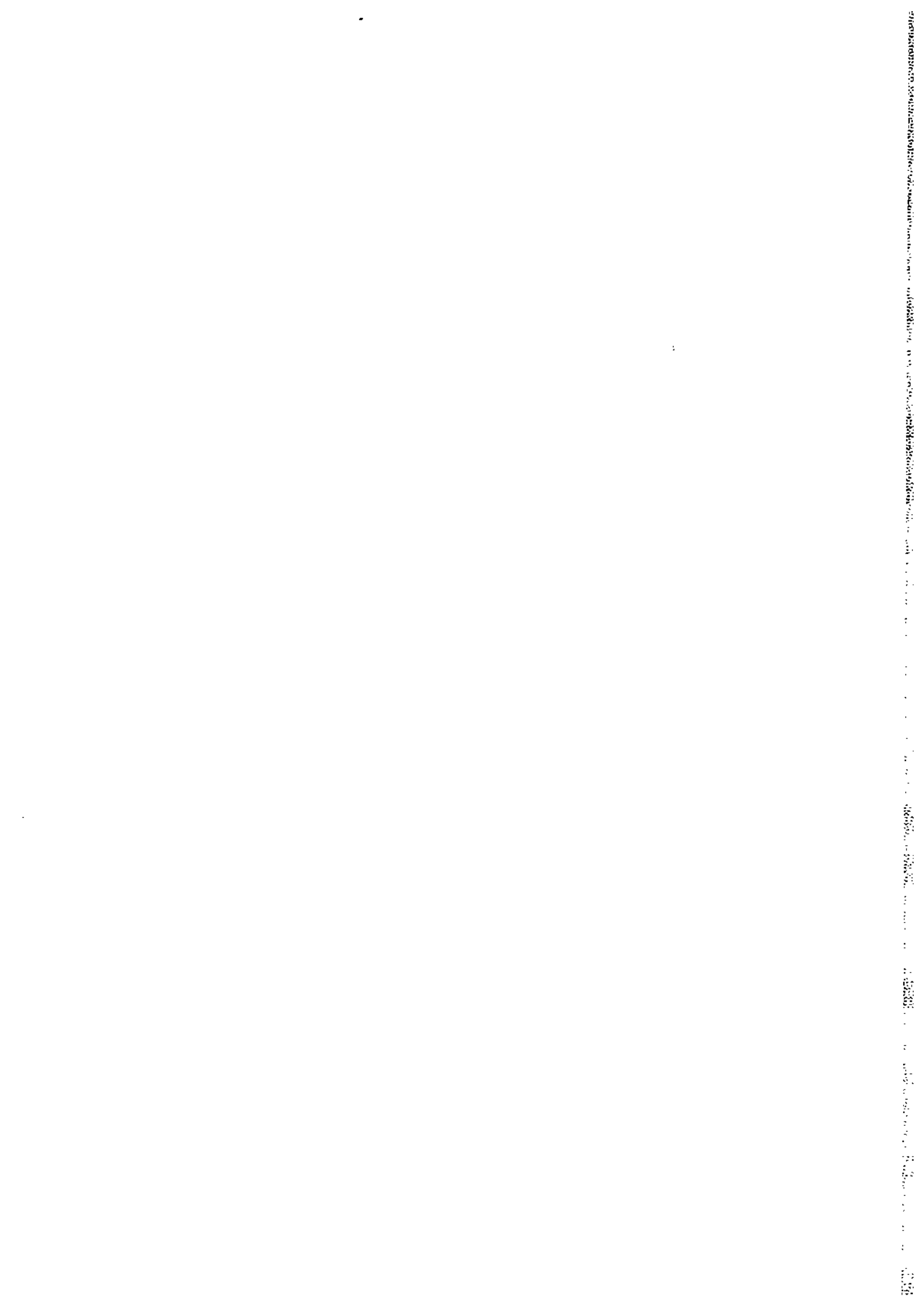
- The EIA report is to be prepared based on three season (pre-monsoon, monsoon and post monsoon) data on hydrology and all relevant soil and water parameters.
- The public hearing is to be conducted in both the states after supplying the EIAEMP documents to the PAPs and the beneficiaries.
- The PFR reports very high values of conveyance efficiency, distribution efficiency and application efficiency. Such high efficiencies may be achievable when respectively, the conveyance system is lined, fields are developed to a uniform slope and water application is highly scientific (not necessarily by pressurized irrigation methods). To claim such high efficiencies, the PA must supply actually field measured data from some of the existing irrigation commands on both the states. Please note that the overall efficiency, which has been taken as 65.52 per cent, actually is between 40 and 50 per cent in many command areas in the country. This factor is directly linked with sustainable irrigation and efficient use of the water available at the reservoir.

The committee also desired that next time, representative of Andhra Pradesh irrigation department should also attend the meeting.

Yours faithfully,

(Dr. S. Bhowmik)
Additional Director

CHAPTER – 3

LAND USE LAND COVER STUDY



CHAPTER 3.0 BASELINE DATA: LAND USE LAND COVERS STUDY

3.1 Introduction

This chapter assimilates the description of the existing environmental setting in the submergence, catchment and command area. Reconnaissance survey and field studies for various environmental attributes were carried out to determine the existing conditions of various environmental components within 10 km radius from the proposed damsite. Data from various secondary sources have also been compiled to understand the environmental setting of the project area. The present land use status of the area is assessed using the latest satellite images.

3.2 Land Use Pattern

For establishing the existing landuse pattern in the study area, satellite imagery (IRS P6, LISS III) of Jan 2006 is interpreted and land use map is prepared. The details are elaborated below:

3.2.1 Methodology

Remote Sensing is a powerful and accurate means of collecting data. Also such data is a classic source of information on natural resources for a region and provides a record of the continuum of resource status because of its repetitive coverage. The study of satellite imagery gives an excellent opportunity to monitor the quantitative extent of vegetation cover as well as qualitative changes due to changes in environment. This aspect is very significant in understanding the dynamics of the earth surface features and phenomenon such as various ecosystems. The present study has been divided into three steps:

1. Creation of input database.
2. Analysis.
3. Preparation of final output

3.2.2 Data

- ❖ Topographical sheet (SOI) scale 1:50,000 No., 56B, 56F/1, 56F/2, 56F/3, 56F/ 4, 56F/5, 56F/6, 56F/7, 56F/8, 56F/9, 56F/10, 56F/11, 56F/12, 56F/13, 56F/14,

56F/15 & 56F/16 were studied for spatial features, ground control points, latitude, longitude and geo-registration of the satellite imageries.

- ❖ The image used for this study was IRS P6, LISS III, January 2006 (5th & 10th Jan 06) , Paths and Rows (98-59, 98-60, 99-60,99-59)

3.2.3 Data Processing

➤ **Image Restoration:** Image restoration aims to correct the distorted or degraded image data to create a more faithful representation of the original scene. This typically involves the initial processing of raw image data to correct for geometric distortions and to calibrate the data radio-metrically. Image rectification and restoration procedures are often termed as processing operations because they normally precede manipulation and analysis of the image data to extract specific information.

➤ **Radiometric Correction:** First order correction was done by dark pixel subtraction technique (Lillesand and Keifer, 1987). This technique assumes that there is a high probability of at least a few pixels within an image, being black (0% reflectance). However, because of atmospheric scattering, the image system records a non- zero DN value at the supposedly dark shadowed pixel location. This represents the DN value that must be subtracted from the particular spectral band to remove the first order scattering component.

➤ **Geometric Correction:** Raw digital images usually contain geometric distortions so significant that they cannot be used as maps. The source of these distortions range from variation in the altitude, and velocity of sensor platform, to factors such as panoramic distortion, earth curvature, atmospheric refraction, relief displacement and non-linearities in the sweep of a sensor's instantaneous field of view (IFOV). The intent of geometric correction is to compensate for the distortion introduced by these factors, so that the corrected image will have the geometric integrity of a map.

Images were registered geometrically using toposheet of Survey of India (SOI) on 1:50,000 scale. The common uniformly distributed Ground Control Points (GCP's) were marked with root mean square error of one third of a pixel and the image was re-sampled by nearest neighbor method. The data set was then co-registered for further analysis.

3.2.4 Satellite image interpretation

The analogue data received from National Remote Sensing Agency (NRSA), Hyderabad was downloaded into the system and a land-use map was prepared. The first step involved was the preparation of standard False Colour Composite (FCC) (using LISS band 4, 3 and 2) and unsupervised classification map of the study area, which was followed by the ground truthing of the image and identification of Ground Control Points for the geo-registration of the images.

On screen digitization was carried out using Window based Arc view 3.2 a GIS software and final layouts were prepared.

Various thematic layers were digitized on the SOI toposheet-1976 (56B, 56F/1, 56F/2, 56F/3, 56F/ 4, 56F/5, 56F/6, 56F/7, 56F/8, 56F/9, 56F/10, 56F/11, 56F/12, 56F/13, 56F/14, 56F/15 & 56F/16) scale 1:50,000. The layers are: -

- I. Delineation of catchment.
- II. Delineation of command.
- III. Digitizing various topographic features - roads, drainage, water body, contours, settlements etc

3.2.5 Reconnaissance Survey, Ground Truthing

Reconnaissance visit was undertaken for broad understanding of the study area. It was vital for obtaining and visualizing the information pertaining to the existing field conditions, assessment of the accessibility of the area, pattern and distribution of vegetation and its composition.

Ground truthing is the process of establishing the correlation between the surface objects and the objects detected, identified, recognized and deduced from the satellite imagery. The occurrence of a particular vegetation type on the ground was correlated with its tonal appearance on satellite images for identification.

3.3 Land Use Classification

A hybrid land use classification has been done using unsupervised classification with sixty classes and recoding into final seven classes. The bands 3, 2, 1 were found to be most appropriate. Finally 7 classes were derived and the image of Jan 2006 was

classified. The classified land use pattern for the catchment is given in Table 3.1 and represented in Figure 3.1. The False Colour Composite of the area is presented in Figure 3.2.

3.3.1 Land use Pattern in Catchment area

i) **Water body:** It is represented mostly by Lendi River, Tiru River and its tributaries such as Kundrala and constitutes about 5%, of the catchment area. There are few other minor tanks in the catchment area.

ii) **Harvested field:** It captures maximum of the available area i.e. 31%. This depicts the influence of agriculture over the other land use type. The major crops grown in the area are given in the table below;

iii) **Standing Crop:** Next to the harvested field, 21% of the land use is contributed by the standing crops. Currently cultivation of *Oryza sativa* Linn, *Pennisetum typhoides* / *americanum*, *Sorghum bicolor*, *Cajanus cajan spreng*, *Cicer arietinum* Linn, *Capsicum annum* Linn, *Saccharum officinarum*, etc is observed for both the *Kharif* and *Rabi* seasons.

iv) **Barren land:** Only 2% of the entire land use is covered under barren land. These are the lands characterized by exposed massive rocks/sheet rocks or land with excessive surface accumulation of stones that render them unsuitable for production of any green biomass. The exposed rocky areas near Mukramabad and other villages such as Ravi Bamni, Udgir, etc contribute to it.

v) **Wasteland:** It is described as an agricultural land, which is taken up for cultivation, but is temporarily allowed to rest, un-cropped for one or more season, but less than one year. This class occupies 25% of the catchment area.

vi) **Settlement:** It correlates the human settlement. Only 1% of the area contributes to the class of the settlement showing sparse distribution of the human population within the catchment area. One of the major settlements in the catchment is Udgir, which is in the upper catchment area.

Figure No:- 3.1 Classified Land use map of Catchment

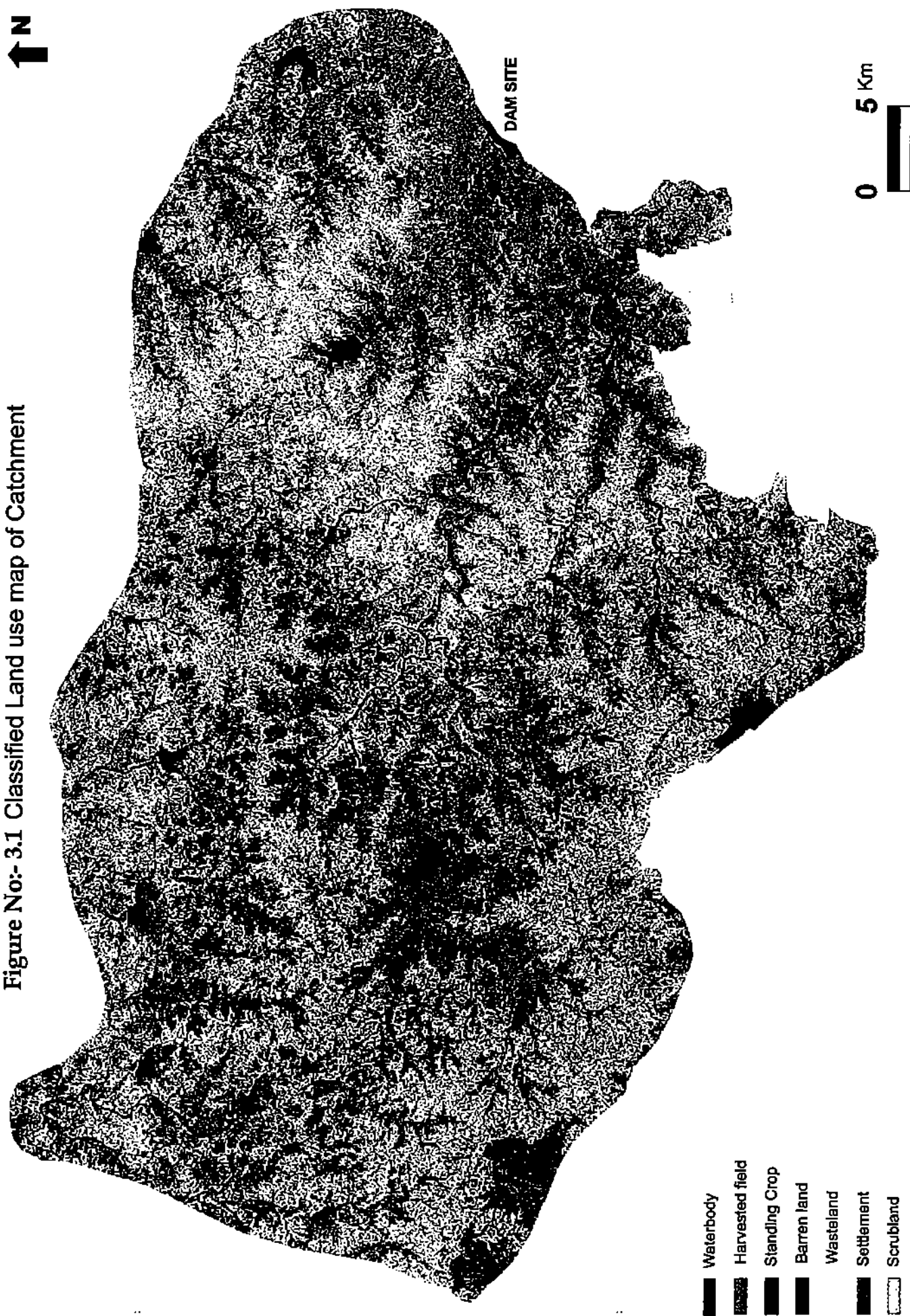
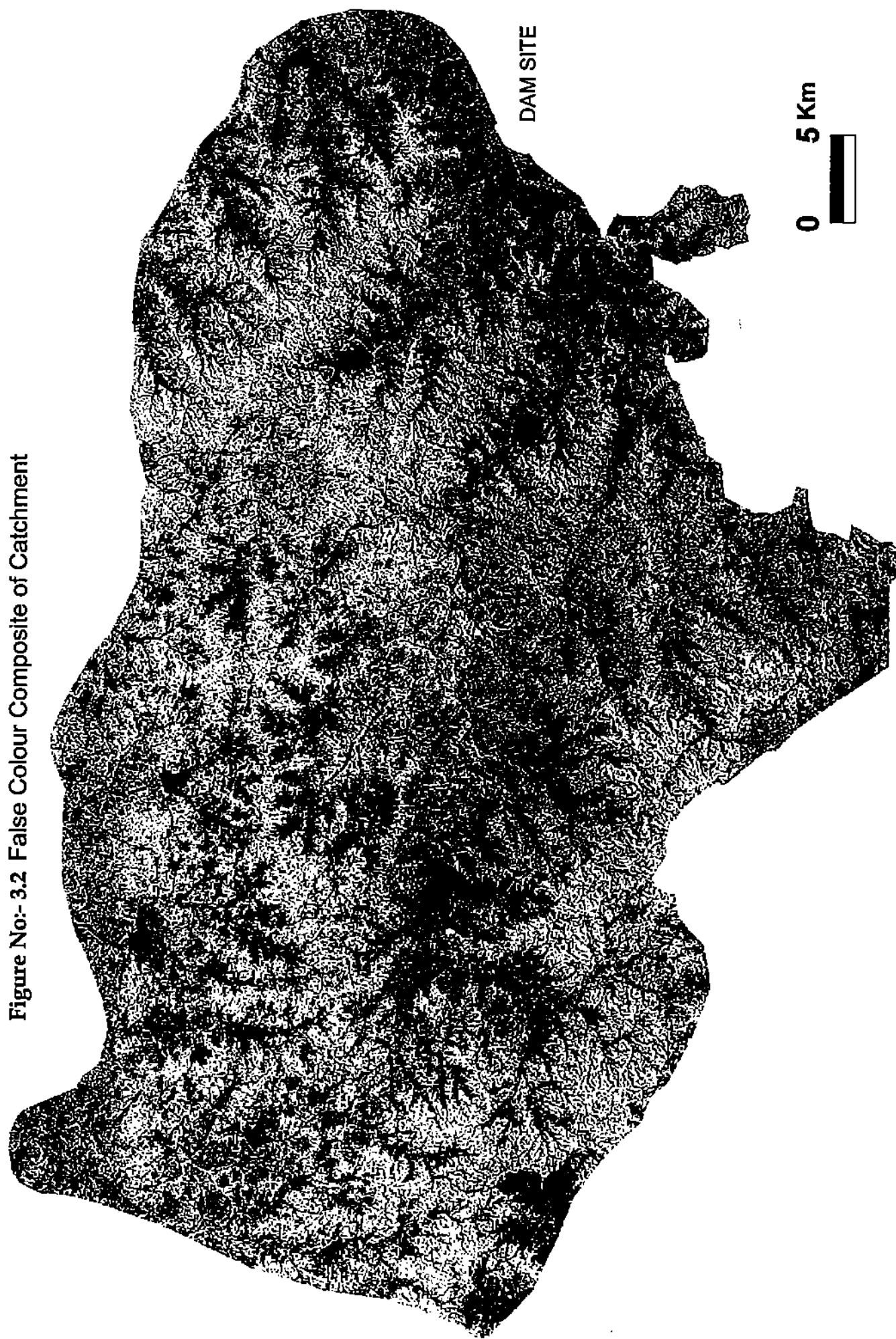
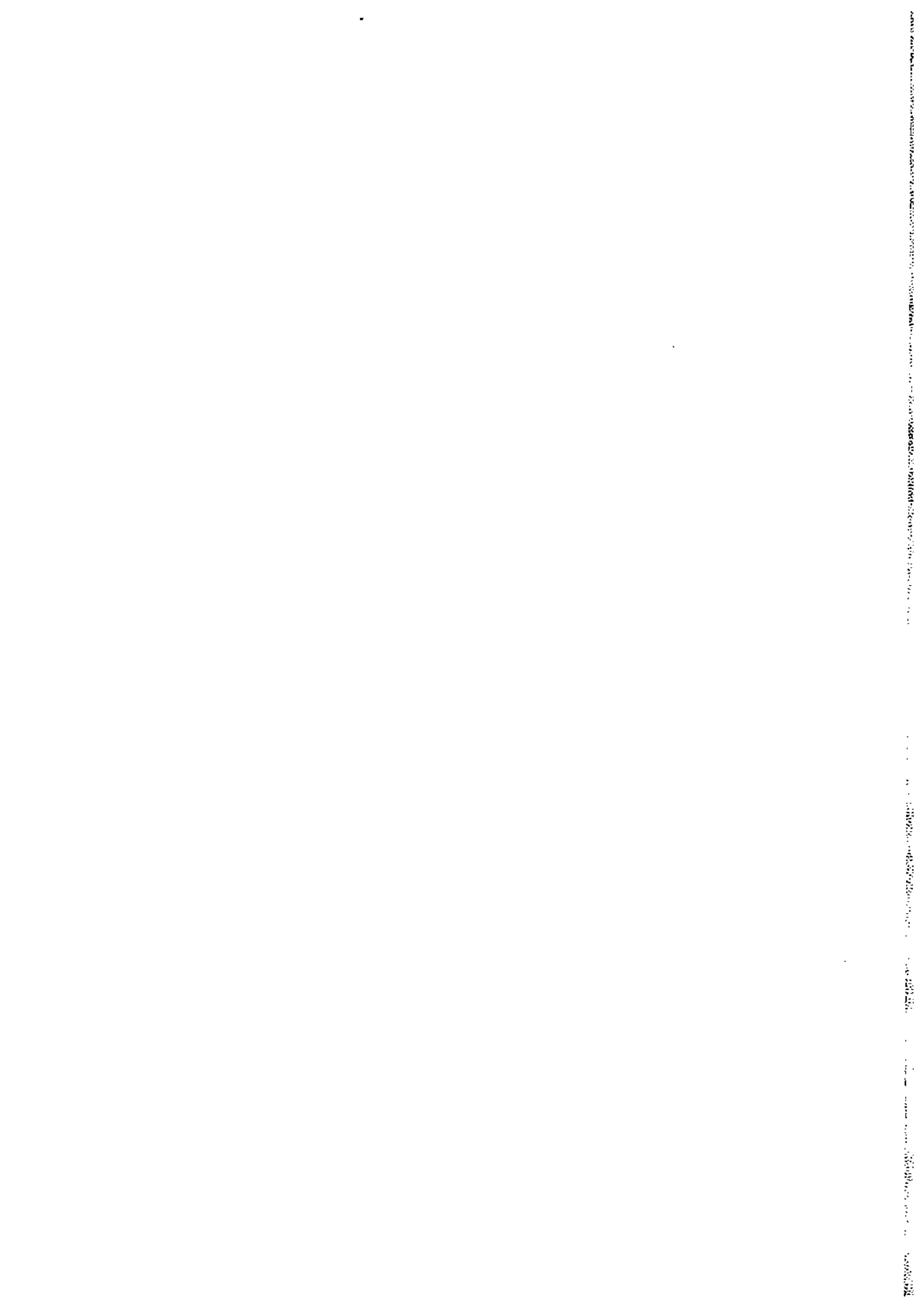


Figure No:- 3.2 False Colour Composite of Catchment



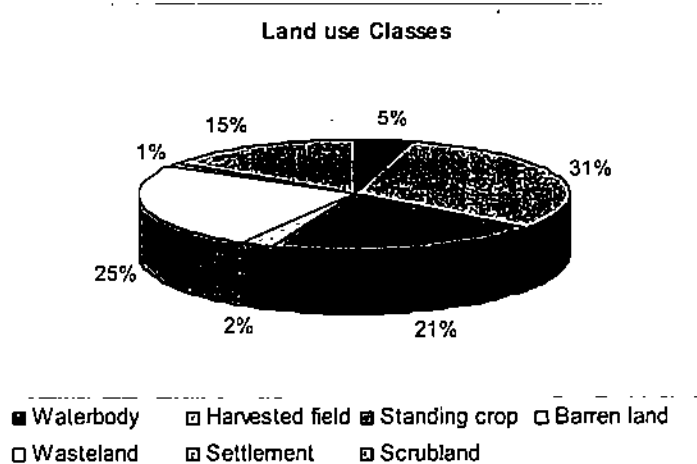


vii) **Scrubland:** Scrubland is plant community characterized by scrub vegetation. "Scrub" consists of low shrubs, mixed with grasses, herbs, and geophytes. Scrublands are sometimes known as heath lands. Scrublands may be either naturally occurring or the result of human activity. They may be the mature vegetation type in a particular region and remain stable over time, or a transitional community that occurs temporarily as the result of a disturbance, such as a major fire. From the present land use 15% contributes to the class of scrub land. It is mostly seen scattered all over the catchment depicting the typical degraded vegetation type. Most of the hilly areas in the catchment are seen occupied by the scrubland. View Figure 3.3 for Classified Land Use pattern of the Catchment area.

Table: 3.1 Land use Classification of Catchment area

Sr. No.	Land use Classes	Area (ha)	Area (%)
i	Water body	9927.35	4.55
ii	Harvested field	66918.60	30.67
iii	Standing crop	45836.05	21.01
iv	Barren land	5129.50	2.35
v	Wasteland	54672.71	25.06
vi	Settlement	2112.61	0.97
vii	Scrubland	33610.40	15.40
Total		218207.22	100.00

Figure 3.3 Classified Land Use Pattern for Catchment



3.3.2 Land use pattern in submergence area:

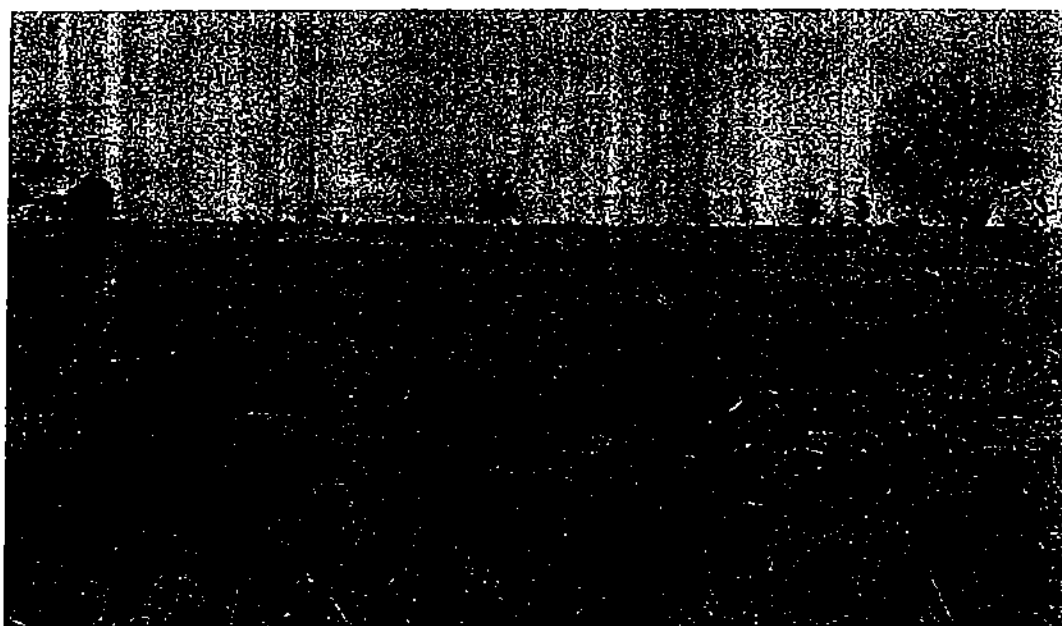
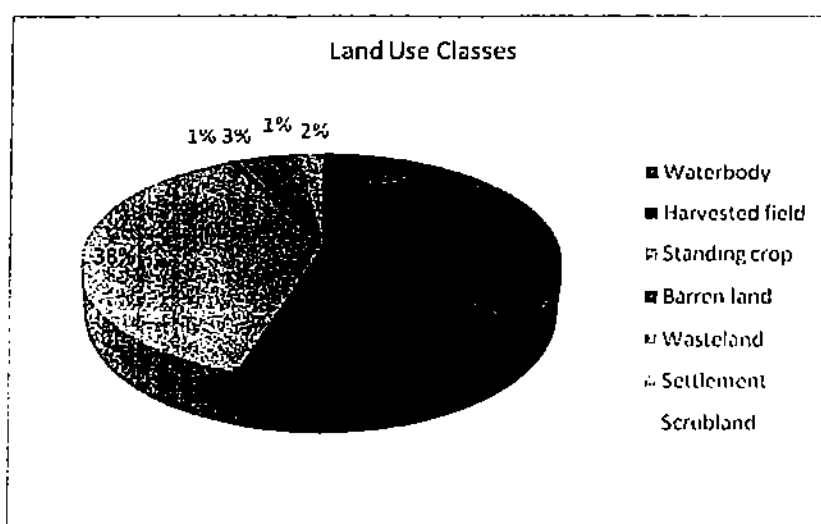
For establishing the existing land use pattern of the submergence area, satellite imagery (IRS P6, LISS III) of Jan 2006 is interpreted and land use map is prepared. The details are elaborated below:

1. **Water Body:** It is represented mostly by Lendi River, Tiru River and its tributaries such as Kundrala and constitutes about 15.13 %, of the submergence area.
2. **Harvested field:** It captures maximum of the available area i.e. 39.77%. This depicts the influence of agriculture over the other land use type.
3. **Standing Crop:** Next to the harvested field, 37.66 % of the land use is contributed by the standing crops. Currently cultivation of *Oryza sativa* Linn, *Pennisetum typhoides / americanum*, *Sorghum bicolor*, *Cajanus cajan* spreng, *Cicer arietinum* Linn, etc is observed for both the *Kharif* and *Rabi* seasons.
4. **Barren land:** Only 0.67 % of the entire land use is covered under barren land. These are the lands characterized by exposed massive rocks/sheet rocks or land with excessive surface accumulation of stones that render them unsuitable for production of any green biomass.
5. **Wasteland:** It is described as an agricultural land, which is taken up for cultivation, but is temporarily allowed to rest, un-cropped for one or more season, but less than one year. This class occupies 3.60 % of the submergence area.
6. **Settlement:** It correlates the human settlement. Only 1.34 % of the area contributes to the class of the settlement showing sparse distribution of the human population within the submergence area.
7. **Scrubland:** Scrubland is plant community characterized by scrub vegetation. "Scrub" consists of low shrubs, mixed with grasses, herbs, and geophytes. Scrublands are sometimes known as heath lands. Scrublands may be either naturally occurring or the result of human activity. From the present land use 1.83% contributes to the class of scrub land. **Figure 3.5** Classified land use map of the submergence area.

Table 3.2 Land-use Classification of the submergence area

Sr. No.	Classes	Area (ha)	Area (%)
1	Water body	556.09	15.13
2	Harvested field	1461.77	39.77
3	Standing crop	1383.92	37.66
4	Barren land	24.70	0.67
5	Wasteland	132.42	3.60
6	Settlement	49.24	1.34
7	Scrubland	67.11	1.83
	TOTAL	3675.235	100
	Correct	3052 ha	

Figure 3.4 Classified Land use pattern of submergence area



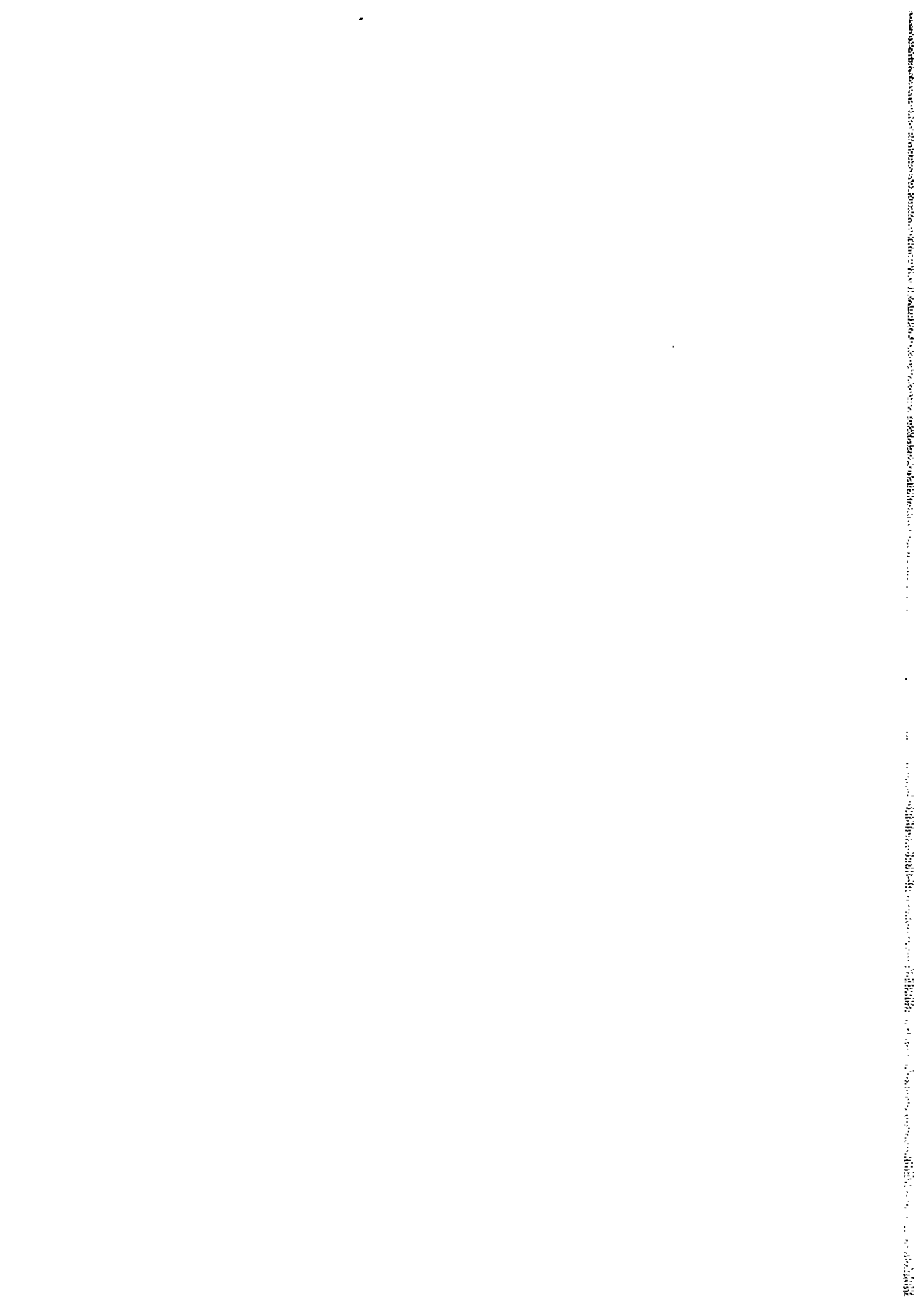
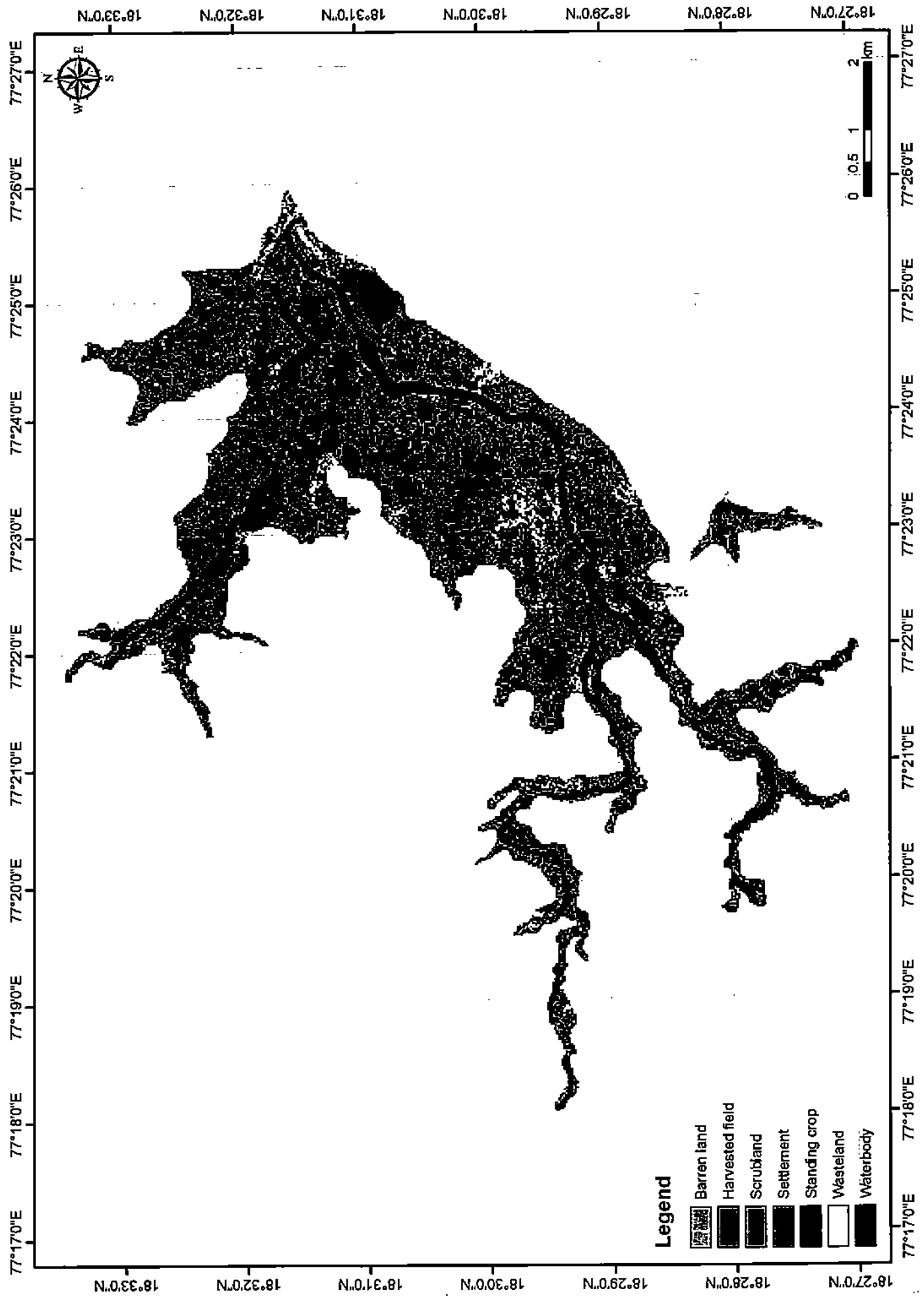
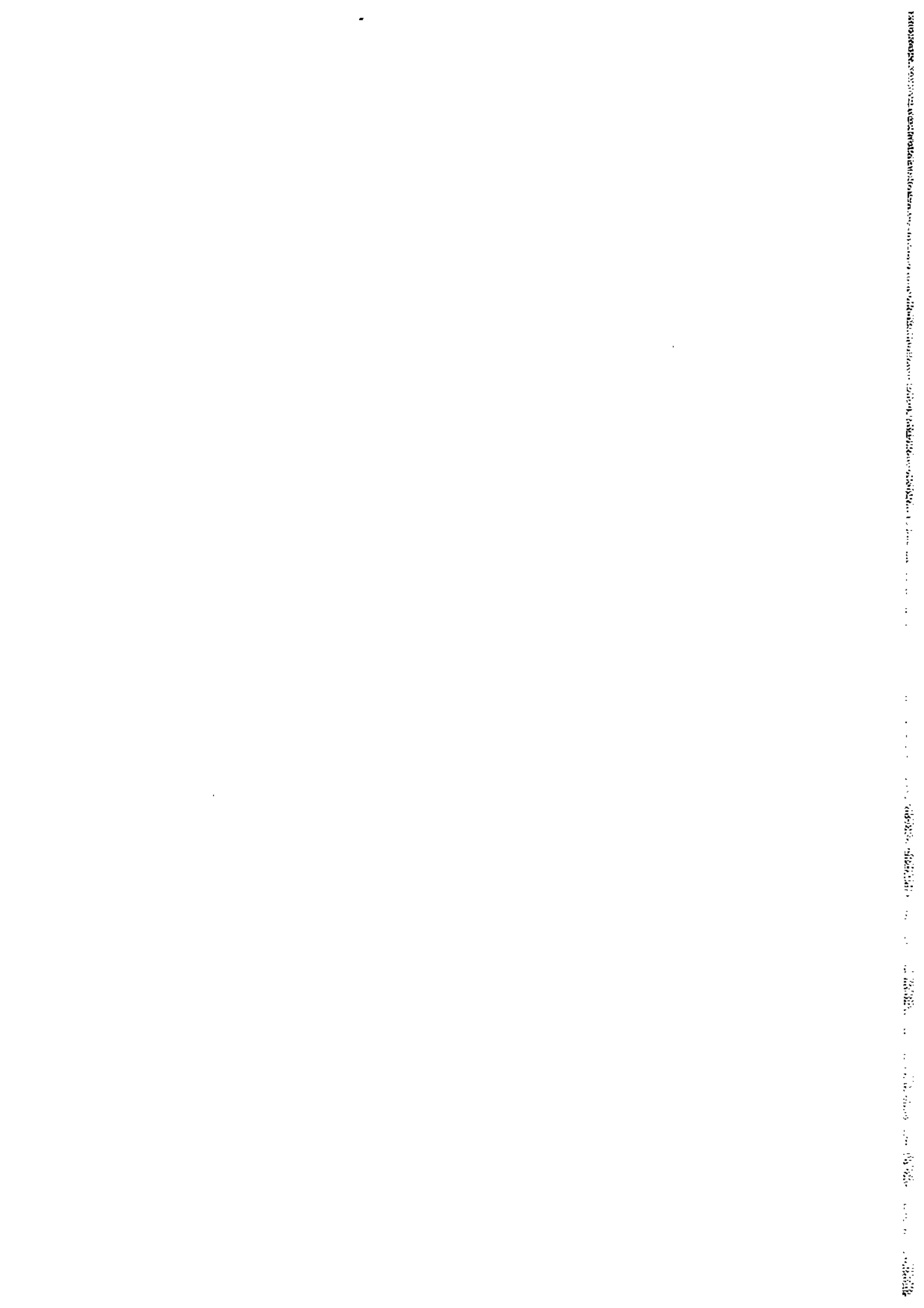


Figure No:- 3.5 Classified Land use map of Submergence



CHAPTER – 4

METEOROLOGY



CHAPTER 4.0 METEOROLOGY

4.1 Introduction

The entire Catchment and Command area experiences tropical climate. The temperature shows large variation. The annual temperature ranges from 5°C in winter to 45°C during summer season. The drainage area lies in the normal annual rainfall range of 900 mm (35 inch) to 1000 mm (39 inch), the weighted average annual rainfall being about 960 mm. It receives most of its precipitation from the southwest monsoon during the period from June to September. The area (Catchment and Command) lies directly in the path of cyclonic storms originating from the Bay of Bengal due to which it receives rains as stated above and therefore it is generally called as an area of moderate rainfall zone. Due to erratic nature of monsoon the area experiences some dry spells in August and September.

The regional surface meteorological data viz., temperature, relative humidity, wind speed and direction, station level pressure, rainfall etc. has been compiled from IMD Pune for Nanded station for the period 1960 – 2004.

4.2 Analysis of the Data Recorded at IMD – Nanded and Nizamabad

The Meteorological data for Nanded station is discussed below:

4.2.1 Temperature: During the months of summer (February to May), temperature shows a steady rise. The highest temperature reached in this season is in the month of May i.e. 44.3°C. The lowest temperature recorded in this season is 11.0°C. During the rainy season i.e. June to September temperature remains at a moderate level and shows a decline in the month of September. This triggers the onset of winter in the area lasting from October to January. The lowest temperature recorded in this season is 8.4°C and the highest temperature recorded is 35.6°C. Major shift in the temperature is not observed in the area and the overall temperature changes indicate that the area falls in moderate temperature zone.

4.2.2 Relative Humidity: The readings of relative humidity recorded in all the three seasons depict an increase during the rainy season. This is but obvious due to the

rainfall and cloud cover which prevails favourable conditions for this increase. Lowest readings for relative humidity were observed during the month of March i.e. during the summer season.

4.2.3 Station Level Pressure: Maximum station level pressure was recorded during the winter season i.e. 975.7% in the month of December. Minimum station level pressure was observed during the month of July i.e. 963.8%. The station level pressure readings depict increase in temperature with decrease in station level pressure and vice versa. The overall readings depicts that the station level pressure is moderate.

4.2.4 Rainfall: The rainy season is observed from the month of June till September. Maximum rainfall was observed during the month of August i.e. 246.2 mm. Minimum rainfall of the season was observed in the month of June i.e. 138.3 mm. Overall the rainfall in the area is average.

4.2.5 Wind Speed/Direction: It was observed from the data that the maximum speed of wind was 10.4 km/h in the month of June and the minimum wind speed was 3.6 km/h in the month of December. The wind speed in the area is moderate and does not depict any high wind speed zone. Due to this the rainfall of the area is also average. The wind roses depict that wind moves south west to west from the month of June to September with an average speed of 10 to 20 km/h. This clearly depicts the onset of southwest monsoon. From October to January shift in the wind direction is observed from west to northwards. This is a typical phenomenon observed for the winter season. The average wind speed observed in the rainy season was between 10 to 20 km/h, which shows a reduction in the winter season to almost 0 to 10 km/h and remains same for the summer season.

Given below is the mandal / Tehsil wise rainfall data available for the Maharashtra and Andhra Pradesh Project areas. The data is available from the year June 2006 to 22nd July 2006, showing excess, normal, deficit and scanty rainfall.

Table 4.1 Statement Showing Tehsil wise Rainfall in Maharashtra (in mm)-Source-IMD

District	Station	Year	Annual		24 Hours Heaviest		
			Average	Days	Hourly	Date	Month
Nanded	Degloor	1963	1285.9	365	83.3	4	8
Nanded	Degloor	1964	750.3	354	96.0	31	8
Nanded	Degloor	1965	943.5	365	95.2	15	7
Nanded	Degloor	1966	843.7	365	105.2	26	7
Nanded	Degloor	1967	776.3	365	62.5	28	7
Nanded	Degloor	1968	756.0	366	60.2	17	9
Nanded	Degloor	1969	869.2	365	85.0	8	11
Nanded	Degloor	1970	1115.4	365	157.0	18	8
Nanded	Degloor	1971	687.3	365	65.0	26	9
Nanded	Degloor	1972	398.7	366	99.6	22	8
Nanded	Degloor	1973	1232.9	365	69.2	26	10
Nanded	Degloor	1974	976.7	365	126.0	22	10
Nanded	Degloor	1975	1334.3	365	77.0	1	7
Nanded	Degloor	1976	770.2	366	87.1	21	7
Nanded	Degloor	1977	989.4	304	79.0	17	7
Nanded	Degloor	1978	1304.4	365	139.0	18	6
Nanded	Degloor	1979	805.5	365	85.0	2	9
Nanded	Degloor	1981	1036.8	365	67.0	3	9
Nanded	Degloor	1982	784.3	365	78.0	7	11
Nanded	Degloor	1984	406.4	92	73.6	14	6
Nanded	Degloor	1985	818.6	365	49.8	2	6
Nanded	Degloor	1986	637.5	365	67.8	2	8
Nanded	Degloor	1987	888.3	365	65.0	17	6
Nanded	Degloor	1988	1392.2	366	128.0	30	9
Nanded	Degloor	1989	1106.0	365	107.0	24	7
Nanded	Degloor	1990	1007.4	365	75.0	30	8
Nanded	Degloor	1991	442.0	365	60.0	12	7
Nanded	Degloor	1992	587.9	366	110.0	11	8
Nanded	Degloor	1993	894.0	365	95.0	19	10
Nanded	Degloor	1994	636.0	365	67.0	6	10
Nanded	Degloor	1995	1178.0	365	220.0	19	10
Nanded	Degloor	1996	1012.0	366	80.0	7	9
Nanded	Degloor	1997	823.1	365	68.0	19	11
Nanded	Degloor	1998	1126.2	365	105.2	10	8
Nanded	Degloor	1999	795.9	364	82.0	8	9
Nanded	Degloor	2000	964.9	366	135.0	22	8
Nanded	Degloor	2001	691.0	365	64.0	19	6
Nanded	Degloor	2002	521.2	365	104.0	24	8
Nanded	Degloor	2003	777.0	364	51.0	6	7

Nanded	Degloor	2004	717.6	366	63.0	11	9
Nanded	Mukhed	1981	850.7	365	56.0	8	9
Nanded	Mukhed	1982	716.9	365	74.4	10	7
Nanded	Mukhed	1983	1546.4	365	170.4	6	10
Nanded	Mukhed	1984	624.9	366	117.4	11	9
Nanded	Mukhed	1985	616.2	365	55.4	24	6
Nanded	Mukhed	1986	532.5	365	77.0	16	7
Nanded	Mukhed	1987	710.6	365	48.2	18	11
Nanded	Mukhed	1988	1457.3	366	108.0	21	8
Nanded	Mukhed	1989	1247.0	365	132.8	24	7
Nanded	Mukhed	1990	1037.6	365	114.0	25	10
Nanded	Mukhed	1991	654.2	365	158.0	12	7
Nanded	Mukhed	1992	596.0	366	86.0	20	6
Nanded	Mukhed	1993	778.2	365	55.0	13	6
Nanded	Mukhed	1994	592.0	365	56.0	19	8
Nanded	Mukhed	1995	932.0	365	160.0	20	10
Nanded	Mukhed	1996	837.0	366	99.0	10	7
Nanded	Mukhed	1997	786.0	365	56.0	21	8
Nanded	Mukhed	1998	1111.1	365	115.0	29	7
Nanded	Mukhed	1999	813.0	365	55.0	2	8
Nanded	Mukhed	2000	866.7	366	60.0	11	7
Nanded	Mukhed	2001	806.0	365	97.0	5	8
Nanded	Mukhed	2002	630.0	365	75.0	24	8
Nanded	Mukhed	2003	695.0	364	53.0	15	7
Nanded	Mukhed	2004	922.0	366	100.0	3	7
Latur	Ahmedpur	1963	984.1	304	75.0	25	8
Latur	Ahmedpur	1964	875.5	366	76.0	21	6
Latur	Ahmedpur	1965	680.9	365	90.0	15	7
Latur	Ahmedpur	1966	750.1	353	58.0	30	8
Latur	Ahmedpur	1968	1024.2	366	87.6	26	7
Latur	Ahmedpur	1969	932.5	365	131.3	2	7
Latur	Ahmedpur	1970	1118.2	365	72.1	5	6
Latur	Ahmedpur	1971	592.9	365	63.0	1	10
Latur	Ahmedpur	1972	366.5	366	60.0	26	6
Latur	Ahmedpur	1973	821.0	365	63.8	15	8
Latur	Ahmedpur	1974	0.0	136	0.0	1	1
Latur	Ahmedpur	1975	1186.6	365	103.0	7	7
Latur	Ahmedpur	1976	482.8	366	64.2	20	7
Latur	Ahmedpur	1977	650.1	365	73.4	16	7
Latur	Ahmedpur	1978	983.8	365	87.4	15	6
Latur	Ahmedpur	1979	936.7	365	96.3	31	7
Latur	Ahmedpur	1980	803.7	366	93.2	20	8
Latur	Ahmedpur	1981	749.0	273	82.4	18	9

Latur	Ahmedpur	1982	707.6	365	88.1	10	7
Latur	Ahmedpur	1983	1511.6	365	140.5	6	10
Latur	Ahmedpur	1984	769.3	366	136.2	12	9
Latur	Ahmedpur	1985	847.2	365	74.4	5	6
Latur	Ahmedpur	1987	883.4	365	44.6	14	8
Latur	Ahmedpur	1988	1517.1	366	94.0	23	6
Latur	Ahmedpur	1989	1119.1	365	92.4	24	7
Latur	Ahmedpur	1990	1358.5	365	102.4	7	8
Latur	Ahmedpur	1991	552.7	365	54.2	8	7
Latur	Ahmedpur	1992	780.0	366	151.4	2	9
Latur	Ahmedpur	1993	963.4	365	49.0	15	7
Latur	Ahmedpur	1994	528.6	365	54.4	31	8
Latur	Ahmedpur	1995	1066.3	365	75.4	19	10
Latur	Ahmedpur	1996	907.6	366	73.8	7	9
Latur	Ahmedpur	1997	847.2	365	71.4	29	10
Latur	Ahmedpur	1998	1166.1	365	163.6	28	7
Latur	Ahmedpur	1999	835.4	365	117.2	2	8
Latur	Ahmedpur	2000	858.7	366	88.0	11	8
Latur	Ahmedpur	2001	1107.9	365	152.0	1	10
Latur	Ahmedpur	2002	778.1	365	75.8	26	6
Latur	Ahmedpur	2003	886.1	365	104.0	24	8
Latur	Ahmedpur	2004	1044.3	366	98.0	11	9
Latur	Chakur	1998	1190.8	365	113.2	3	10
Latur	Chakur	1999	828.8	365	85.6	26	5
Latur	Chakur	2000	1078.2	366	143.2	24	8
Latur	Chakur	2001	887.8	365	150.0	1	10
Latur	Chakur	2002	754.4	365	90.0	24	8
Latur	Chakur	2003	950.8	365	87.0	10	7
Latur	Chakur	2004	1096.1	366	121.0	30	7
Latur	Udgir	1960	732.8	366	66.8	26	6
Latur	Udgir	1961	1076.8	365	95.3	9	10
Latur	Udgir	1962	1145.2	365	63.5	15	9
Latur	Udgir	1963	1184.2	365	104.1	24	8
Latur	Udgir	1964	760.7	366	62.2	10	11
Latur	Udgir	1966	712.2	365	59.0	8	6
Latur	Udgir	1968	682.7	365	68.0	25	7
Latur	Udgir	1969	705.2	365	65.0	4	7
Latur	Udgir	1970	1090.3	365	96.4	21	9
Latur	Udgir	1971	471.8	365	56.4	23	8
Latur	Udgir	1972	215.7	366	48.0	21	8
Latur	Udgir	1973	872.8	365	78.3	8	10
Latur	Udgir	1974	908.9	365	73.0	4	8

Latur	Udgir	1976	741.0	366	65.2	21	7
Latur	Udgir	1977	677.9	365	58.3	22	7
Latur	Udgir	1978	817.3	365	58.0	5	6
Latur	Udgir	1979	759.7	365	85.0	19	6
Latur	Udgir	1980	808.4	366	66.0	19	8
Latur	Udgir	1981	379.0	243	58.0	31	7
Latur	Udgir	1983	1483.4	365	129.0	5	10
Latur	Udgir	1984	666.3	366	100.0	11	9
Latur	Udgir	1985	876.0	365	73.0	26	7
Latur	Udgir	1987	752.3	365	54.4	7	8
Latur	Udgir	1988	1320.0	366	139.0	2	9
Latur	Udgir	1989	1157.1	365	142.7	16	7
Latur	Udgir	1990	1155.0	365	104.0	16	8
Latur	Udgir	1991	649.8	365	55.4	8	7
Latur	Udgir	1992	659.0	366	82.0	20	11
Latur	Udgir	1993	676.4	365	80.6	30	6
Latur	Udgir	1994	534.6	365	48.2	22	8
Latur	Udgir	1995	875.4	365	83.4	19	10
Latur	Udgir	1996	1127.8	366	86.3	16	9
Latur	Udgir	1997	917.8	365	66.2	28	8
Latur	Udgir	1998	1299.1	365	82.2	27	7
Latur	Udgir	1999	847.6	365	105.2	26	5
Latur	Udgir	2000	947.4	366	127.4	24	8
Latur	Udgir	2001	899.0	365	144.0	1	10
Latur	Udgir	2002	852.1	365	120.0	24	8
Latur	Udgir	2003	846.8	365	131.0	10	7
Latur	Udgir	2004	1016.5	366	112.0	30	7

Source: IMD Pune

Table 4.2 Statement Showing the Mandal wise Rainfall in Nizamabad District (in mm)

Sr. No	Mandal Name	June 2006		July 2006		Cumulative		% of Deviation	EX/NO R/DEF/SCN
		Normal	Actual	Normal	Actual	Normal	Actual		
1	Ranjal	181.0	101.0	216.5	73.0	397.5	174.0	-56.2%	D
2	Navipet	164.0	59.8	219.3	92.2	383.3	152.0	-60.3%	S
3	Nandipet	169.0	78.4	206.5	95.0	375.5	173.4	-53.8%	D
4	Armur	200.0	87.4	201.5	134.8	401.5	222.2	-44.7%	D
5	Balkonda	188.0	98.0	163.9	111.8	351.9	209.8	-40.4%	D
6	Mortad	167.0	116.0	192.3	122.0	359.3	238.0	-33.8%	D
7	Kammar Palle	194.0	57.2	200.1	90.4	394.1	147.6	-62.6%	S
8	Bheemgal	202.0	74.0	200.1	73.0	402.1	147.0	-63.4%	S
9	Velpur	183.0	119.4	169.6	104.2	352.6	223.6	-36.6%	D
10	Jakranpalle	183.0	70.2	198.7	87.6	381.7	157.8	-58.7%	D
11	Makloor	170.0	125.6	171.7	97.2	341.7	222.8	-34.8%	D
12	Nizamabad	167.0	149.4	193.7	81.6	360.7	231.0	-36.0%	D

Sr. No	Mandal Name	June 2006		July 2006		Cumulative		% of Deviation	EX/NO R/DEF/ SCN
		Normal	Actual	Normal	Actual	Normal	Actual		
13	Yeda Palle	161.0	114.8	195.2	87.4	356.2	202.2	-43.2%	D
14	Bodhan	179.0	87.6	195.9	82.6	374.9	170.2	-54.6%	D
15	Kotgiri	183.0	69.2	215.7	99.8	398.7	169.0	-57.6%	D
16	Madnur	152.0	80.2	220.7	95.8	372.7	176.0	-52.8%	D
17	Jukkal	150.0	84.2	206.5	31.4	356.5	115.6	-67.6%	S
18	Bichkunda	147.0	108.0	212.9	57.2	359.9	165.2	-54.1%	D
19	Birkoor	151.0	110.0	194.5	67.2	345.5	177.2	-48.7%	D
20	Varni	171.0	66.8	212.9	92.6	383.9	159.4	-58.5%	D
21	Dich Palle	166.0	93.8	220.7	82.2	386.7	176.0	-54.5%	D
22	Dhar Palle	193.0	97.0	182.4	60.5	375.4	157.5	-58.0%	D
23	Sirkonda	188.0	70.0	178.8	36.0	366.8	106.0	-71.1%	S
24	Marchareddy	128.0	51.6	182.4	48.2	310.4	99.8	-67.8%	S
25	Sadasivanagar	150.0	84.8	154.0	58.6	304.0	143.4	-52.8%	D
26	Gandhari	182.0	137.1	158.3	110.3	340.3	247.4	-27.3%	D
27	Banswada	204.0	167.8	181.0	57.0	385.0	224.8	-41.6%	D
28	Pitlam	169.0	173.4	188.8	53.4	357.8	226.8	-36.6%	D
29	Nizam Sagar	165.0	101.2	173.9	46.0	338.9	147.2	-56.6%	D
30	Yellareddy	181.0	73.2	232.1	49.6	413.1	122.8	-70.3%	S
31	Naga Reddipet	162.0	51.2	171.7	35.0	333.7	86.2	-74.2%	S
32	Lingampet	161.0	93.8	160.4	51.2	321.4	145.0	-54.9%	D
33	Tadwai	162.0	71.2	181.7	62.0	343.7	133.2	-61.2%	S
34	Kamareddy	138.0	135.2	203.0	70.0	341.0	205.2	-39.8%	D
35	Bhiknur	148.0	58.2	200.1	52.2	348.1	110.4	-68.3%	S
36	Domakonda	138.0	56.8	203.7	30.8	341.7	87.6	-74.4%	S
	Dist. Total	6097.0	3373.5	6961.2	2679.8	13058.2	6053.3	-53.6%	D
	Dist. Average	169.0	93.7	193.0	74.4	362.0	168.1	-53.6%	D

Source: IMD Pune

The present data is provided for the overall Nizamabad district. In the context of Lendi Major interstate project the command area falls under two mandals namely, Madnoor and Bichkunda of Nizamabad District. Within the Madnoor Mandal the actual rainfall was 80.2 mm for the June, whereas the Normal rainfall was 152.0 mm. During the month of July the Actual rainfall was 95.8 mm and the actual rainfall was 220.7 mm. The overall observation showed that the rainfall is deficit in the command area. For Bichkunda Mandal the actual rainfall is 108.0 mm in the month of June and the Normal rainfall was 147.0 mm. During the month of July the actual rainfall is 57.2 mm and the normal rainfall is 165.2 mm. This indicates that the Mandal receives deficit rainfall. As the rainfall is deficit in the command area there is need to provide additional water to the command area through various irrigation practices. This is initiated by various projects in the command area as mentioned above and the present Lendi major interstate project envisages the same. Water harvesting and

conservation practices will be an emphasized part of the proposed farmers training program through this Command Area Development Plan (CADP).

Wind Data for Nizamabad district (Andhra Pradesh): Observations from the wind rose data tell that the area receives monsoon due to the movement of wind in the south west direction during the month of June to September. But as the wind speed is moderate the area comes under deficit zone for the rainfall, as discussed above. Over all patterns of the wind direction and wind speed mostly normal. Summer is mostly calm and dry and winter are less severe to moderate.

The detailed meteorological data has been provided below in Table No 4.4 A & 4.4 B and the wind rose data is provided in the figure 4.1 and 4.2 for the Nanded district and figure 4.3 and 4.4 for the Nizamabad district. Additionally the meteorological data from the year 1989 to 2004 was assessed which is also provided in the table no 4.1.

4.3 Analysis of Data Available from Other Secondary Sources

The nearest meteorological station for this project is located at Parbhani at 8.30 LMT. The station shows high percentage of relative humidity at the ground, which is of the order of 83% in July/ August. During June to September i.e. the monsoon period air is moist. The relative humidity is still higher during this period. At 17.30 LMT, relative humidity is less compared to 8.30 LMT at Parbhani station. The mean surface wind speed is generally high during the monsoon period.

Table 4.3 The Mean Surface Relative Humidity percentages Observed at Parbhani Station at 8.30 LMT and 17.30 LMT for the entire year are given as under:

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
@8.30 L.M.T											
49	37	34	37	48	72	82	82	81	68	55	53
@ 17.30 L.M.T											
27	20	18	21	24	47	65	66	62	49	37	36

The overall climatology of the area depicts average to low rainfall in the region. The average temperature humidity ranges from moderate to high. Low rainfall associated with low to moderate wind speed, high temperature and moderate humidity prevails overall a dry weather.

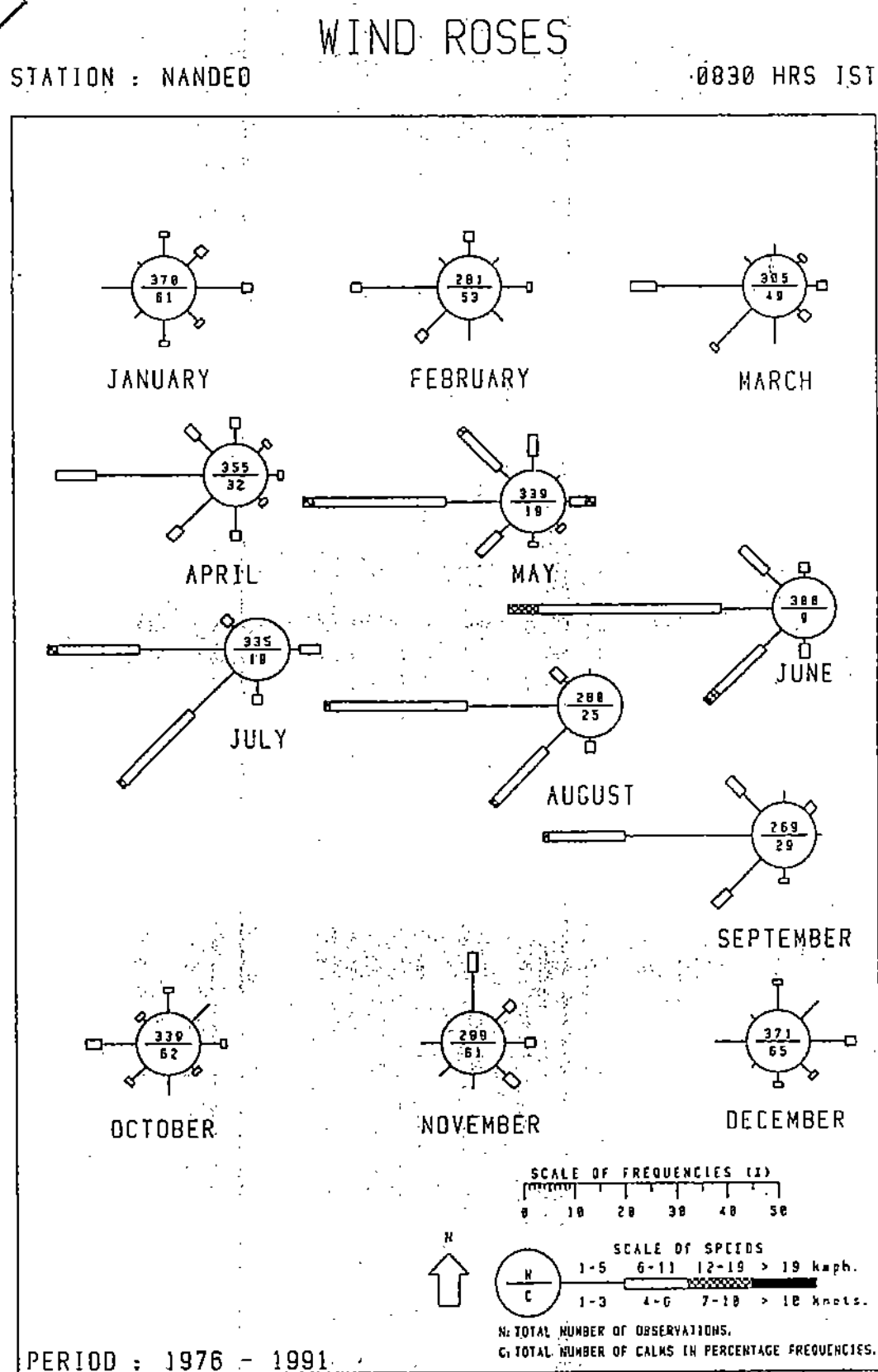
Table 4.4 : Climatological Table 1961-1990 – Nanded

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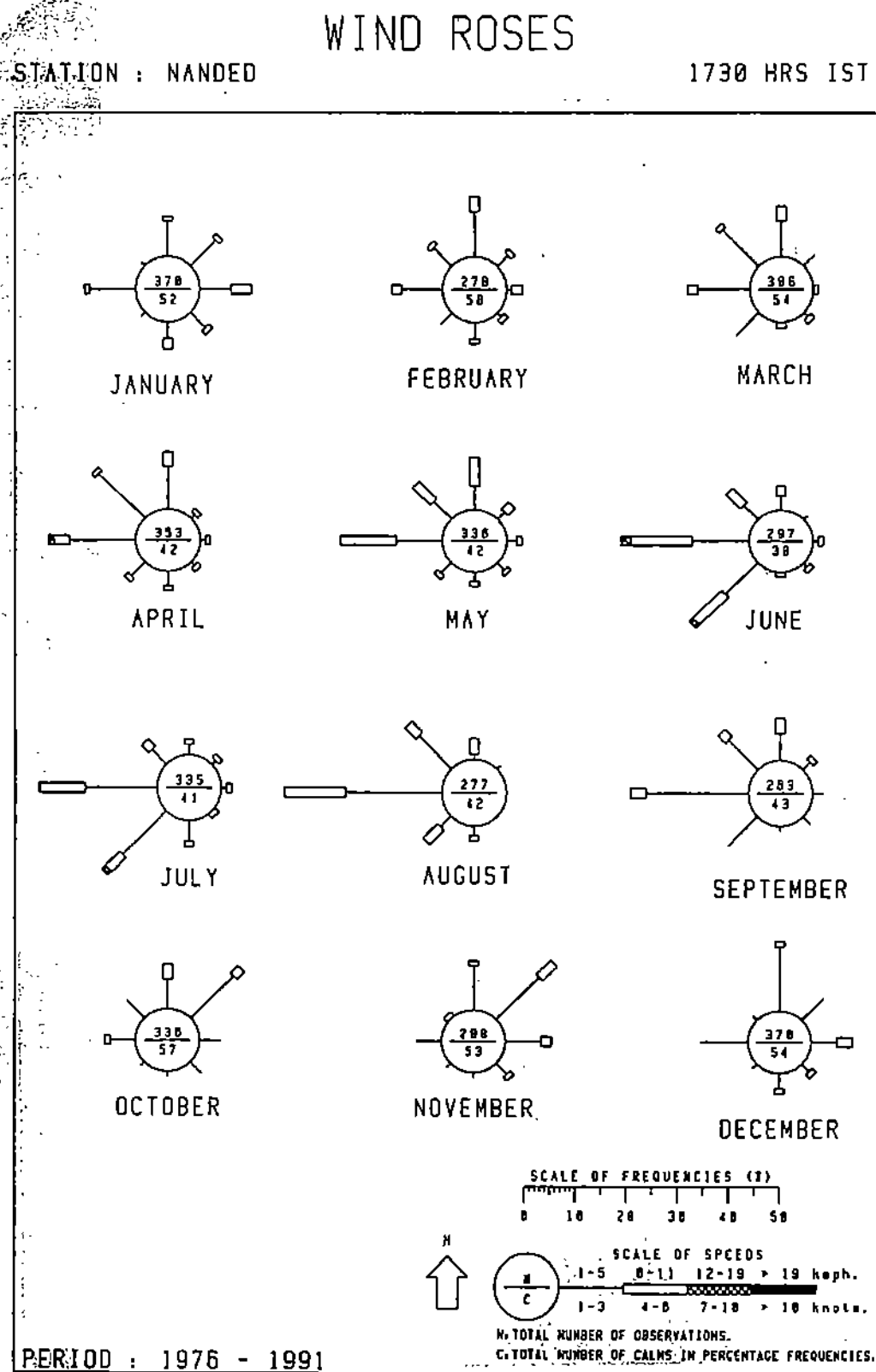
Source: India Meteorological Department, Pune

Figure 4.1 Wind rose data: IMD – Nanded (0830 HRS) (1976-91)



Source: India Meteorological Department, Pune

Figure 4.2 Wind rose data: IMD – Nanded (1730 HRS)



Source: India Meteorological Department, Pune

CLIMATOLOGICAL TABLE

Station : Fartnare

STATION : Huzarabad

Month	Mean Temperature			Mean Rainfall			Mean Wind Speed			Mean Humidity			Mean Cloudiness			Mean Visibility		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
JAN	20.0	10.0	15.0	10.0	0.0	5.0	10.0	0.0	5.0	10.0	0.0	5.0	10.0	0.0	5.0	10.0	0.0	5.0
FEB	22.0	12.0	17.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0
MAR	25.0	15.0	20.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0
APR	28.0	18.0	23.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0
MAY	30.0	20.0	25.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0
JUN	32.0	22.0	27.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0
JUL	34.0	24.0	29.0	24.0	0.0	11.0	24.0	0.0	11.0	24.0	0.0	11.0	24.0	0.0	11.0	24.0	0.0	11.0
AUG	32.0	22.0	27.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0	22.0	0.0	10.0
SEP	30.0	20.0	25.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0	20.0	0.0	9.0
OCT	28.0	18.0	23.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0	18.0	0.0	8.0
NOV	25.0	15.0	20.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0	15.0	0.0	7.0
DEC	22.0	12.0	17.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0	12.0	0.0	6.0
ANNUAL TOTAL OR MEAN	26.2	16.2	21.2	16.2	0.0	8.0	16.2	0.0	8.0	16.2	0.0	8.0	16.2	0.0	8.0	16.2	0.0	8.0
NUMBER OF YEARS	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25

Source: India Meteorological Department, Pune

Figure 4.3 Wind rose data: IMD – Nizamabad (0830 HRS) (1975-90)

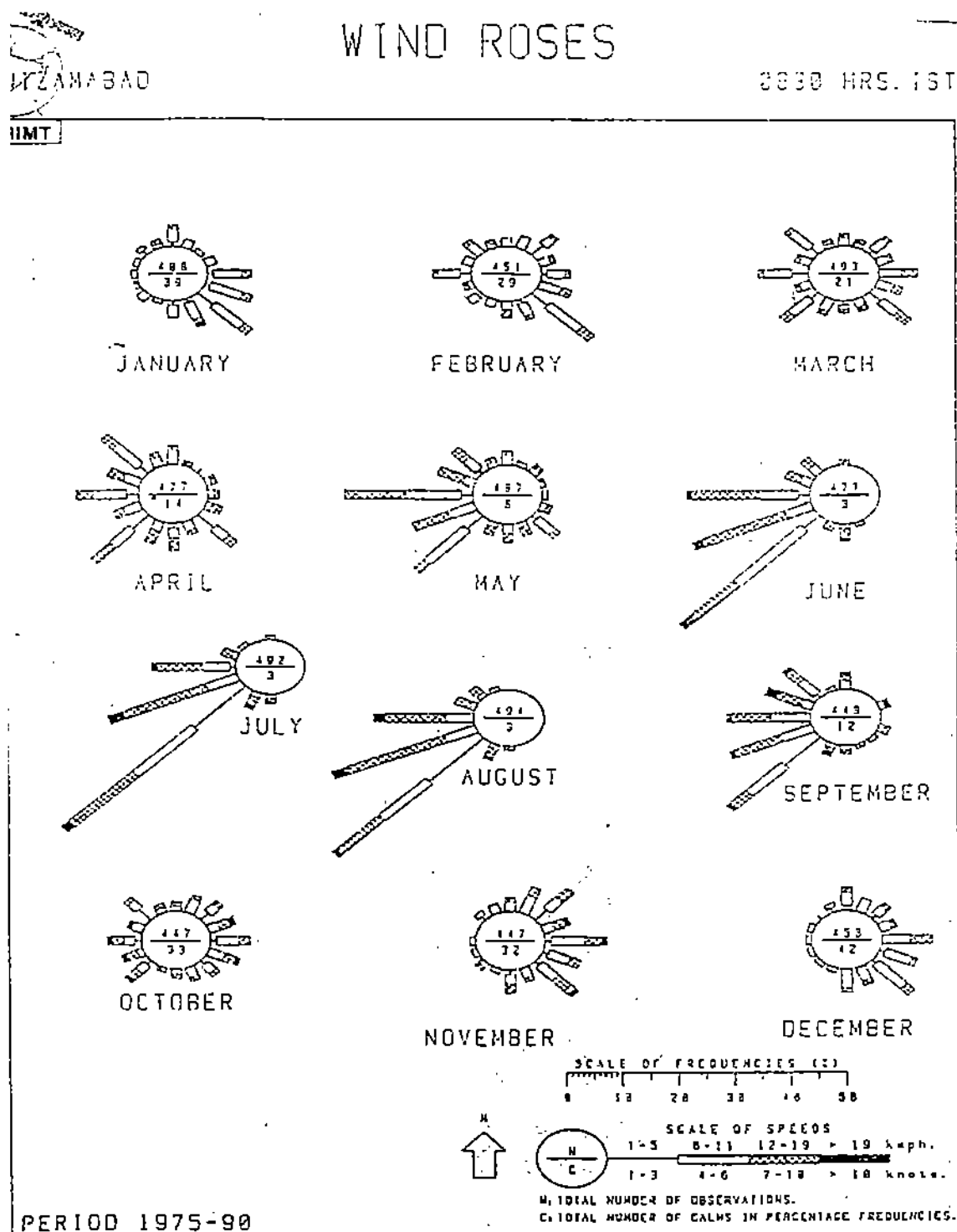
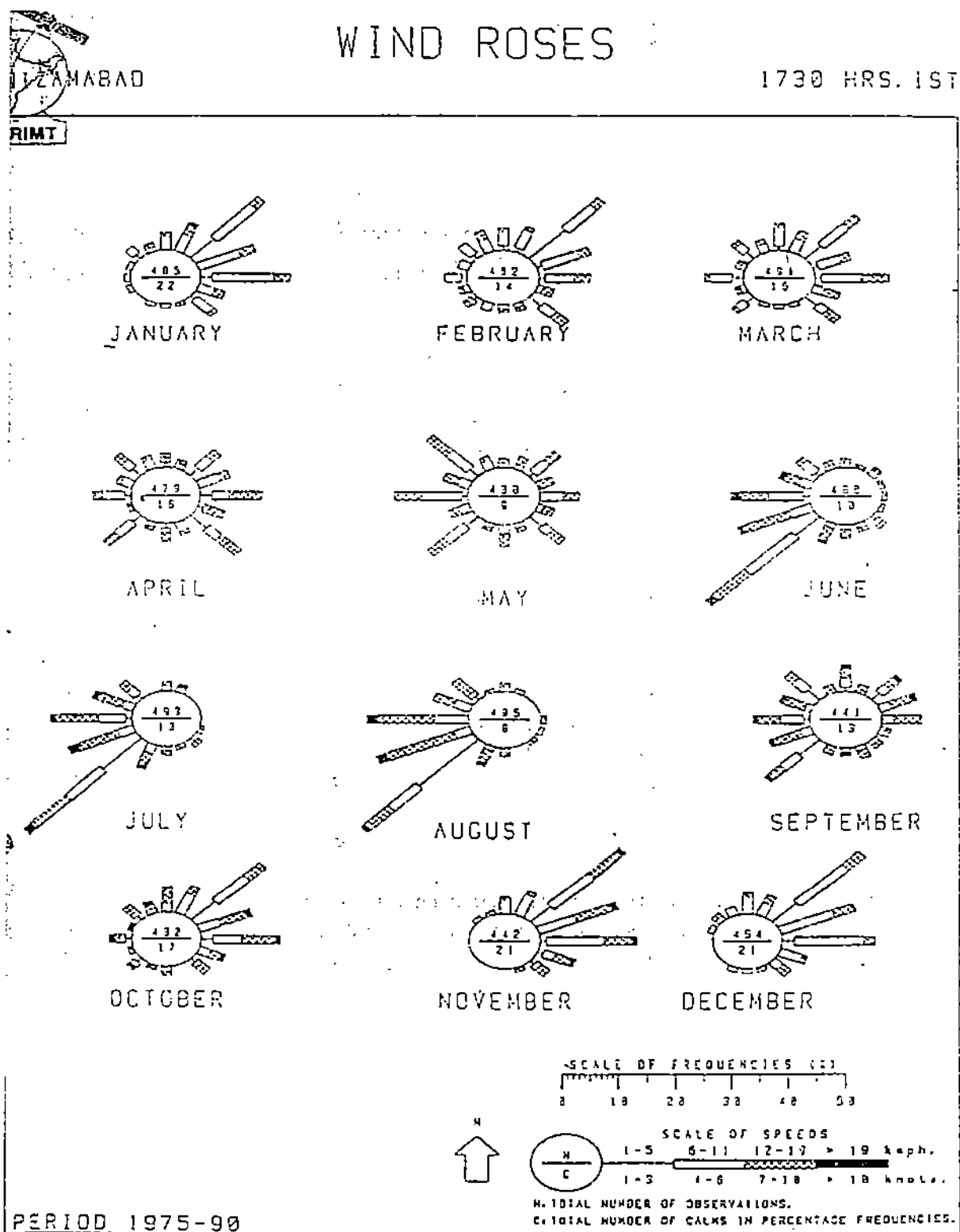


Fig. 2

Source: India Meteorological Department, Pune

Figure 4.4 Wind rose data: IMD – Nizamabad (1730 HRS)

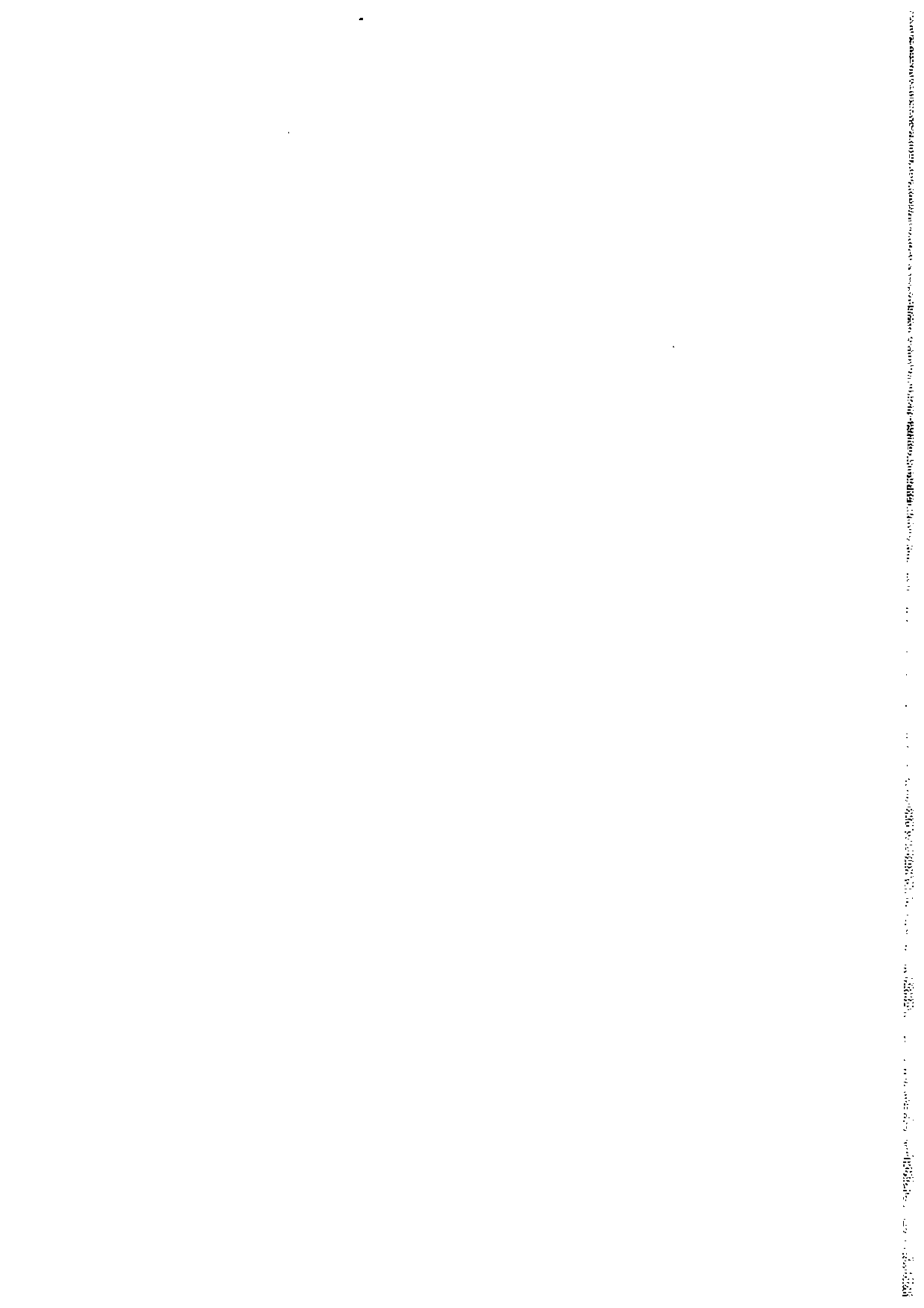


source: Meteorological Centre, Hyderabad Airport

Source: India Meteorological Department, Pune

CHAPTER – 5

SOIL QUALITY



CHAPTER 5.0 SOIL QUALITY

5.1 Introduction

With the construction (Dam and canals etc) of the project, land is likely to be affected by deforestation, digging and quarrying operations, construction of infrastructure, canals and various components of the projects often lead to a change in land use and increase in soil erosion. The impact of erosion aggravates weathering along the active slopes causing on-site soil loss and depletion of soil fertility, whereas offsite effect is sedimentation of river. Besides this, during the construction activities, considerable vehicular movement generates dust and aerosols.

Temporary construction of large number of hutments and provision of basic facilities at work site for workers may also lead to soil erosion. Meeting their daily fuel requirement from nearby shrubs may result in degradation of the relative natural habitat and consequently leads to soil erosion. Most of these activities are supposed to be temporary and are expected to continue till the completion of the project. However necessary actions will be taken for meeting the daily needs of labourers without disturbing the environment in general. Depending upon the quality of soil, the impacts of such activities may vary. Therefore, there is a need for testing soil quality. Additionally, in order to know the anticipated impacts due to the inception water in the command area, during the operation phase, baseline data on the soil quality is must. Therefore we have made an attempt to address this issue by both primary data collection for two seasons as well as available secondary data on soil and water by the Directorate of Irrigation Research & Development (DIRD) - IV, Poona and Irrigation Research Division, Aurangabad (IRDA).

5.2 Secondary Data Analysis

The report by Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004) can be classified as under:

- ❖ Infiltration rate (mm per hour) for the major soil groups identified,
- ❖ Physicochemical characteristics of water from river Lendi,
- ❖ Ground water quality in periphery of 10 km from the FRL of the dam site.

- ❖ The command area is divided into different sub areas. Each sub area is an area bounded by canal on upper side and river on the lower sides. The areas bounded by nallah /river form units of natural drainage and are, therefore, designated as different sub areas,
- ❖ Soil depths were noted by probe in shallow soils and by auger pits in medium and deep soils (Maximum pit depth 250 mm)
- ❖ Collection of soil samples for every fourth bore on alternate cross section and from consecutive three pits near the river for some land units was undertaken
- ❖ Survey was conducted covering major streams/ nallah
- ❖ Observations on well depth / water level as well as quality was carried out
- ❖ Mechanical analysis of 3 samples from a bore selected for testing. One sample – 15mm to 30mm depth, second – 90mm to 120mm and third – 210mm to 250mm depth
- ❖ Salinity and alkalinity of all samples was examined
- ❖ Tests for saturation moisture and capillary rise.
- ❖ Other data collected include Climatological Data (Temperature Rainfall), Crop data for the entire command and Crop data for the areas irrigated by well.

As indicated in the table below, the entire project area was classified in three depth classes viz. shallow, medium and deep as under:

Table 5.1 Distribution of Command Area in Different Depth Classes

Sr. No.	Type of Soil	Area in ha	Percentage
1	Shallow soils (0 – 45 mm)	1259.54	5.46
2	Medium soils (45 – 250 mm)	1670.90	7.25
3	Deep soils > 250 mm	20124.37	87.29
	Total	23054.81	100.00

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

This indicates that the deep soils are predominant in the command area. These soils are fine textured, moderately eroded and moderately drained. They have developed over old riverine alluvium derived from basaltic material.

Medium and deep soil areas are considered suitable for irrigation. Among such areas, those within 1/4th mile limits of village areas in the command are not considered suitable for perennial irrigation. This is done on a public health ground.

Table 5.2 Medium Soils from command area

Sr. No.	Particulars	Area(ha)
1	Total Command Area	1670.90
2	High Water Table Area	(-) 13.00
3	Cut Up Area	(-) 21.50
4	Area suitable for irrigation	1636.40
5	Area within ¼ mile limits of villages	(-) 61.50
6	Area suitable for perennial irrigation	1574.90

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

Table 5.3 Deep Soils from command area

Sr. No.	Particulars	Area(ha)
1	Total Command Area	20124.37
2	High Water Table Area	(-) 51.80
3	Cut Up Area	(-) 268.80
4	Area suitable for irrigation	19803.77
5	Area within ¼ mile limits of villages	(-) 1427.20
6	Area suitable for perennial irrigation	18376.57

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

Table 5.4 Area suitable for irrigation

Sr. No.	Particulars	Area ha	For Perennial Irrigation (ha)
1	Medium deep Soil	1636.40	1574.90
2	Deep Soil	19803.77	18376.57

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

Areas suitable for irrigation in the Lendi command are therefore can be as under:

Table 5.5 Infiltration Rate for Major Soil Groups

Sr. No.	Type of Soil	Infiltration Rate in mm/hr
1	Shallow soils	At Surface 21 mm/hr
2	Medium soils	At Surface 9.60 mm/hr
3	Deep soils	At Surface 8.80 mm/hr

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

The assessment of soil fertility and its index is as under:

Table 5.6 Tehsil-wise Fertility Index for the Nanded District.

Sr. No.	Tehsil	Nitrogen	Phosphorus	Potassium
1	Nanded	L	L	VH
2	Hadgaon	L	L	H
3	Bhokar	L	L	H
4	Kandhar	L	L	H
5	Degloor	L	L	VH
6	Biloli	L	L	H
7	Mukhed	L	L	H
8	Kinwat	M	L	MH

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

L: Low, H: High, VH: Very High, MH: Medium High, VL: Very Low, (Source Epitome Part II 2002).

High to very high Potassium content and medium to low Nitrogen content shows imbalance of nutrients in the soil. Thus, the fertility assessment indicates that the soil is poor in Nitrogen and phosphorus and requires amendments of Nitrogen and Phosphorous rich fertilizers.

Salinity and alkalinity: Of the 150 profiles examined, 8 (5%) were saline – and located in deep soil areas of the land units (1 to 5). Sub-catchments 6 to 8 were free from salinity. Total 19 profiles (8%) had shown alkalinity at some level, 2 of such profiles are in medium soil while 17 in deep soil. Alkaline profiles are distributed in all land units except land unit no.6 which is free of salinity and alkalinity.

Classification of soils based on textural characteristics is provided in the table below:

Table 5.7 Textural classes of the soils from the command area

Type of Soil	Soil Depth in mm	Fine Soil Sandy Clay & Finer	Medium Textured i.e. Loamy Soils	Coarse Soils
Deep	15 – 30	80.43%	19.57%	-
	90 – 120	84.78%	15.22%	-
	210 - 250	83.95%	16.06%	-
Medium	15 – 30	50%	50%	-
	90 - 120	100%	-	-

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

It is seen that the proportion of fine soils is considerable in areas with deep soil. However medium soils differ from deep soils in having fine texture at lower depths. The coarse type of soil texture is totally absent from both the medium and deep soils.

Drainage: The command area is surrounded by three major rivers i.e. Lendi, Manjara and Manar. There are 7 major nallas traversing the command and many small nallas. The length of rivers available for drainage is 70 km. Lendi River is having exposed rocks in many places in the bed as well as on the banks. Exposed rock is prominent in sub areas 1, 3, 4 etc. The intercepting nallas have also rock outcrops at several places. It will be necessary to see if these rock obstructions are required to be removed to improve the drainage of the area.

Soil irrigability: The pre-irrigation soil survey was under taken to classify the command into different irrigability classes (irrigation suitability classes). The classification developed by United States Bureau of Reclamation is widely used for irrigability classes while we use here the classification given in the handbook of Water Management Division of Ministry of Food, Agriculture, Community Development and Cooperation, India. The hand book considers effective depth (useful for crops), texture of surface, permeability, water holding capacity, coarser fragments, gravel and kanker, rock out crops, salinity, alkalinity, sub – soil drainage characteristics, soil erosion status etc for irrigability classes. While suggesting the irrigability classification for Lendi Project, above factors are taken into account except for the soil erosion status. The reason for not considering soil erosion is, land development for irrigating command area has been accepted as a necessity practice in Maharashtra State. It is, therefore, presumed that the work of ayacut development will be taken up and soil erosion will be automatically taken care off. One additional factor taken into consideration was the existing sub-soil water table and how it will behave under irrigation conditions.

While suggesting the classification, the requirement of an irrigation system in the State of Maharashtra needs a consideration. The undulating terrain, variations in soil depth and salinity conditions limits the intensity of perennial crops such as sugarcane. Secondly, high water requirements of perennial crops are normally up to 10 times that of seasonal crops. This restricts spread of perennials and promotes less water intensive crop so as to irrigate large areas. It becomes therefore necessary to indicate percentage of perennials that can be allowed in various parts of the command. With these considerations, the tentatively cropping pattern of the area can be as under –

Class I - Perennials (sugarcane) from 5 to 7 %

Class II – Perennials from 3 to 5 %

Class III – Perennials from 2 to 3 %

Class IV – Perennials up to 2%

Class V A – No perennials but only two seasonal can be allowed

Class V B – Only Kharif seasonal can be grown

Class VI – Totally unfit for irrigation

In the above classification, areas within 1/4th mile limit of villages where no perennial crops are allowed.

Land Drainage: Land drainage is an accepted important corollary to irrigation systems. The old canal systems in the Deccan areas have amply demonstrated this. The State Government has also accepted principally to provide drainage will also be provided in the canal commands.

The classes I-VI are the initial classification based on primarily natural drainage factor and other soil characteristics revealed during the soil survey. A continuous watch on the behaviour of sub soil water table will be necessary before and after irrigation to consider the requirement of artificial drainage. The drainage will also be provided in the command of Lendi Project as and when necessary. It is rather difficult to locate the areas where drainage would be necessary unless the irrigation starts and the damages make appearance. The United States Bureau of Reclamation's hand book has also given the similar reference. However some preliminary steps will be taken to improve the drainage of the area. This includes Ayacut development work which is expected to provide for surface drains to collect and carry away extra irrigation water. These surface drains will empty in the natural drains and finally extra water will flow into the river i.e. the main drain.

All natural nallas and sub nallas will be improved in their drainage capacity by removing the obstructions such as rock bars etc. and by providing steeper gradients where necessary. Some nallas will be deepened sufficiently to cut through the percolating substrata to improve the internal drainage considerably.

Soil depth: The entire command area of Lendi has been divided into 8 sub areas / catchments according to the "Report of Pre-Irrigation Soil Survey of the Command of

Lendi Project Volumes I & II by Shri A. R. Kaulgud, November 1971". For each of these 8 sub-areas, total area surveyed and distribution of soils was noted.

Depth-wise salinity profile: Depth-wise analysis of profiles with reference to salinity indicates that, for depth 0 – 60 mm total soluble salts in land unit no. 1 to 8 varies from 1 to 39 ds/m, likewise for depth 60 – 120 mm, it ranges from 1 to 34 ds/m and for depth 120 – 250 mm, it ranges from 1 to 34 ds/m.

Depth-wise alkalinity profile: Depth-wise analysis of profiles with reference to alkalinity indicates that, for the depth range of 0 – 60 mm, the highest number of soil profile from the 8 land units tested were reported to be slightly alkaline with their pH ranging from 8.5 to 9.0. In the depth range of 60 – 120 mm, the highest number of soil profiles tested were reported to be almost slightly alkaline with pH value ranging from 8.01 – 8.5. In the depth range of 120 – 250 mm maximum number of soil profiles exhibit pH in the range of 8.5 to 9.0 which is again towards alkaline.

Depth-wise textural profile: The textural classification of medium soil in the various land unit areas show that in the depth ranging from 15 – 30 mm the soil profiles mostly exhibit clay or silty clay loam textures. Soil profiles in the depth ranging from 90 – 130 mm show only clayey texture.

A similar exercise had also been carried out for textural classification of deep soil. In the depth region 15 – 30 mm, maximum soil profiles were of clayey texture followed by silty clay loam and clay loam textures. For both the depth range of 90 – 120 mm and 210 – 250 mm, the trend remains exactly the same. Hence, the entire command is dominated by clayey soils.

Table 5.8 Statement showing the hectares under different irrigability classes under the command area

Land unit No.	Class I		Class II		Class III		Class IV		Class V		Class VB	Total Area In ha
	Medium	Deep	Medium	Deep	Medium	Deep	Medium	Deep	Medium	Deep		
1	2	3	4	5	6	7	8	9	10	11	12	13
1	-	-	-	-	-	-	67.90	378.77	-	-	181.44	628.11
2	-	-	-	-	90.65	590.52	139.35	442.18	-	-	395.00	1657.70
3	-	-	-	-	106.80	667.10	-	-	-	-	74.50	848.40
4	-	-	705.90	6029.60	-	-	-	-	-	-	453.20	7188.70
5	-	-	-	-	417.80	3639.40	-	-	-	-	100.40	4157.60
6	-	-	142.50	3578.20	-	-	-	-	-	-	55.00	3775.70
7	-	-	-	1134.42	-	-	-	1585.38	-	-	-	2719.80
8	-	-	-	-	-	-	-	2078.80	-	-	-	2078.80
Total	-	-	848.40	10742.22	615.25	4897.02	207.25	4485.13	-	-	1259.54	23054.81

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

Maximum area of land under the command comes under irrigability Class II (Perennials form 3 to 5%), followed by irrigability Class III (Perennials form 2 to 3%) and irrigability Class IV (Perennials up to 2%).

It has been observed that there are a few soil samples collected from different land units which shows presence of salts in excess of 1.0%. In land unit no.1 there is one soil sample, in land unit no.2 there are 2 samples, land unit 3 has 1 sample, land unit 4 has 3 samples and land unit 5 has 1 sample in the depths ranging from 30 – 60 mm, 0 – 15 mm, 150 – 180 mm, 0 – 15 mm, 15 – 30 mm, 30 – 60 mm, 210 – 250 mm and 0 – 15 mm respectively.

Out of 150 sampling stations examined at various depths, there are only 19 soil samples from land unit no.1 to 8 which have reported pH in excess of 9.0. This includes, 3 samples from land unit no.1 in the depth range 15-30 mm, 30 – 60 mm and 15 – 30 mm, 6 samples from land unit no.2 in the depth range 60 – 90 mm, 30 – 60 mm, 15 – 30 mm, 30 -60 mm, 15 – 30 mm and 210 – 250 mm, 1 sample from land unit no.3 in the depth range 90 – 120 mm, 1 sample from land unit no.4 in the depth range 90 – 120 mm, 2 samples from land unit no.5 in the depth range of 150 – 180 mm and 0 – 15 mm, 3 samples from land unit no.7 in the depth range of 90 – 120 mm, 210 – 250 mm and 30 – 60 mm and lastly 3 samples from land unit no.8 in the depth range 0 – 15 mm, 0 – 15 mm and 0 – 15 mm, all show pH value above 9.0

5.3 Primary Studies on the Soil Quality

5.3.1 Study area:

Lendi Dam Irrigation project is located at Nanded District in Maharashtra. Irrigation facilities from this project would benefit to the areas largely in Nanded District in Maharashtra and Nizamabad District of Andhra Pradesh. The irrigable area planned under this project is 26924ha. The project envisages construction of an earthen dam and masonry weir across the Lendi River, upstream of village Gonegaon, Taluka Mukhed in Nanded District for irrigating the land of both the States i.e. Mukhed and Degloor talukas of Nanded district of Maharashtra and Madnoor and Bichkunda mandal / Tehsils of Nizamabad district of Andhra Pradesh. Reconnaissance survey was carried out and sampling stations for soils were determined, and sampling was carried out. The sampling locations are spread across the command area in both the state. The details of sampling locations are given in table below and they represent the soil type of the project area. Samplings were done in the Pre & Post Monsoon and winter season.

5.3.2 Methodology:

Sampling procedure:

- ❖ Selection of the sampling stations were based on the reconnaissance survey of the entire study area

- ❖ Care has been exercised so that the sampling stations represent the soils of the command area.
- ❖ Number of samples collected as per the suggestions by the EAC in TOR
- ❖ The following standard method is used for the collection of soil samples
 - ✓ Khurpi was used for sample collection.
 - ✓ Sample was taken from the surface to plough depth 0-22 mm from 15 spots in the field of uniform nature.
 - ✓ Recently fertilized, old bunds, marshy spots, near trees, compost heaps and farm sheds etc. these locations are avoided at time of sampling.
 - ✓ Sample was collected uniformly thick 2cm slice of soil bottom to top of the exposed soil face from V shaped hole.
 - ✓ Collected sample placed in a clean bucket. 15 small samples collected from the uniform area in to the same bucket.
 - ✓ Collected soil from 15 locations is mixed and soil divided in to four equal parts and two opposite quarters was rejected. Remaining two portions again mixed and one kilogram of a sample was taken for analysis.

5.4 Soil Quality Study - Maharashtra

It is intended to use both the primary data as well as secondary data on soil to determine soil quality of the command area after reviewing secondary data fresh sample collection and analysis was undertaken for two more seasons, from specific sampling stations. This will help to infer the impact of irrigation (water) as well as various construction and anthropogenic activities on the soil and quality of soil across season of the command area. The soil sampling stations are enumerated in table 5.9.

Table 5.9 List of Sampling Stations for Soil Quality - Maharashtra

Sr. No.	Stations Code	Name of Sampling Stations	Description
1	S1	Kolnoor – Catchment (Maharashtra)	Rain fed area, brownish black soil. Area under cultivation.
2	S2	Hatral – Catchment (Maharashtra)	Rain fed area, hilly area, less soil cover, reddish soil
3	S3	Ravankola – Catchment (Maharashtra)	Rain fed area, black soil
4	S4	Nalgir – Catchment	Rain fed area, area under cultivation

Sr. No.	Stations Code	Name of Sampling Stations	Description
		(Maharashtra)	
5	S5	Unhali - Command (Maharashtra)	Black soil, irrigated using Minor irrigation tank.
6	S6	Tamlur - Command (Maharashtra)	Black soil, Irrigated using ground water
7	S7	Shahpur - Command (Maharashtra)	Black soil, irrigated using ground water irrigated.
8	S8	Dongli - Command (Andhra Pradesh)	Rain fed black soil.
9	S9	Sultanpeth - Command (Andhra Pradesh)	Red soil, not under cultivation.
10	S10	Chainpur - Command (Andhra Pradesh)	Rain fed soil under cultivation
11	S11	Takli (Jahagir) Command (Maharashtra)	Rain fed area, brownish black soil. Area under cultivation.
12	S12	Mujaga Command (Maharashtra)	Rain fed area, hilly area, less soil cover, reddish soil
13	S13	Bomnali Command (Maharashtra)	Rain fed area, black soil
14	S14	Horga Command (Maharashtra)	Rain fed area, area under cultivation
15	S15	Sontgi (Bu) Command (Maharashtra)	Black soil, irrigated using Minor irrigation tank.
16	S16	Hanuman Hipparga Command (Maharashtra)	Black soil, Irrigated using ground water
17	S17	Koratgi (Bu) Command (Maharashtra)	Black soil, irrigated using ground water irrigated.
18	S18	Matgi Command (Maharashtra)	Rain fed black soil.
19	S19	Thadi Sawargaon Command (Maharashtra)	Red soil, not under cultivation.
20	S20	Up - Sawargaon Command (Maharashtra)	Rain fed soil under cultivation
21	S21	Sangivi Umer Command (Maharashtra)	Black soil, irrigated using Minor irrigation tank.
22	S22	Madan Kallur Command (Maharashtra)	Black soil, Irrigated using ground water
23	S23	Tamlur Command (Maharashtra)	Black soil, irrigated using ground water irrigated.
24	S24	Selgaon Command (Maharashtra)	Rain fed area, brownish black soil. Area under cultivation.
25	S25	Shekapur Command (Maharashtra)	Rain fed area, less soil cover, reddish soil
26	S26	Nandura Command (Maharashtra)	Rain fed area, black soil

The soil samples were examined for 12 parameter enumerated with method of analysis in table number 5.10 below.

Table 5.10 Parameters for Soil Quality Assessment

Sr. No.	Parameter
1	pH (1:2.5 Soil Water Extract)
2	EC (ds/m)
3	Texture a. Sand (%) b. Clay (%) c. Silt (%)
4	Bulk Density (g/cm^3)
5	Porosity (%)
6	Available Nitrogen as N (kg/Ha)
7	Available Potassium as K (kg/Ha)
8	Available calcium as Ca (mg/100 gm)
9	Iron as Fe
10	Copper as Cu
11	Manganese as Mn
12	Zinc as Zn

Table 5.11 Physical/ Mechanical Analysis of the Soil

Sampling Stations Code	Name of Sampling Stations	Texture			Textural Class
		Clay (%)	Silt (%)	Sand (%)	
S1	Kolnur	55	20	25	Clay
S2	Hatral	50	22	28	Clay
S3	Ravankola	33	37	30	Clay loam
S4	Nalgir	33	37	30	Clay loam
S5	Unhali	40	50	10	Silty clay
S6	Tamlur	43	52	05	Silty clay
S7	Shahpur	25	50	25	Silty clay
S8	Dongli	23	45	32	Silty loam
S9	Sultanpet	08	10	82	Sandy Loam
S10	Chainpur	03	02	95	Sand
S11	Takli	60	15	25	clay
S12	Mujaga	15	60	25	Silt loam
S13	Bomnali	25	40	35	loam
S14	Horga	50	23	27	clay
S15	Sontgi	38	50	12	loam
S16	Hanuman Hipparga	25	55	20	Silty loam
S17	Koratgi (Bu)	20	55	25	Silty loam
S18	Matgi	35	45	20	Silty clay loam
S19	Thadi	50	15	35	Clay

S20	Up- Sawargaon	15	20	65	Sandy loam
S21	Sangivi Umer	55	20	25	Clay
S22	Madan Kallur	30	20	50	Sandy clay loam
S23	Tamlur	55	15	30	Clay
S24	Selgaon	45	20	35	Clay
S25	Shekapur	25	35	40	loam
S26	Nandura	25	55	20	Silty clay

Kolnur, Hatral, Takli, Hoga, Thadi, sangivi Umer, Tamlur and selgaon : Soil in this area is clayey in texture. The water holding capacity of such soil is generally high. These kinds of soils require proper management of water. It is advised that the soils are not good for excess irrigation. When wet, they are very sticky but when dry they form hard clots. As clay contains high nutrient levels, plants grow well if drainage is adequate.

Ravankola and Nalgir : Soils are clayey loam in nature. High percentage of available potassium is observed in this type of soil, which is suitable for normal field crops.

Unhali, Tamlur, Shahpur, Nandura and Dongli

The soil is silty clay, and suitable for general field crops. The soils have moderate drainage and good soil nutrients.

Bomnali, Shekapur and Sontgi : The soil in this region is loamy in nature. Such soils are mixture of sand and clay soil. However, these soils are fertile in nature because it contains large quantities of humus, or decayed organic matter. Considered to be perfect soil, loamy soils are combination of roughly 40% sand, 40% silt and 20% clay. Characteristically they drain well while retaining moisture.

Chainpur : The soil in Chainpur region is sandy in texture. If sandy soil contains enough organic matter it is easy to cultivate. However, it is prone to over-draining and summer dehydration, and in wet weather it can have problems retaining moisture and nutrients.

Sultanpet and Up- Sawargaon : The soil in Sultanpet and Up- Sawargaon region is sandy loam in texture. If sandy soil contains enough organic matter it is easy to cultivate. However, it is prone to over-draining and summer dehydration, and in wet weather it can have problems retaining moisture and nutrients.

Table 5.12 Chemical Analysis of Soil for post monsoon season

Sr. No.	Sample Code	Village Name	Parameters												Cu (mg/kg)
			pH (1:2.5)	EC (dS/m)	Organic Carbon (%)	Calcium Carbonate (%)	Ca (µg/g)	Mg (µg/g)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	
1	S1	Kolnur	8.11	0.30	0.51	6.5	4734.08	2779.5	200	10	818	17.8	5.2	0.3	5.2
2	S2	Hatral	7.06	0.24	0.4	3	4998.23	2367.27	225	20.1	423	32.8	28.6	0.5	4.2
3	S3	Ravankol	7.85	0.30	0.75	4.5	4978.54	2377.77	225	16	1109	18	5.8	0.6	5.8
4	S4	Nalgir	7.15	0.30	0.42	3.75	5321.56	1972.53	200	9	457	38.6	37.8	0.45	7.4
5	S5	Unhali	8.56	0.22	0.66	5.25	5319.86	1977.63	213	21	450	14	18	0.46	6.2
6	S6	Tamlur	8.05	0.25	0.51	4.2	5324.13	1967.13	223	27	706	17.2	18.8	1.6	7.2
7	S7	Shahpur	8.02	0.21	0.6	4.25	4897.58	1909.41	200	9	784	16	15.8	1.2	3.6
8	S8	Dongli	8.26	0.35	0.42	4.25	4887.68	1911.43	275	15.2	470	15.8	15.2	0.8	3.8
9	S9	Sultanpeth	6.22	0.30	0.18	2.25	4550.52	1520.61	288	14	269	13.8	6	0.8	4.8
10	S10	Chainpur	7.78	0.40	0.18	3.2	4549.58	1523.62	250	21	627	18	6.8	0.55	4.6
11	S11	Takli (Jahagir)	7.5	0.30	0.36	3.75	4582.87	2221.34	220	24.11	589.68	19.37	13.7	0.56	2.27
12	S12	Mujaga	7.85	0.35	0.39	4.5	4581.77	2231.44	219	17.96	1048.32	15.05	18.31	0.5	2.25
13	S13	Bomnali	7.26	0.25	0.4	4.52	4981.05	2192.37	225	17.75	1050	17.1	8.35	0.41	2.27
14	S14	Horga	8.5	0.32	0.45	3.65	4992.12	2182.31	121	35.57	551	18.41	10.21	0.89	3.25
15	S15	Sontgi	6.85	0.20	0.42	3.75	4777.37	1497.02	203	36.67	546	19.43	10.24	0.9	2.27
16	S16	Hanuman Hipparga	7.2	0.30	0.43	3.75	4570	1370.27	205	37	540	10.2	10.2	0.9	2.29
17	S17	Koratgi (Bu)	8.15	0.20	0.48	5.38	4957.06	1365.7	232	19.5	982.8	13.47	9.59	0.58	4.15
18	S18	Matgi	7.02	0.21	0.5	2.31	4875.27	1361.94	230	18.9	980.7	13.49	9.52	0.57	4.13
19	S19	Thadi Sawargaon	6.95	0.22	0.41	2.13	4947.67	1344.23	240	29.14	480	14.45	11.82	0.12	2.78

Sr. No.	Sample Code	Village Name	Parameters												Cu (mg /kg)
			pH (1:2.5)	EC (ds/m)	Organic Carbon (%)	Calcium Carbon ate (%)	Ca (µg/g)	Mg (µg/g)	Available Nitrogen (kg/ha)	Available Phosphoru s (kg /ha)	Available Potassium (kg /ha)	Fe (mg /kg)	Mn (mg/k g)	Zn (mg /kg)	
20	S20	Up-Sawargaon	6.25	0.20	0.42	2.5	4732.34	1038.15	238	29.24	480.48	14.48	11.82	0.14	2.88
21	S21	Sangivi Umer	7.49	0.15	0.45	3.13	5122	2529.65	235	33.34	458.64	13.47	7.07	0.7	2.5
22	S22	Madan Kallur	7.4	0.30	0.43	3.11	5200.19	1577.16	230	33.24	460.54	13.45	7.1	0.7	2.53
23	S23	Tamlur	7.8	0.25	0.3	3.25	5015.72	1604.09	203	34.36	698.88	13.39	8.78	0.6	2.88
24	S24	Selgaon	7.95	0.21	0.32	5.27	4482.98	1774.88	220	33.78	700.1	13.27	8.75	0.67	2.88
25	S25	Shekapur	6.8	0.25	0.43	3.38	4740.44	1587.26	220	26.67	480.48	10.82	16.71	0.56	2.75
26	S26	Nandura	7.1	0.20	0.37	2.18	5554.53	2914.02	211	20.52	770.1	12.06	21.87	0.54	2.7

Table No 5.13 Results of soil analysis for Pre Monsoon season

Sr. No.	Sample Code	Village Name	Parameters												
			pH (1:2.5)	EC (ds/m)	Organic Carbon (%)	Calcium Carbonate (%)	Calcium (µg/ g)	Magnesium (µg/ g)	Available Nitrogen (kg/ ha)	Available Phosphorus (kg /ha)	Available Potassium (kg /ha)	Fe (mg / kg)	Mn (mg /kg)	Zn (mg /kg)	Cu (mg /kg)
1	S1	Kolnur	7.10	0.12	0.50	5.05	6990.00	3240.63	210.10	15.60	820.70	10.65	8.30	0.32	4.30
2	S2	Hatral	7.08	0.1	0.60	2.80	7000.00	3578.07	228.93	23.80	529.92	26.54	28.98	0.59	4.00
3	S3	Ravankol	7.02	0.14	0.40	4.35	6930.00	3575.06	230.15	28.09	710.80	24.53	4.15	0.58	2.33
4	S4	Nalgir	7.05	0.06	0.39	4.30	4832.01	1890.10	219.10	26.10	460.60	16.39	37.17	0.47	2.20
5	S5	Unthali	7.00	0.36	0.36	4.38	4818.74	1899.00	235.20	29.75	458.64	17.26	17.25	0.50	2.58
6	S6	Tamlur	7.10	0.15	0.40	4.37	4820.70	1890.00	230.20	30.00	455.60	16.50	17.10	1.49	2.60
7	S7	Shahpur	7.25	0.13	0.42	2.10	4520.60	1327.10	203.80	36.02	501.10	12.32	14.22	1.30	4.00

Sr. No.	Sample Code	Village Name	Parameters												
			pH (1:2.5)	EC (ds/m)	Organic Carbon (%)	Calcium Carbonate (%)	Calcium (µg/ g)	Magnesium (µg/ g)	Available Nitrogen (kg/ ha)	Available Phosphorus (kg /ha)	Available Potassium (kg /ha)	Fe (mg / kg)	Mn (mg /kg)	Zn (mg /kg)	Cu (mg /kg)
8	S8	Dongli	8.00	0.08	0.43	2.30	4620.70	1220.20	220.60	25.60	550.00	13.01	14.41	0.32	4.10
9	S9	Sultanpeth	7.10	0.03	0.45	2.15	3760.00	1320.10	235.00	24.62	560.70	15.61	5.01	0.48	2.30
10	S10	Chainpur	7.05	0.1	0.42	2.20	3570.20	1220.20	230.10	24.30	501.10	15.83	5.10	0.50	2.32
11	S11	Takli (Jahagir)	7.20	0.1	0.41	2.30	3445.10	1320.40	240.15	23.10	470.80	14.24	13.00	0.42	2.02
12	S12	Mujaga	7.12	0.4	0.40	2.45	3560.70	1130.40	244.60	28.00	490.10	14.10	18.24	0.42	2.51
13	S13	Bornali	7.15	0.35	0.42	2.60	3520.60	1320.08	240.75	24.62	502.30	15.42	8.32	0.35	2.30
14	S14	Horga	7.10	0.48	0.42	2.50	3525.67	1327.07	222.66	24.62	502.32	15.13	9.25	0.40	2.35
15	S15	Sontgi	7.20	0.09	0.40	2.90	3220.60	1220.10	220.60	29.20	501.30	11.11	10.20	0.33	2.18
16	S16	Hanuman Hipparga	7.30	0.12	0.43	4.60	3445.20	960.10	222.65	29.40	560.80	14.23	10.00	0.32	2.05
17	S17	Koratgi (Bu)	7.05	0.4	0.45	4.90	4228.30	965.10	225.30	30.00	540.70	10.20	8.50	0.34	2.37
18	S18	Matgi	7.03	0.15	0.39	5.00	4286.27	169.25	241.47	29.24	567.84	16.82	8.20	0.53	3.13
19	S19	Thadi Sawargaon	7.00	0.1	0.40	5.10	4285.20	960.00	240.40	30.20	430.80	10.20	10.40	0.51	3.30
20	S20	Up- Sawargaon	7.30	0.085	0.39	5.00	4328.00	960.00	242.30	29.40	450.10	13.24	10.80	0.58	3.13
21	S21	Sangvi Umer	6.95	0.25	0.45	3.13	3662.00	1320.00	244.61	26.67	436.80	15.33	5.90	0.40	2.40
22	S22	Madan Kallur	7.20	0.2	0.42	3.10	3552.10	1320.60	244.60	31.00	430.70	14.89	6.40	0.57	2.18
23	S23	Tamlur	7.02	0.3	0.45	3.15	3650.00	1310.50	240.30	29.10	540.10	13.93	7.53	0.30	2.15
24	S24	Selgaon	7.05	0.45	0.45	3.70	3360.70	1311.50	258.10	25.60	520.00	15.20	8.40	0.40	2.11
25	S25	Shekapur	7.10	0.21	0.60	3.75	3362.57	1311.51	257.15	24.62	546.00	15.95	15.38	0.43	2.12
26	S26	Nandura	7.00	0.32	0.40	3.10	4330.10	1708.10	265.30	24.60	640.30	15.75	20.20	0.53	3.70

Table No 5.14 Results of soil analysis for Winter Season

Sr. No.	Sample Code	Village Name	pH	EC (dS/m)	Organic Carbon (%)	Calcium Carbonate (%)	Ca (µg/g)	Mg (µg/g)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Potassium (kg/ha)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
1	S1	Kolnur	7.61	0.21	0.51	5.78	5862.04	3010.07	205.05	12.80	819.35	14.23	6.75	0.31	4.75
2	S2	Hatral	7.07	0.17	0.50	2.90	5999.12	2972.67	226.97	21.95	476.46	29.67	28.79	0.55	4.10
3	S3	Ravankol	7.44	0.22	0.58	4.43	5954.27	2976.42	227.58	22.05	909.90	21.27	4.98	0.59	4.07
4	S4	Nalgir	7.10	0.18	0.41	4.03	5076.79	1931.32	209.55	17.55	458.80	27.50	37.49	0.46	4.80
5	S5	Unhali	7.78	0.29	0.51	4.82	5069.30	1938.32	224.10	25.38	454.32	15.63	17.63	0.48	4.39
6	S6	Tamlur	7.58	0.20	0.47	4.29	5072.42	1928.57	226.60	28.50	580.80	16.85	17.95	1.55	4.90
7	S7	Shahpur	7.64	0.17	0.51	3.18	4709.09	1618.26	201.90	22.51	642.55	14.16	15.01	1.25	3.80
8	S8	Dongli	8.13	0.22	0.43	3.28	4754.19	1565.82	247.80	20.40	510.00	14.41	14.81	0.56	3.95
9	S9	Sultanpeth	6.66	0.17	0.32	2.20	4155.26	1420.36	261.50	19.31	414.85	14.71	5.51	0.64	3.55
10	S10	Chainpur	7.42	0.25	0.30	2.70	4059.89	1371.91	240.05	22.65	564.05	16.92	5.95	0.53	3.46
11	S11	Takli (Jahagir)	7.35	0.20	0.39	3.03	4013.99	1770.87	230.08	23.61	530.24	16.81	13.35	0.49	2.15
12	S12	Mujaga	7.49	0.38	0.40	3.48	4071.24	1680.92	231.80	22.98	769.21	14.58	18.28	0.46	2.38
13	S13	Bomnali	7.21	0.30	0.41	3.56	4250.83	1756.23	232.88	21.19	776.15	16.26	8.34	0.38	2.29
14	S14	Horga	7.80	0.40	0.44	3.08	4258.90	1754.69	171.83	30.10	526.66	16.77	9.73	0.65	2.80
15	S15	Sontgi	7.03	0.15	0.41	3.33	3998.99	1358.56	211.80	32.94	523.65	15.27	10.22	0.62	2.23
16	S16	Hanuman Hipparga	7.25	0.21	0.43	4.18	4007.60	1165.19	213.83	33.20	550.40	12.22	10.10	0.61	2.17
17	S17	Koratgi (Bu)	7.60	0.30	0.47	5.14	4592.68	1165.40	228.65	24.75	761.75	11.84	9.05	0.46	3.26
18	S18	Matgi	7.03	0.18	0.45	3.66	4580.77	765.60	235.74	24.07	774.27	15.16	8.86	0.55	3.63
19	S19	Thadi Sawargaon	6.98	0.16	0.41	3.62	4616.44	1152.12	240.20	29.67	455.40	12.33	11.11	0.32	3.04
20	S20	Up-Sawargaon	6.78	0.14	0.41	3.75	4530.17	999.08	240.15	29.32	465.29	13.86	11.31	0.36	3.01
21	S21	Sangvi Umer	7.22	0.20	0.45	3.13	4392.00	1924.83	239.81	30.01	447.72	14.40	6.49	0.55	2.45
22	S22	Madan Kallur	7.30	0.25	0.43	3.11	4376.15	1448.88	237.30	32.12	445.62	14.17	6.75	0.64	2.36

23	S23	Tamlur	7.41	0.28	0.38	3.20	4332.86	1457.30	221.65	31.73	619.49	13.66	8.16	0.45	2.52
24	S24	Selgaon	7.50	0.33	0.39	4.49	3921.84	1543.19	239.05	29.69	610.05	14.24	8.58	0.54	2.50
25	S25	Shekapur	6.95	0.23	0.52	3.57	4051.51	1449.39	238.58	25.65	513.24	13.39	16.05	0.50	2.44
26	S26	Nandura	7.05	0.26	0.39	2.64	4942.32	2311.06	238.15	22.56	705.20	13.91	21.04	0.54	3.20

Table 5.15 Uses of soil based on their quality

Sr. No	Quality	pH	EC	SAR	RSC	Na	B	Cl ⁻	Mg: Ca	Uses:
1	Very Good	7.0	<0.25	<10	<1.25	<50	<1	<5	<1.5	Suitable to all soil & crops.
2	Good	7.5-8.0	0.25-0.75	10-18	1.25-1.75	50-65	1-2	5-10	1.5-3.00	Good to medium drained soils & medium to high salts tolerant crops.
3	Doubtful	8.0-8.5	0.75-2.25	18-26	1.75-2.25	65-92	2-3	10-15	>3.00	Drainage, organic manures, CaSO ₄ (alkali), salt tolerant crops.
4	Not suitable	>8.5	>2.25	>26	>2.25	>92	>3	>15	>3.00	Not suitable for normal field crops.

(Source: Directorate of Irrigation Research & Development, Poona and Irrigation Research Division Aurangabad (Dec. 2004)

Soil pH: One of the most enlightening attributes of soils is its pH. It measures the relative concentration of hydrogen ions in solution. In the present study of this project, for all the 26 soil samples the pH was observed for two different season's e.g. Post monsoon, summer and winter season. It was observed that in summer season, pH ranges from 6.95 to 8.00 and in post monsoon season, pH ranges from 6.22 to 8.56 and in winter season pH ranges from 6.66 to 8.13. Higher pH values recorded in post monsoon season. It was also observed that in post monsoon, average pH was 7.50 and in summer season, average pH was 7.15 and in winter average, pH was 7.32.

It means overall natures of soil are found to be neutral to slightly alkaline. These high values are possibly due to precipitates of calcium, magnesium and fertilizer ingredients. Higher range of pH observed during the post monsoon season was comparable to that of summer season, though the values were slightly lower in summer season. This may be because of the capillary action in summer that brings up Ca, Na, carbonates and nitrates, which in turn may bring the pH levels down.

Electrical conductivity: Electrical conductivity is used for in the estimation of the total soluble salts content of the soils. In the present study of this project, for all the 26 soil samples the electrical conductivity was observed for three different seasons i.e. for Post monsoon season, summer season and winter season. It was observed that for the post monsoon season EC ranges from 0.15 to 0.40 dS/m and in summer, EC ranges from 0.03 to 0.48 dS/m and in winter season EC ranges from 0.14 to 0.40 dS/m. However, the recorded EC values for three the seasons were well within the limits. The EC values are comparable for three the seasons, except for some values.

Calcium Carbonate: Results of the have indicated that CaCO_3 content in soil varies from 2.10 to 5.10 % , 2.25 to 6.50% and 2.20 to 5.78% for the post monsoon, summer and winter season respectively. Most of the samples exhibit non-calcareous properties for both the seasons while a few samples are moderately calcareous. The higher percentage of CaCO_3 in soil samples (S NO S1, S5, S6, S7, S8, S12, S14, S17 & S23) observed during the post monsoon season can be attributed to alkaline pH, lower rainfall and higher rate of evaporation. These activities are linked with accumulation and precipitation of CaCO_3 . Non-irrigated soils like in the projects areas known to have more calcareous soils.

Organic matter: The organic matter is an important component of the soil that contributes to the fertility. Organic matter is derived from the remains of plants and animals. Organic matter helps in improving porosity of the soil.

Observed organic carbon content ranges from 0.18 to 0.66% in post monsoon and 0.36 to 0.60% for the summer season and 0.30 to 0.58 % for winter season. Overall the range is moderate (0.41-0.60) for three the seasons. The relatively lower levels of organic carbon in summer is may be related to lower moisture content leading to less release of organic matter by bacterial activities. The lower levels of organic

matter, is also evident from the slightly alkaline pH of the soil. In general, majority of the soils exhibited medium to low carbon content, indicating need for application of organic fertilizers.

Available Nitrogen: Nitrogen is one of the major plant nutrients. It is most important component for vegetative crop growth. Present study observed that the available soil nitrogen ranges from 200 to 288 kg per ha in post monsoon and 203 to 288 kg per ha in summer and 171.83 to 261.50 kg per ha in winter season. Overall, the levels are low for the three seasons. Comparatively slightly higher available nitrogen in summer may be attributed to the cultivation of pulses as a kharif crop in the area. Project area is known for cultivation of Tur (*Cajanus cajan*) legume crops known to fix Nitrogen. Also preparations of land with ploughing and harrowing activities are common in this season which may results in turning of soils of root zone areas.

Available Phosphorus: Phosphorus is a major nutrient that plays vital role in plant reproductive outputs or yield. For the study area, the available Phosphorus ranges from 9 to 37 kg /ha for the Post monsoon while 15 to 36 kg per ha for the summer season and 12.80 to 33.20 kg /ha for the winter season. Overall the levels are lower to moderate when compared to the recommended limits.

Available Potassium: The available Potassium (K) levels in the soil ranges from 269 to 1109 kg/ha for post monsoon, while 460 to 820 kg/ha for the summer season and 414.85 to 909.90 kg/ha for winter season. The study area lies in Deccan, which is black cotton soil and known to have higher levels of K. During post monsoon season, K known to participate in the activation of various enzymes which are involved in physiological process of plants. On the contrary, summer season, area is devoid of crops. In post monsoon season values of K are higher this is possible due the application of chemical fertilizers. In summer season values of K are well within the limit as per recommendation. K is also known to be released from clay, in higher pH conditions.

Exchangeable Magnesium: The exchangeable Magnesium ranges from 1338.15 to 2914 PPM, 960 to 3578 PPM and 765.5 to 3010 kg/ha in post, pre monsoon and winter seasons respectively.

Exchangeable Calcium: In soil, calcium replaces hydrogen (H) ions from the surface of soil particles when limestone is added to reduce soil acidity. It is beneficial to microorganisms as they turn crop residues into organic matter, release nutrients, and improve soil aggregation and water holding capacity. Calcium helps enable nitrogen fixing bacteria that form nodules on the roots of leguminous plants to capture atmospheric nitrogen and convert into a form that plants can use.

Micronutrients: During the study, all the 26 soil samples were examined for two seasons, for the levels of the micronutrients such as Ferrous, Copper, Zinc and Manganese. It was observed that the levels of these micronutrients do not differ across the seasons.

Ferrous: The Ferrous in the soil ranges from 10.20 to 38.25 mg /kg, 10.20 to 26.54 mg /kg and 11.84 to 29.67 mg/kg in post monsoon, summer and winter season respectively. The level of Ferrous in the soil is sufficient. Slightly higher values of ferrous recorded in post monsoon season as compared to summer.

Copper: The copper in the soil ranges from 2.74 to 7.4 mg /kg, 2.02 to 4.30 mg /kg and 2.15 to 4.90 kg/ha in post monsoon, summer and winter season respectively. The level of copper in the soil is sufficient.

Zinc: The zinc in the soil ranges from 0.12 to 1.6, 0.30 to 1.49 and 0.31 to 1.55 mg /kg on post monsoon, summer and winter season respectively.

Manganese: The manganese in the soil ranges from 5.2 to 37.8 mg /kg and 4.7 to 37.17 mg /kg on post monsoon season and summer season respectively.

5.5 Conclusion -Maharashtra

Secondary as well as primary data examination of soil quality indicates that the soil from the command area of the Lendi project is medium to deep, fine textured and moderately drained. Since soil is medium to deep, it is suitable for perennial irrigation purpose. Fertility assessment indicates that the soils are poor in nitrogen and phosphorous and high in Potassium. Soils require amendments of Nitrogen and Phosphorous.

Soil samples from Kolnur, Hatral, Takli, Hoga, Thadi, sangivi Umer, Tamlur and selgaon stations are clayey in texture and proper management is required for these sites in order to avoid water logging. This is because clayey soils are prone to water logging. This calls for proper scheduling of the irrigation as per the requirement. The electrical conductivity of the soil is normal and there is no cause for the alarm. The soils of the project area are suitable for deep rooted crops e.g. Pulses, Sugarcane, Cotton, Banana, etc.

The soil samples of Ravankola and Nalgir were found to be of clayey loam in texture with low nitrogen content. Soils of Unhali, Tamlur, Shahpur, are silty clay in texture where as soil from Dongli is silty loam in texture. Generally, these types of soils are suitable for normal field crops. Except at Tamlur, the Potassium content of the soil was found to be very high; other soils are good for agricultural activities. Proper irrigation, use of fertilizers and manure practices can yield good crop for the soils rich in Potassium. Calcareous soil is found in many sampling stations except for the Sultanpet, Dongli and Shahpur. Soil from Sultanpet is loamy sand while it is sandy at Chainpur.

The particle density, bulk density and porosity of the soil from Chainpur were investigated by the mechanical analysis. Salinity and alkalinity of the soil is low, leading to low electrical conductivity. Frequent irrigation to such soils is necessary to maintain the quality of the soil. In such cases short duration crops like Ridge Gourd, Bitter Gourd, Coriander, and Cucumber etc. can be drawn from such types of soils. Drip irrigation will prove to be more beneficial to the crops, than the flood irrigation. The phosphorous and nitrogen content of the soil vary from soil to soil. Typical application external fertilizers as a source of P and N would be useful. The micronutrients reported are Fe, Mn, Zn, Cu etc. The overall micronutrients availability is moderate to low and needs to be supplemented.

5.6 Soil Quality Study - Andhra Pradesh

As directed by the EAC, additional soil sampling stations were established for the command areas of the Andhra Pradesh. There are additional 15 soil sampling stations established for the Andhra Pradesh. The sampling were done in pre monsoon, post monsoon and winter season.

Soil samples were examined for 26 parameters enumerated in the table provided below. The detailed soil quality investigation was undertaken for the summer season at selected sampling stations of the command areas of Andhra Pradesh. The details of the sampling stations are provided in Table number 5.16.

5.5.1 Study Area: For Andhra Pradesh, the area planned to be irrigated as a part of Lendi Project is 11214 ha. This command area is spread across Madnoor and Bichkunda tehsils of Nizamabad district of Andhra Pradesh. Care has been exercised so that the sampling covers the entire command area.

Table 5.16 The Standard methods adopted for soil analysis.

Sr. No.	Parameter	Method
1.	pH (1:2.5 soil water extract)	Potentiometry
2.	Electrical conductivity	Conductometry
3.	Texture	Hydrometer
4.	Bulk density	Picnometer
5.	Porosity	Walkey and Black wet oxidation
6.	Organic Matter	Walkey and Black wet oxidation
7.	Organic Carbon	Walkey and Black wet oxidation
8.	Available nitrogen as N	Alkaline Permanganate
9.	Available phosphates as P_2O_5	$0.5 NaHCO_3 (p^{H8.5})$
10.	Available Potassium as K	NN NH_4AOC
11.	Available calcium as Ca	Versenate titration
12.	Exchangeable magnesium as Mg	Versenate titration
13.	Exchangeable Na	Flame-photometry
14.	Chlorides as Cl	Volumetric
15.	Sulphates as SO_4	Turbidimetric
16.	DTPA Iron	A.A.S.
17.	DTPA Cu	A.A.S.
18.	DTPA Zn	A.A.S.
19.	DTPA Mn	A.A.S.
20.	DTPA As	A.A.S.
21.	Boron Hot water soluble B	Azomethine -H

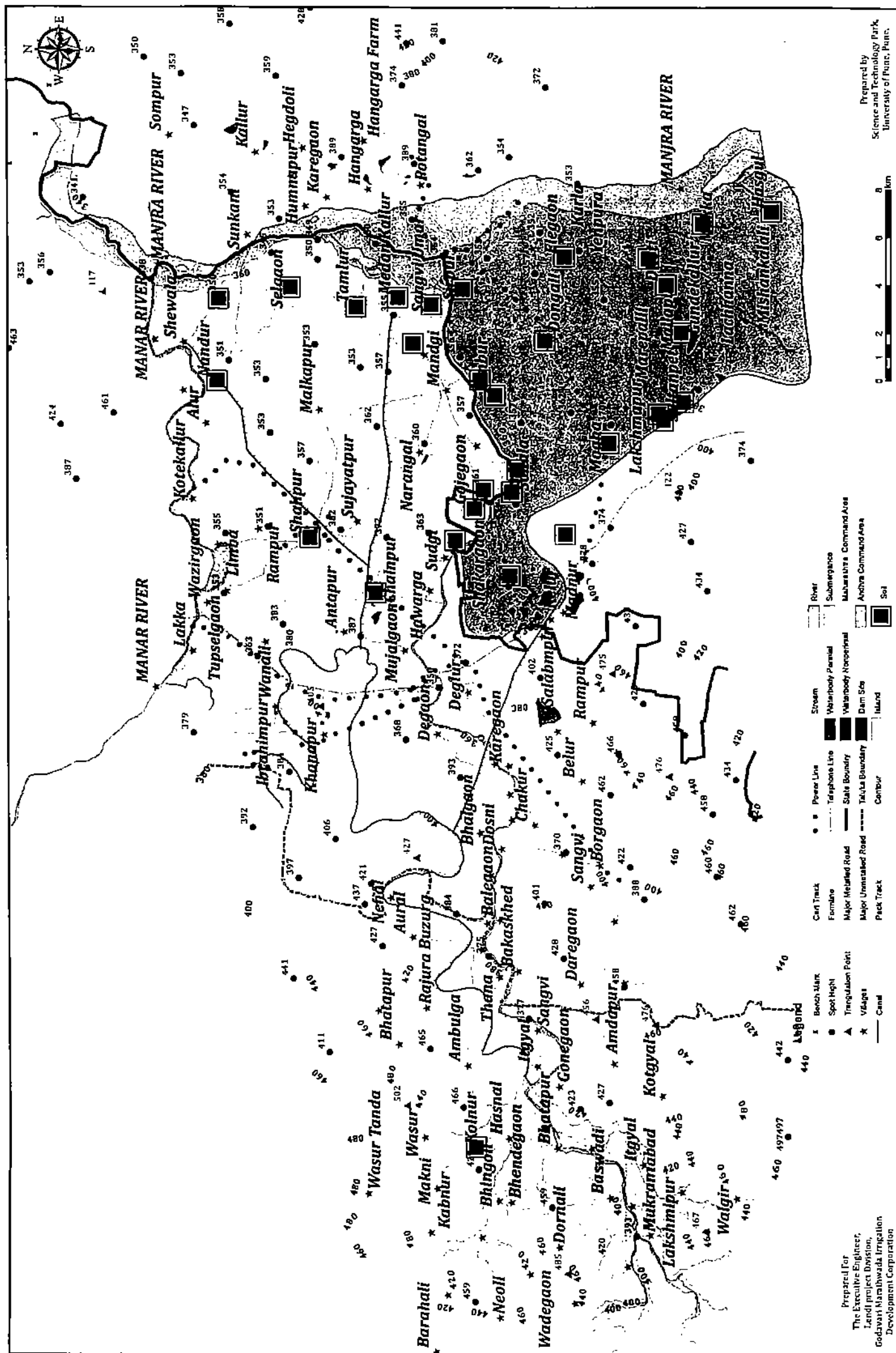
22.	Cadmium as Cd	A.A.S.
23.	Lead as Pb	A.A.S.
24.	Nickel as Ni	A.A.S.
25.	Molybdenum as Mo	A.A.S.
26.	ESP	Flame-photometry

5.5.2 Sampling Stations

Table 5.17 The soil sampling stations are given below – Andhra Pradesh

Code	Station	Tehsil	Co ordinates	Elevation
S1	Sonala	Madnoor	N – 18° 30' 47.1" E – 77° 38' 56.8"	347 m
S2	Sakharga	Madnoor	N – 18° 32' 28.9" E – 77° 37' 58.6"	340 m
S3	Hipparga	Madnoor	N – 18° 32' 41.5" E – 77° 39' 22.2"	357 m
S4	Limbur	Madnoor	N – 18° 32' 13.3" E – 77° 41' 15.5"	365 m
S5	Hasan Takli	Madnoor	N – 18° 32' 53.5" E – 77° 41' 49.9"	372 m
S6	Shirpur	Madnoor	N – 18° 34' 05.7" E – 77° 42' 29.3"	365 m
S7	Yelgaon	Madnoor	N – 18° 28' 44.4" E – 77° 40' 31.2"	373 m
S8	Dongali	Madnoor	N – 18° 31' 03.7" E – 77° 42' 18.00"	359 m
S9	Khatgaon	Bichkunda	N – 18° 28' 42.7" E – 77° 44' 12.1"	367 m
S10	Shetloor	Bichkunda	N – 18° 27' 42.0" E – 77° 44' 58.00"	355 m
S11	Hasgul	Bichkunda	N – 18° 26' 03.1" E – 77° 45' 08.5"	369 m
S12	Dhoti	Bichkunda	N – 18° 28' 31.3" E – 77° 43' 36.2"	369 m
S13	Mallapur	Bichkunda	N – 18° 28' 06.0" E – 77° 42' 39.1"	368 m
S14	Sulthan Peth	Bichkunda	N – 18° 28' 01.4" E – 77° 41' 0.55"	374 m
S15	Mogha	Bichkunda	N – 18° 28' 48.9" E – 77° 40' 46.9"	368 m

Нормативное финансирование



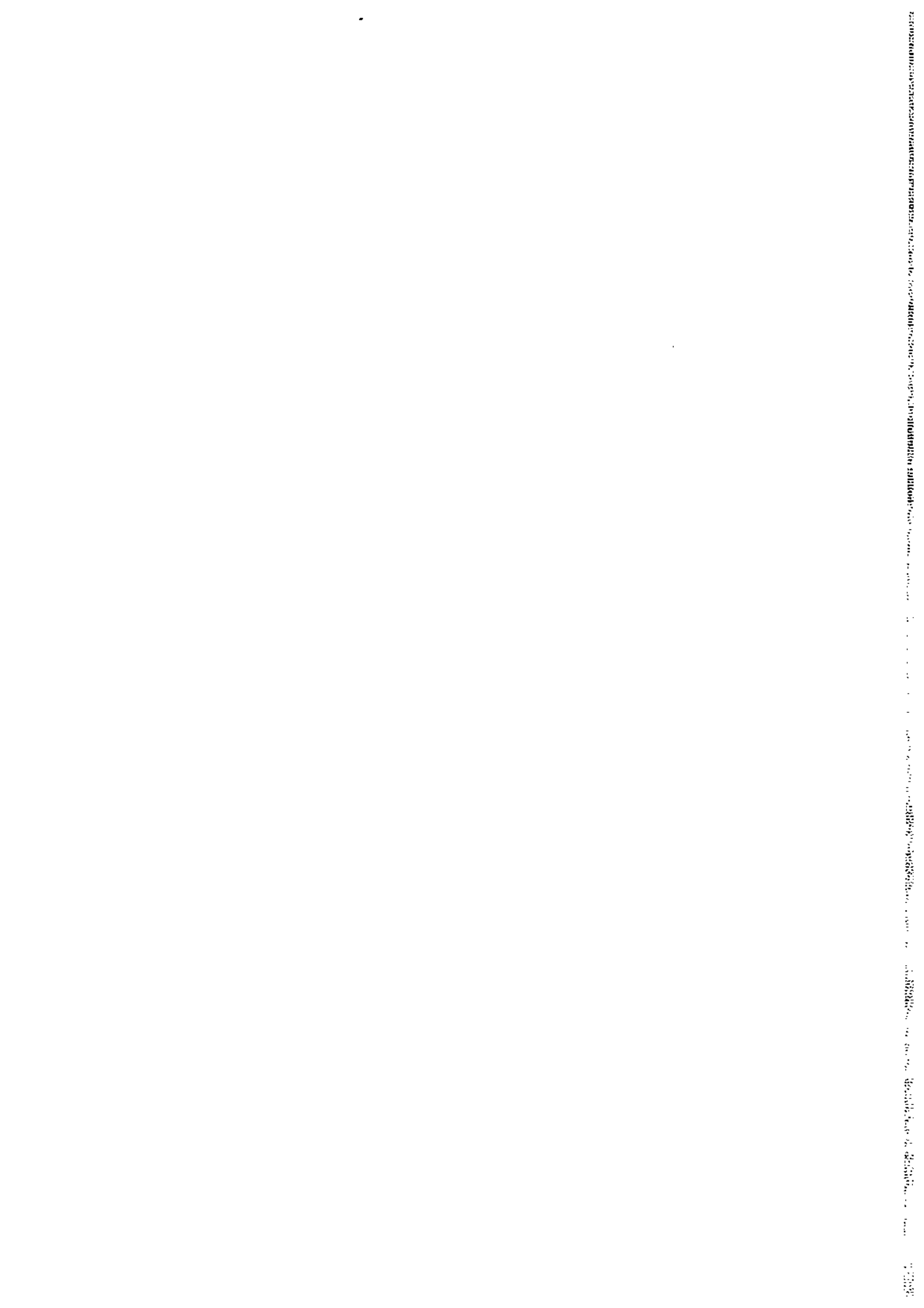


Table 5.18 Physical/ Mechanical Analysis of the Soil

Sample code	Sampling locations	Texture			Texture class	Bulk density (g/cm ³)	Porosity (%)
		Sand (%)	Silt (%)	Clay (%)			
S1	Sonala	52.19	17.33	30.48	Sandy clay loam	1.22	50.62
S2	Sakharga	52.36	18.62	29.02	Sandy clay loam	1.34	51.87
S3	Hipparga	48.63	18.94	32.43	Sandy clay loam	1.29	50.49
S4	Limbur	51.23	19.62	29.15	Sandy clay loam	1.35	51.26
S5	Hasantakali	50.21	17.24	32.55	Sandy clay loam	1.28	51.39
S6	Shirpur	51.09	18.26	30.65	Sandy clay loam	1.64	51.48
S7	Yelgaon	49.68	18.85	31.47	Sandy clay loam	1.32	51.24
S8	Dongali	51.29	18.59	30.12	Sandy clay loam	1.47	52.69
S9	Khatgaon	51.21	17.98	30.81	Sandy clay loam	1.32	50.22
S10	Shetlur	52.22	17.28	30.5	Sandy clay loam	1.35	51.23
S11	Hasgul	54.38	16.99	28.63	Sandy clay loam	1.29	51.29
S12	Dhoti	51.29	18.46	30.25	Sandy clay loam	1.45	54.28
S13	Mallapur	51.29	18.65	30.06	Sandy clay loam	1.35	52.16
S14	Sultanpeth	52.34	18.22	29.44	Sandy clay loam	1.54	50.12
S15	Modha	50.27	18.56	31.17	Sandy clay loam	1.22	54.26

Soil Texture: Soil texture refers to the relative proportion of clay, silt and sand in a sample of soil. Based on dominance of the size fraction, the soil texture can be classified under various types, such as clayey, sandy clay, silty clay etc. The fine particle fraction of the soil is described as loam. Higher content of clay in soils are often described, as 'heavy' while sandy soils are known as 'light, but clayey soils retain more water/moisture against the gravity and consequently warm up more slowly in spring. The soil samples were collected from command area in Andhra Pradesh. It was found that all sample shows sandy clay loam nature.

Porosity: Between the soil particles there are empty spaces which are occupied by air and water and are termed as pore spaces. Pore spaces between the aggregates of soil particles are macro pores and those between the individual particles of the aggregates are micro pores. Sandy soils have a higher percentage of macro pores. Typically, sandy soils never become water logged and allow water to percolate downward more rapidly than clay soils. The moisture retention in sandy soils is relatively low compared to clay soils.

Clay soils contain a higher percentage of micro pores compared to sandy soils. Clay soils are more susceptible to water logging which can adversely affect root respiration and microbial activities. A proper balance between the macro and micro pores can be maintained by the timely aeration.

Recent studies conducted have shown that out of 15 soil samples examined for the command of the Lendi project in Andhra Pradesh, all sample has porosity of soil above 50 percent. This means, the soil of the command area are well drained and good for the agricultural practices.

Bulk Density: Bulk density is a measure of the weight of the soil per unit volume (g/cm^3). The bulk density of soil ranges from $1.22 \text{ g}/\text{cm}^3$ to $1.64 \text{ g}/\text{cm}^3$.



Table 5.19 Results of Chemical Analysis of Soil for winter season

Sample code	Sampling Locations	Parameters										
		pH	EC (dS/m)	Organic Matter %	Organic Carbon %	Available N (kg/ha)	Available phosphates (kg/ha)	Available K (kg/ha)	Available Ca (mg/100 gm)	Exchangeable Mg (mg/100 gm)	Na (mg/100gm)	Cl (mg/100 gm)
S1	Sonala	7.66	0.237	1.22	0.7	50.66	29.64	215.36	1.25	0.18	2.39	0.039
S2	Sakharga	7.51	0.19	1.09	0.63	59.78	28.37	218.64	1.43	0.14	2.67	0.054
S3	Hipparga	7.69	0.42	1.32	0.76	51.39	26.98	207.96	1.25	0.12	2.42	0.037
S4	Limbur	7.65	0.321	1.02	0.59	45.23	22.36	201.36	1.12	0.11	2.46	0.019
S5	Hasantakali	7.84	0.51	1.33	0.77	50.19	29.84	200.95	1.24	0.11	2.54	0.034
S6	Shirpur	7.64	0.28	1.14	0.66	54.36	24.56	216.31	1.1	0.17	2.35	0.031
S7	Yelgaon	7.29	0.34	1.34	0.78	34.28	22.54	207.45	1.26	0.14	2.33	0.033
S8	Dongali	7.46	0.19	1.28	0.74	36.97	26.35	209.65	1.34	0.12	2.45	0.085
S9	Khatgaon	7.39	0.27	1.52	0.88	50.28	20.78	200.98	1.28	0.19	2.57	0.074
S10	Shetlur	7.56	0.654	1.34	0.77	50.21	22.19	204.26	1.45	0.23	2.69	0.036
S11	Hasgul	7.84	0.528	1.27	0.73	47.36	26.38	219.99	1.55	0.24	2.75	0.029
S12	Dhoti	7.33	0.23	1.45	0.84	49.65	24.56	200.78	1.64	0.21	2.67	0.087
S13	Mallapur	6.97	0.354	1.35	0.78	51.29	22.54	198.63	1.35	0.14	2.36	0.039
S14	Sultanpeth	7.64	0.648	1.26	0.73	35.67	26.98	245.65	1.64	0.13	2.54	0.054
S15	Modha	7.52	0.527	1.54	0.89	46.98	26.98	216.39	1.26	0.24	2.58	0.061

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Sample code	Sampling Locations	Parameters											
		SO ₄ (mg/100 gm)	DTPA Ferrous (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn ((mg/kg)	As (ppm)	B (ppm)	Cd (ppm)	Pb (ppm)	Ni (ppm)	Mo (ppm)	ESP
S1	Sonala	0.00254	2.59	0.32	0.55	1.09	BDL	0.32	BDL	BDL	BDL	0.42	2.1
S2	Sakharga	0.00316	2.64	0.27	0.61	0.64	BDL	0.24	BDL	BDL	BDL	0.49	2.64
S3	Hipparga	0.00269	2.51	0.46	0.43	0.59	BDL	0.31	BDL	BDL	BDL	0.31	2.54
S4	Limbur	0.0024	51	0.39	0.41	0.69	BDL	0.35	BDL	BDL	BDL	0.55	2.18
S5	Hasantakali	0.0031	2.31	0.31	0.59	0.57	BDL	0.19	BDL	BDL	BDL	0.27	2.18
S6	Shirpur	0.0017	2.59	0.38	0.52	1.06	BDL	0.27	BDL	BDL	BDL	0.49	2.39
S7	Yelgaon	0.0017	2.68	0.37	0.57	0.69	BDL	0.22	BDL	BDL	BDL	0.48	2.19
S8	Dongali	0.0034	2.47	0.35	0.64	0.57	BDL	0.19	BDL	BDL	BDL	0.35	2.31
S9	Khatgaon	0.0047	2.14	0.49	0.65	0.84	BDL	0.42	BDL	BDL	BDL	0.29	2.38
S10	Shetlur	0.00645	2.56	0.36	0.54	1.06	BDL	0.33	BDL	BDL	BDL	0.46	2.54
S11	Hasgul	0.00297	2.87	0.55	0.55	0.52	BDL	0.54	BDL	BDL	BDL	0.38	2.64
S12	Dhoti	0.00452	2.34	0.19	0.63	0.62	BDL	0.19	BDL	BDL	BDL	0.49	2.56
S13	Mallapur	0.0026	2.36	0.34	0.46	0.69	BDL	0.32	BDL	BDL	BDL	0.51	2.41
S14	Sultanpeth	0.0016	2.54	0.42	0.45	0.87	BDL	0.42	BDL	BDL	BDL	0.35	2.41
S15	Modha	0.0045	2.64	0.19	0.39	0.51	BDL	0.37	BDL	BDL	BDL	0.44	2.21

Table No 5.20 Results of Chemical Analysis of soil for Post Monsoon Season

Sample code	Sampling Locations	pH	EC (dS/m)	Organic Matter %	Available N (kg/ha)	Available phosphates (kg/ha)	Available K (kg/ha)	Available Ca (mg/100 gm)	Exchangeable Mg (mg/100 gm)	Na (mg/100gm)	Cl (mg/100 gm)
S1	Sonala	7.73	0.24	1.16	50.93	33.57	220.23	1.175	0.13	2.29	0.033
S2	Sakharga	7.39	0.20	0.97	57.77	33.29	221.90	1.34	0.12	2.58	0.053
S3	Hipparga	7.60	0.41	1.285	52.91	31.24	199.03	1.2	0.11	2.31	0.036
S4	Limbur	7.78	0.35	0.985	46.72	21.93	205.76	1.11	0.10	2.28	0.017
S5	Hasantakali	7.87	0.48	1.09	47.65	28.17	198.05	1.195	0.10	2.48	0.032
S6	Shirpur	7.75	0.29	1.03	59.78	24.83	213.28	1.025	0.14	2.25	0.028
S7	Yelgaon	7.47	0.38	0.93	34.77	22.15	201.28	1.055	0.13	2.26	0.031
S8	Dongali	7.48	0.22	0.965	38.54	25.90	204.83	1.245	0.11	2.4	0.08
S9	Khatgaon	7.60	0.28	1.31	51.19	21.18	207.99	1.14	0.19	2.51	0.077
S10	Shetlur	7.53	0.63	1.295	50.11	21.85	199.68	1.375	0.20	2.59	0.035
S11	Hasgul	7.77	0.49	1.255	46.28	25.92	220.05	1.5	0.24	2.67	0.029
S12	Dhoti	7.39	0.22	1.225	48.88	24.83	192.94	1.52	0.20	2.61	0.078
S13	Mallapur	7.00	0.37	1.325	53.25	23.87	201.87	1.3	0.13	2.28	0.039
S14	Sultanpeth	7.55	0.60	1.205	36.94	27.74	235.58	1.57	0.11	2.49	0.049
S15	Modha	7.56	0.53	1.395	44.54	26.62	215.70	1.13	0.22	2.49	0.055

Continue...

Sample code	Sampling Locations	SO ₄ (mg/100 gm)	DTPA Ferrous (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn ((mg/kg)	As (ppm)	B (ppm)	Cd (ppm)	Pb (ppm)	Ni (ppm)	Mo (ppm)	ESP
S1	Sonala	0.00267	2.42	0.3	0.535	1.035	BDL	0.315	BDL	BDL	BDL	0.41	2.05
S2	Sakharga	0.00308	2.545	0.255	0.595	0.6	BDL	0.23	BDL	BDL	BDL	0.47	2.57
S3	Hipparga	0.002595	2.405	0.455	0.415	0.595	BDL	0.305	BDL	BDL	BDL	0.30	2.49
S4	Limbur	0.00225	2.455	0.37	0.4	0.67	BDL	0.345	BDL	BDL	BDL	0.54	2.14
S5	Hasantakali	0.00305	2.28	0.305	0.57	0.56	BDL	0.195	BDL	BDL	BDL	0.26	2.17
S6	Shirpur	0.0016	2.545	0.37	0.51	1.02	BDL	0.265	BDL	BDL	BDL	0.47	2.37
S7	Yelgaon	0.0016	2.62	0.39	0.555	0.67	BDL	0.235	BDL	BDL	BDL	0.46	2.17
S8	Dongali	0.0033	2.41	0.365	0.66	0.555	BDL	0.2	BDL	BDL	BDL	0.35	2.26
S9	Khatgaon	0.0046	2.13	0.47	0.64	0.845	BDL	0.41	BDL	BDL	BDL	0.29	2.36
S10	Shetlur	0.006475	2.515	0.34	0.53	1.01	BDL	0.315	BDL	BDL	BDL	0.44	2.49
S11	Hasgul	0.002985	2.735	0.525	0.525	0.51	BDL	0.545	BDL	BDL	BDL	0.36	2.59
S12	Dhoti	0.00436	2.295	0.175	0.615	0.61	BDL	0.17	BDL	BDL	BDL	0.46	2.45
S13	Mallapur	0.00255	2.31	0.345	0.455	0.67	BDL	0.31	BDL	BDL	BDL	0.53	2.43
S14	Sultanpeth	0.0015	2.525	0.41	0.435	0.86	BDL	0.415	BDL	BDL	BDL	0.33	2.40
S15	Modha	0.00455	2.645	0.2	0.37	0.505	BDL	0.36	BDL	BDL	BDL	0.4	2.18

Table no 5.21 Results of Chemical Analysis of soil for Pre Monsoon

Sample code	Sampling Locations	pH	EC (dS/m)	Organic Matter %	Available N (kg/ha)	Available phosphates (kg/ha)	Available K (kg/ha)	Available Ca (mg/100 gm)	Exchangeable Mg (mg/100 gm)	Na (mg/100gm)	Cl (mg/100 gm)
S1	Sonala	7.8	0.25	1.1	51.2	37.5	225.1	1.1	0.095	2.2	0.028
S2	Sakharga	7.26	0.21	0.85	55.75	38.2	225.15	1.25	0.1	2.5	0.052
S3	Hipparga	7.5	0.4	1.25	54.42	35.5	190.1	1.15	0.1	2.2	0.035
S4	Limbur	7.9	0.38	0.95	48.2	21.5	210.15	1.1	0.098	2.1	0.015
S5	Hasantakali	7.89	0.45	0.85	45.1	26.5	195.15	1.15	0.095	2.42	0.030
S6	Shirpur	7.85	0.3	0.92	65.2	25.1	210.25	0.95	0.12	2.15	0.025
S7	Yelgaon	7.65	0.42	0.52	35.25	21.75	195.1	0.85	0.12	2.2	0.030
S8	Dongali	7.5	0.25	0.65	40.1	25.45	200	1.15	0.1	2.35	0.075
S9	Khatgaon	7.8	0.28	1.1	52.1	21.58	215	1	0.2	2.45	0.080
S10	Shetlur	7.5	0.6	1.25	50	21.5	195.1	1.3	0.18	2.5	0.035
S11	Hasgul	7.7	0.45	1.24	45.2	25.45	220.1	1.45	0.25	2.6	0.030
S12	Dhoti	7.45	0.21	1	48.1	25.1	185.1	1.4	0.2	2.56	0.070
S13	Mallapur	7	0.38	1.3	55.2	25.2	205.1	1.25	0.12	2.2	0.040
S14	Sultanpeth	7.45	0.55	1.15	38.2	28.5	225.5	1.5	0.1	2.45	0.045
S15	Modha	7.6	0.53	1.25	42.1	26.25	215	1	0.21	2.4	0.050

Continue...

Sample code	Sampling Locations	SO ₄ (mg/100 gm)	DTPA Ferrous (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Mn ((mg/kg)	As (ppm)	B (ppm)	Cd (ppm)	Pb (ppm)	Ni (ppm)	Mo (ppm)	ESP
S1	Sonala	0.0028	2.25	0.28	0.52	0.98	BDL	0.31	BDL	BDL	BDL	0.4	2
S2	Sakharga	0.003	2.45	0.24	0.58	0.56	BDL	0.22	BDL	BDL	BDL	0.45	2.5
S3	Hipparga	0.0025	2.3	0.45	0.4	0.6	BDL	0.3	BDL	BDL	BDL	0.3	2.45
S4	Limbur	0.0021	2.4	0.35	0.39	0.65	BDL	0.34	BDL	BDL	BDL	0.54	2.1
S5	Hasantakali	0.003	2.25	0.3	0.55	0.55	BDL	0.2	BDL	BDL	BDL	0.25	2.17
S6	Shirpur	0.0015	2.5	0.36	0.5	0.98	BDL	0.26	BDL	BDL	BDL	0.45	2.35
S7	Velgaon	0.0015	2.56	0.41	0.54	0.65	BDL	0.25	BDL	BDL	BDL	0.44	2.15
S8	Dongali	0.0032	2.35	0.38	0.68	0.54	BDL	0.21	BDL	BDL	BDL	0.36	2.22
S9	Khatgaon	0.0045	2.12	0.45	0.63	0.85	BDL	0.4	BDL	BDL	BDL	0.3	2.35
S10	Shetlur	0.0065	2.47	0.32	0.52	0.96	BDL	0.3	BDL	BDL	BDL	0.42	2.45
S11	Hasgul	0.003	2.6	0.5	0.5	0.5	BDL	0.55	BDL	BDL	BDL	0.35	2.54
S12	Dhoti	0.0042	2.25	0.16	0.6	0.6	BDL	0.15	BDL	BDL	BDL	0.44	2.35
S13	Mallapur	0.0025	2.26	0.35	0.45	0.65	BDL	0.3	BDL	BDL	BDL	0.55	2.45
S14	Sultanpeth	0.0014	2.51	0.4	0.42	0.85	BDL	0.41	BDL	BDL	BDL	0.32	2.4
S15	Modha	0.0046	2.65	0.21	0.35	0.5	BDL	0.35	BDL	BDL	BDL	0.41	2.15

Soil pH: One of the most enlightening attributes of soils is its pH. It measures the relative concentration of hydrogen ions in solution. For the present study, for all the 15 sampling stations, pH was examined for pre, post and winter season. Overall the values were comparable for season and for all the sampling stations examined. Normally, the capillary action brings up Ca, Na, carbonates and nitrates, in summer which result in slightly increases pH levels. The normal classification of soil based on the pH and other parameters is provided in table 5.22 as a reference.

Table 5.22 Standard Soil Classification

Sr. No.	Soil Tests	Classification
1.	pH	< 4.50 extremely acidic 4.51-5.00 very strongly acidic 5.01-5.50 strongly acidic 5.51-6.00 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.00 strongly alkaline 9.01 very strongly alkaline
2.	Electrical Conductivity (ds/m)	Up to 1.00 average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3.	Organic Carbon	Up to 0.2: very low 0.21-0.4: low 0.41-0.5: moderate 0.51-0.8: moderately high 0.81-1.0: High >1.0 : Vey high
4.	Nitrogen (kg/ha)	< 140 very low 141-280 low 281-420 Medium 420-560 Moderately high 561-700 High > 700 Very high
5.	Phosphorus (kg/ha)	< 7 very low 7-13 low 14-20 Medium 21-27 Moderately high 28-34 High > 35 Very high
6	DTPA Fe (mg/kg)	< 4.5 low >/= 4.5 sufficient
7	DTPA Zn (mg/kg)	< 0.6 low >/= 0.6 sufficient
8	DTPA Mn (mg/kg)	< 2.0 low >/= 2.0 sufficient
9	DTPA Cu (mg/kg)	< 0.2 low >/= 0.2 sufficient

Source: Six tier system developed by MPKV Rahuri, Maharashtra.

Electrical conductivity: Electrical conductivity is estimation of the total soluble salts content of the soils. Electrical conductivity of the soil was examined for all the 15 soil

sampling stations for three the seasons. It was observed that EC ranges from 0.19 to 0.65 dS/m in winter season, 0.20 to 0.63 dS/m in post monsoon and 0.21 to 0.60dS/m in pre monsoon season. The values of EC were comparable and well within the prescribed limits, indicating no immediate salinity hazards.

Organic matter: The organic matter is an important component of the soil that contributes to the fertility. Organic matter is derived from the remains of plants and animals. Organic matter helps in improving porosity of the soil. Organic content was examined for all the 15 soil sampling stations. The observed organic carbon content ranged from 1.02 % to 1.54% in winter season, 0.93% to 1.39% in post monsoon season and 0.52 % to 1.3 % in pre monsoon season. The higher percentage of organic matter is found in soil samples.

Available Nitrogen: Nitrogen is one of the major plant nutrients. It is most important component for vegetative crop growth. Overall, nitrogen level in soil is found to be very low. Legume crops are known to fix nitrogen. In spite of this the available nitrogen content of the soil is low, indicating need for external application of nitrogen supplements to the soil. The use of organic manures helps to built up available nitrogen in soil. The use of Azotobactor, Azospirillum will also helpful.

Available Phosphorus: Phosphorus is a major soil nutrient that plays a vital role in plant reproductive outputs / yield. The levels of phosphorus in soil are moderate.

There is tendency of soil to fix phosphates and make it less available for crop by fixation of phosphorus and its insoluble forms. The phosphate solubilizing bacteria will help to increase availability of phosphorus.

Available Potassium: The available potassium (K) levels in the soil ranged from 198.63 to 245.65 kg/ha in winter, 192.94 to 235.5/8 kg/ha in post monsoon and 185.1 to 225.5 kg/ha in pre monsoon season. The study area lies in Deccan, which is black cotton soil and known to have higher levels of K. For the winter season, the values of K were slightly higher.

Exchangeable Magnesium: Values of magnesium are slightly higher in three seasons.

Exchangeable Calcium: Exchangeable calcium of the soil was examined for all the 15 soil sampling stations. The exchangeable Calcium ranges from 1.1 to 1.64 mg/100 gm

in winter, 0.10 to 0.25 mg/100gm in post monsoon and 0.10 to 0.25 in pre monsoon season.

In soil, calcium replaces hydrogen (H) ions from the surface of soil particles when limestone is added to reduce soil acidity. It is beneficial to microorganisms as they turn crop residues into organic matter, release nutrients, and improve soil aggregation and water holding capacity. Calcium enables nitrogen fixing bacteria that form nodules on the roots of leguminous plants to capture atmospheric nitrogen and convert into a form that plants can use.

Sodium: Sodium level of the soil was examined for all the 15 soil sampling stations. The sodium (Na) levels in the soil ranges from 2.33 to 2.75 mg/100 gm in winter, 2.25 to 2.68 mg/100gm in post monsoon and 2.10 to 2.60 mg/100gm in pre monsoon season. The level of sodium is well within the limit.

Chlorides: The Chloride content of the soil is the measure of salinity of the soil. The Chloride content of the soil ranged from 0.019 to 0.087mg/100g in winter season, 0.02 to 0.08 mg/100gm in post monsoon and 0.02 to 0.08 mg/100g in pre monsoon season.

The chloride content was taken as major factor for the estimation of salinity of the soil samples.

The salts of chloride and sulphates turn normal soil to saline soil. However, these salts are soluble they can be leached out by supplying good quality water and drainage.

Sulphates: Sulphate content of the soil was examined for all the 15 soil sampling stations. Sulphate content of the soil is the measure of salinity of the soil. The sulphates content of the soil ranged between 0.0016 to 0.00645 mg/100g in winter, 0.0022 to 0.0033 mg/100g and 0.0014 to 0.0065 mg/100g in post monsoon. The sulphates content was taken as major factor for the estimation of salinity of the soil samples.

Micronutrients: In general, DTPA Fe, Zn and manganese are deficient in soil. It might be due to application of major nutrient supplying fertilizer and non application of micro nutrient fertilizers and growing high filed varieties.

5.7 Conclusion – Andhra Pradesh

The electrical conductivity of the soil is normal and there is no cause for the alarm. The soils of the project area are suitable for deep rooted crops e.g. pulses, sugarcane, cotton, banana, etc.

Salinity and alkalinity of the soil is low, leading to low electrical conductivity. Frequent irrigation to such soils is necessary to maintain the quality of the soil. In such cases short duration crops like Ridge Gourd, Bitter Gourd, Coriander, and Cucumber etc. can be drawn from such types of soils. Drip irrigation will prove to be more beneficial to the crops, than the flood irrigation. The phosphorous and nitrogen content of the soil vary from soil to soil. Typical application external fertilizers as a source of P and N would be useful. The micronutrients reported are Fe, Mn, Zn, Cu etc. The overall micronutrients availability is low and needs to be supplemented with micronutrient fertilizers.

The quality of irrigation water is directly influencing the fertility of soil. If irrigation water is saline/ sodic, it will turn soils in to saline soil, sodic soils or saline – sodic soils.

If water is good for irrigation, judicious use of water will sustain yield and soil fertility. Indiscriminate use of water must be avoided.

CHAPTER – 6

NOISE AND AIR QUALITY

CHAPTER 6.0 NOISE AND AIR QUALITY

6.1 Noise Quality Study

The physical description of sound concerns its loudness as a function of frequency. Noise in general is unwanted/undesired sound, composed of many frequency components of various loudness distributed over the audible frequency range. The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise. The environmental impact assessment of noise from the proposed project, construction activity, and vehicular traffic can be undertaken by taking into consideration various factors like potential damage to hearing, physiological responses, and annoyance and general community responses.

The Ministry of Environment has notified ambient air standards with respect to noise and forests vide gazette notification dated 26th December 1989. It is based on the A weighted equivalent noise level (Leq). The standards are presented in table below:

Table 6.1 Ambient Noise Standards

Area Code	Category of Area	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note:

- Day-time: between 6a.m. and 9 p.m.
- Night-time: between 9 p.m. and 6a.m.
- Silence zone is referred as areas up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
- Mixed categories of areas should be declared as one of the four above-mentioned categories by the Competent Authority.

Ambient noise level survey was conducted for the dam site and adjacent area during post-monsoon season; these locations are presented in Figure 6.1. The main objective of the noise monitoring was establishing the baseline noise levels. The noise quality monitoring study was carried out in pre monsoon season in the year of 2008.

Table 6.2 Noise Qualities at and around the dam site

No	Location	Site description	Average Noise Levels dB (A) Leq	
			Day Time	Night Time
1	Ravangaon	Submergence. Small village around a distance of 1 km approximately from the dam site	48	44
2	Gonegaon	Submergence. Small village at a distance of 1.5 km a approximately from the dam site	46	45
3	Itgyal	Command. Village downstream of the dam site at a distance of 1.5km approximately.	49	48
4	Mukramabad	Partial Submergence. Market place for the small villages around the dam site. Approximately 5km from the dam site.	49	47
5	Damsite	Up stream of the dam site	51	48
6	Damsite	Downstream of the dam site	50	47
7	Damsite	Construction site	76	46

Duration: Day time: 14:00 hrs to 16:00 hrs; Night time: 23:00 hrs to 1:00 hrs.

Overall noise levels in the area depicts the ambient noise levels to be lower as compared to those taken at the dam site, which is due to the construction activity and vehicular movement at the site. The noise levels downstream and upstream of the dam site and those at the ambient locations are well below the standard limits.

Conclusion:

The noise levels at the dam site are comparatively higher than those at the ambient site because of various construction activities, machines and vehicular movement. Though the noise levels are comparatively high, it is understood that the effect is of temporary nature. This is also clear from the noise levels taken during the night time which are almost equal to ambient noise level. The overall ambient noise levels are also well below the standards. Thus the effect of elevated noise levels is temporary and will not affect the livelihood in the vicinity of the dam.

[illegible]

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6.2 Ambient Air Quality Study

The air sampling was carried out so as to determine the ambient air quality. Ambient air quality is also indicative of kind of activities happening in the surrounding. Sampling stations were selected include the dam site, downwind, upwind and cross wind spread across catchment, command and submergence. Four samples were taken at the dam site including downwind and upwind side of the dam; these locations are presented in Figure 6.2

Table 6.3 Ambient Air quality at and around the Dam site

Sr. No.	Location	Ambient Temperature	Relative Humidity	SPM ($\mu\text{g}/\text{NM}^3$)	SO ₂ ($\mu\text{g}/\text{NM}^3$)	NO _x ($\mu\text{g}/\text{NM}^3$)
1	Thana	34 ⁰ C	72%	48	6	4
2	Bhaswadi	34 ⁰ C	72%	30	8	6
3	Gonegaon	30 ⁰ C	64%	38	3.6	2.6
4	Itgyal - Command	30 ⁰ C	64%	40	2.2	1.4
5	Ravangaon	25 ⁰ C	71%	42	4.4	3.2
6	Ambulga (Kh)	25 ⁰ C	71%	54.6	3.8	2.4
7	Mukramabad	23 ⁰ C	76%	64	5.2	6.8
8	Degloor	23 ⁰ C	76%	76	6.8	9.0
9	Lendi Dam Project Site – upwind	29 ⁰ C	59%	52	9.2	8.2
10	Lendi Dam Project Site – Downwind	29 ⁰ C	59%	82.4	7.8	10.6
11	Lendi Dam Project Site – upwind	34 ⁰ C	41%	42	6.4	8.0
12	Lendi Dam Project Site – Downwind	34 ⁰ C	41%	22	10.2	7.2

Standard Limits

SPM ($\mu\text{g}/\text{NM}^3$)	SO ₂ ($\mu\text{g}/\text{NM}^3$)	NO _x ($\mu\text{g}/\text{NM}^3$)
500.0	120.0	120.0

Limits are as prescribed by the Central Pollution Control Board vide Notification 1982. The ambient air quality study was carried out in pre monsoon season in the year of 2008.

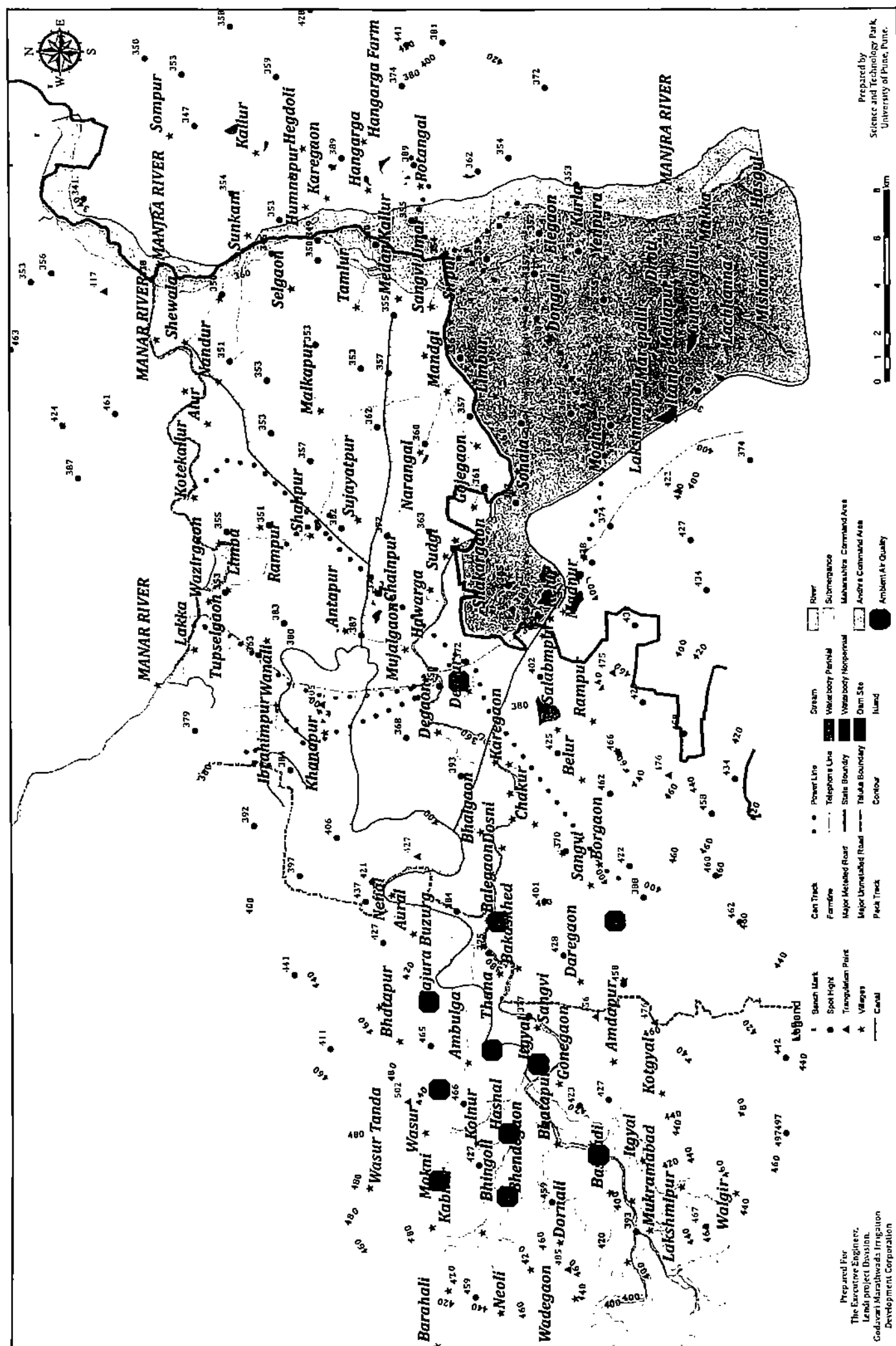
It is observed that the ambient air quality is within the prescribed limits at all the sites studies. However, few sampling locations have higher level of SO₂ and NO_x than the others, but within the acceptable limits.

Conclusion:

The air sampled at the twelve sites depict that the ambient air quality is in the prescribed limit and no need for alarm. Occurrences of high SPM, SO₂ and NO_x values are due to burning of fossil fuels, constructions activities and movement of vehicles, in case of the dam site. However, construction and vehicular movement is a temporary phenomenon and thus will not hamper long-term air quality.

Figure 6.2 Sampling Stations for Ambient Air Quality

Figure :- 6.2 Sampling Station of Air Quality Study



CHAPTER – 7

GEOLOGY AND

SEISMOLOGY

CHAPTER 7.0 GEOLOGY AND SEISMOLOGY

7.1 Introduction

The Lendi Major Irrigation project is a joint venture of Maharashtra state and Andhra Pradesh state. Irrigation facilities from this project will be available to areas largely in Nanded District in Maharashtra state and Nizamabad District in Andhra Pradesh state.

The project envisages a construction of earthen dam and masonry weir across the Lendi River upstream of village Gonegaon, Taluka Mukhed in Nanded district for irrigating the land of both the states i.e. Mukhed and Degloor talukas of Nanded district of Maharashtra and Madnoor and Bichkunda mandal / Tehsils of Nizamabad district of Andhra Pradesh.

The geological profile for command and catchment areas of Lendi Interstate Project is almost the same as it lies in the Deccan Plateau. The detail geological profile is discussed below.

7.2 Geographical Profile of Maharashtra

Located in the north centre of Peninsular India, with a command of the Arabian Sea through its port of Mumbai, Maharashtra has a remarkable physical homogeneity, enforced by its underlying geology. The Sahyadri Range is the physical backbone of Maharashtra, rising on an average to an elevation of 1000m. It falls in steep cliffs to the Konkan on the west. Eastwards, the hill country falls in steps through a transitional area known as Mawal to the plateau level. Except around Mumbai, and along the eastern limits, the State of Maharashtra presents a monotonously uniform, flat-topped skyline. The state area, barring the extreme eastern Vidarbha region, parts of Kolhapur and Sindhudurg, is practically co-terminus with the Deccan Traps. The State of Maharashtra has rivers such as the Krishna, Bhima, Godavari, Tapi-Purna and Wardha-Wainganga River. The soils of Maharashtra are residual, derived from the underlying basalts. In the semi-dry plateau, the regur (black-cotton soil) is clayey, rich in iron, but poor in nitrogen and organic matter; it is moisture-retentive. Where they redeposit along the river valleys, these black soils are deeper and heavier, better

suited for Rabi crops. Farther away, with a better mixture of lime, the Morand' soils form the ideal Kharif zone. The higher plateau areas have Pather soils, which contain more gravel. In the rainy Konkan, and the Sahyadri Range, the same basalts give rise to the brick-red laterites productive under a forest-cover as latsols, but readily stripped into a *warkas* (non-productive), when the vegetation is removed. By and large, soils of Maharashtra are shallow and somewhat poor.

7.3 Geology of Deccan Plateau

The Deccan Trap is a large igneous province located in west-central India and is one of the largest volcanic features on Earth. It consists of multiple layers of solidified flood basalt that together are more than 2,000 m thick and cover an area of 500,000 km². The term 'traps' is derived from the Swedish word for stairs, referring to the step-like hills forming the landscape of the region. The Deccan Traps formed between 60 and 68 million years ago, at the end of the Cretaceous period. Before it was reduced to its current size by erosion and continental drift, it is estimated that the original area covered by the lava flow was as large as 1.5 million km². The volume of basalt is estimated to have been 5, 12,000 km³. It is postulated that the Deccan Trap eruption was associated with a deep mantle plume. The area of long-term eruption (the hotspot), known as the Reunion hotspot, is suspected of causing both the Deccan Traps eruption and opening the rift that once separated the Seychelles plateau from India. Seafloor spreading at the boundary between the Indian and African Plates subsequently pushed India north over the plume, which now lies under Reunion Island in the Indian Ocean, southwest of India. A large impact crater has been recently reported in the sea floor off the west coast of India - Called the Shiva crater; it has also been dated at 65 million years, right at the Cretaceous-Tertiary (K/T) boundary. Researchers suggest that the impact may have been the triggering event for the Deccan Traps as well as contributing to the acceleration of the Indian plate in the early Tertiary.

The Deccan Plateau is bounded by the Western Ghats in the west, the Eastern Ghats to the east, the Nilgiris in the south and the Satpura and Vindhya ranges in the north. The plateau elevation is about 500 m on an average. It is composed of black volcanic

basalt soil. The Godavari River and its tributaries, including the Indravati, drain most of the northern portion of the plateau, rising in the Western Ghats and draining east towards the Bay of Bengal. The Tungabhadra, Krishna River and its tributaries, including the Bhima River, which also run from west to east, drain the central portion of the plateau. The southernmost portion of the plateau is drained by the Kaveri River, which rises in the Western Ghats of Karnataka and bends south to break through the Nilgiri hills into Tamil Nadu, emptying into the Bay of Bengal.

The Deccan is rich in minerals. Primary mineral ores found in this region are mica and iron ore in the Chhota Nagpur region, and diamonds, gold and other metals in the Golconda region. The profile of the area indicates that the black-cotton soil of the command area is clayey, rich in iron, but poor in nitrogen and organic matter; it is moisture-retentive.

7.4 Geology of Nanded District

In the Nanded district, the main trend of the hills is from north-west to south-east in parallel ranges with offshoots generally running in a perpendicular direction though this simple pattern has been considerably modified by differential erosion. Beginning from the north, the first of these ranges known as the *Satmala* enters the district after the gap cut by the Penganga just west of Mahur. It rises in three distinct terraces, the first being some 100 meters above the valley flats of the Penganga at an altitude of 350 meters above sea level. On this terrace are some small tanks and a few villages set in the midst of cultivated fields. Mahur is the largest of them and is considered as a sacred place. The next higher terrace is at a level of 570 meters above sea level, rising sharply from all sides except the south where it is cut apart by stream erosion. There is a fort on this terrace which enjoyed the protection afforded by the Penganga surrounding the hill on all the sides except the east in addition to that afforded, by the densely clad jungle slopes inhabited by wild animals. There is a still higher terrace at a level of 600 metres covered with dense jungle.

As the Mahur hills extend south-eastwards, they are bordered on the north by a ridge whose summits rise over 600 metres and are separated from them by a very narrow

trough which is occupied by sections of various minor streams. It may be noted that the road and the railway line from Ambadi to Adilabad use this narrow depression.

To the south of the *Satmala* ranges are the *Nirmala* ranges running parallel to them and east of the Penganga. They are linked to the former by offshoot hills which are aligned more or less parallel to the course of the river and on which the district boundary runs.

The hill range which forms the water-divide between the Penganga and the Godavari enters the district from a north westerly direction and broadens out to about 3 kilometres in width as the Savargaon plateau stretching south-eastwards with a summit level of 525 metres or 150 metres above the surrounding plains. On this plateau with fertile black soils regular crops of Jowar, Cotton, Tur, Udid, Mung, Wheat and Rice are grown. There is a small pond on which depends the village of Savargaon for its water-supply. From this elongated plateau a spur runs north-eastwards to Hadgaon, determining the course of the Kayadhu River to the north of it. The town of Hadgaon (population: 5,522) at the end of the spur in the space between the spur and the river Penganga has grown on account of the convergence of routes afforded by such a geographical situation. This northward running spur has been dissected into two parallel ridges by the erosion of a minor stream.

From the Savargaon plateau the main range continues for about 13 kilometres and then splits into three main ranges extending eastwards, south-eastwards and southwards. All these are generally less than 540 metres. The first of these ranges runs in an east-north-easterly direction as far as Wasi and then turns south-eastwards. The road from Nanded to Bhokar crosses the saddle between the first two ranges and then continues south eastwards on the flat top of the second range. From the third Lunge running southwards, five kilometres north of the Somanthuna peak, a major spur proceeds south-eastwards, dissected into a broken series of flat topped hills.

The hills to the south of the Godavari are generally of lower elevation. The Latur-Nanded road enters the district about 2 kilometres south of Malegaon and runs on the flat summit of a ridge over 480 metres above sea level running in a north-easterly

direction towards Loha. About 6 kilometres before Loha is reached, the ridge however swerves in an easterly direction as far as the Bhimtek peak, which is, situated about 8 kilometres north-east of Kandhar. At Bhimtek it splits into two branches, one running in a north-easterly direction and the other some what lower running in a south-easterly direction forming the water-divide between the Manar and the Godavari. South of Manar the water-divide separating this river from the Tiru and Lendi rivers is of considerable width running in a south-easterly direction with summit levels at about 520 metres. South of the Lendi River there is again an east-west ridge with a summit level of about 510 metres and made use of by the road passing by Hanegaon.

Economic Minerals

Building Stone: Granites in various shades form excellent building stones. Deccan traps being dense, hard and durable are locally used for building and decorative purposes, The rock is hard, resists abrasion and possesses good binding properties which make it well suited for road metal and aggregate in cement concrete.

Clays: Green, red and variegated clays occur associated with lime stones and cherts of the inter-trappean beds. The bed range in thickness from less than a fraction of a metre to 6 metres. They are small lenticular masses to extensive beds covering an area over 5 sq. km. These clays are gritty to greasy and non-plastic, unsuitable for any economic use. The rich red variety may be used in paints.

Iron Ore: In the form of banded haematite quartzite iron ore is recorded at some places. An average sample of the ore from Sirala tank (19°4':77°54'.) gave 38.5% of Fe_2O_3 .

Lime stone: A dense, splintery, cream coloured limestone bed, 1 to 1.5 metres thick, is seen to occur in the inter-trappeans at Shirpulli, Buzurg, Kasral, Mala, Bhaisa, Matul, Pipaldhu, Jheri and Mahalungi. Some of the picked sample gave 80 to 92 % CaCO_3 .

Quartz: White granular quartz suitable for glass is available in enormous quantities from the quartz veins near Tarora. Cryptocrystalline silica in the form of chalcedony, agate, plasma and jasperoid chert occur in profuse quantities. In the trap on the

saddle of hillock close to and east of Bhaisa, east of Tarora and in Dodharna and Belgaon areas.

Steatite: Massive fine-grained steatite has been recorded at Gollapalli. It is reported to be suitable for use as linings for kilns and acid tanks.

Water-Supply: The area comprises two main formations, the peninsular granite complex and the Deccan trap. The granites are seen to have decomposed from a few metres to 15 metres from ground surface. Water table varies from 2 to 15 metres. Depending upon the extent of decomposition of the granites and underground solid rock barriers. The water table in Bhaisa area varies from 10 to 15 metres deep from surface. The Deccan Traps, being massive and fine grained are unsuitable for groundwater storage. It is through joints and fissures in them that the rain water finds its way down and also the groundwater storage is small being limited to available spaces along these joints.

7.5 Geology of Andhra Pradesh State

Andhra Pradesh (AP), by virtue of its location in peninsular India embodying defined, tectonic elements, contains fairly good record of the Achaean, the Middle–Upper, Proterozoic and the Gondwana strata. During the last two decades substantial geological information came from at least three new areas in AP: the auriferous minor greenstone belts of Chittoor–Anantapur Districts, alkaline and other intrusive rocks of Prakasam District, and the sub-crop Tertiary sequences of coastal and off-shore K. G. basin. This has enhanced the importance of highlighting the regional aspects of the state's geology.

In southern peninsular India, the Achaean Schistose rocks and the Gneissic Complex of the Dharwar–Karnataka (craton) served as a reference standard for various reasons. When the Achaean group of rocks of AP forms part of the Dharwar craton and that nearly two-thirds of the Eastern Block of Dharwar craton lies within AP and that itself constitutes 60% of the state.

The minor schist belts of Veligallu, Gadwal, South Kolar belt (known earlier as Bisanattam schist belt), Kadiri, Ramagiri–Penakacherla, Jonnagiri and Peddavuru, which are equated with the Kolar-type auriferous greenstone (2700 M.a. age). The environment of the Ramagiri Schist Belt is that of island arc setting while the Kolar Schist Belt is that of the ocean floor. This is based on the geochemical studies of the associated basalts. The supracrustal rocks of Nellore Schist Belt (NSB) and the Khammam Schist Belt (KSB) are seen forming the MTZ. So also are the newly found Karimnagar Granulite Belt (KGB) and the counterpart Bhopalpatnam Granulite Belt (BGB) across the Gondwana of the Godavari valley in Bastar. Extension of KSB north of the Gondwana in Khammam district can be seen as the supracrustals of Mailaram part of this belt with copper mineralization occurring here.

The Gneissic Complex which constitutes a very large part of the state is classified into Peninsular Gneiss and Younger Granites. Geological information on the distribution of these two types covering the entire state is still incomplete partly due to their field disposition with frequent intermixing and migmatization on various scales.

7.5.1 Minerals Found In Nizamabad District

The District is not rich in minerals. Iron ore of poor quality occurs at few places as laterite capping and as ferrous quartzites. Aluminous blocks containing 25% to 35% Alumina are reported from Gurjakunta of Bhiknoor Mandal and Karadpally in Tadwai mandal. The calcareous and relictinised earth is formed near Tippapur, Bhiknoor and Kuprial areas. The granites of various shades and the Deccan Trap rocks are yielding excellent material in the district, for construction of buildings and for laying roads. Export potential of granite is yet to be exploited fully.

7.6 Seismic History in Maharashtra

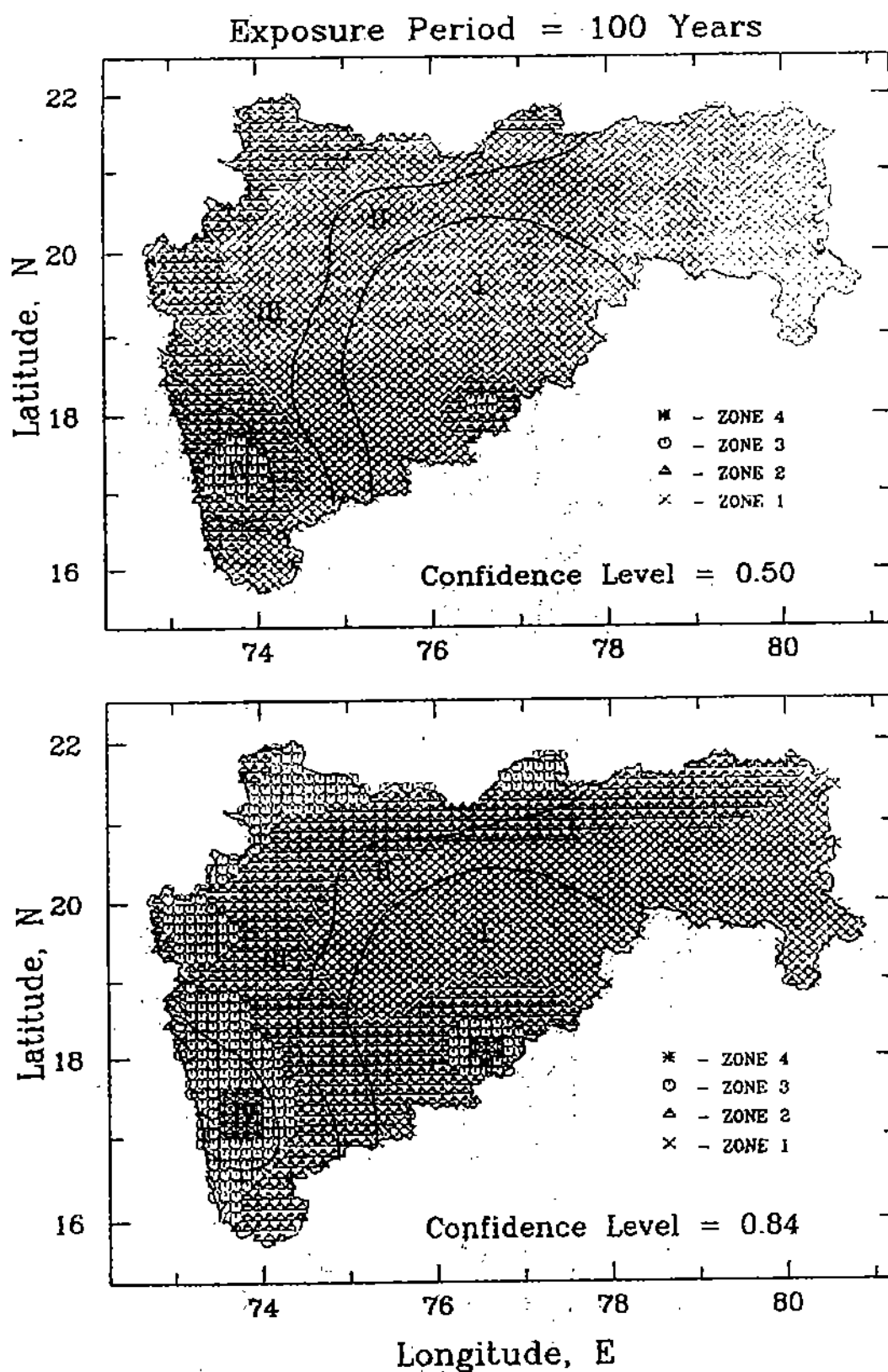
The Latur (Killari), Maharashtra, earthquake of September 30, 1993 is one of the most devastating earthquakes in the world. Its epicenter was located in a region considered to be a seismic. This earthquake occurred in the typical rural setting of India. The severity of the destruction was compounded by the nature of village settlements. While most of the engineered structures survived the earthquake, the non-engineered

ones were totally damaged. Over 10,000 lives were lost in this earthquake and several villages were destroyed. With a magnitude 6.3 and focal depth less than 10 km, this earthquake is similar to other moderate events in the Australian and Canadian shields.

As per the geological and seismological profile of the area it can be concluded that to some extent the area has been prone to moderate to severe seismic attacks. The geological profile of the Deccan plateau proves to be helpful in these seismic attacks as they are step formations of the lava flow. The same is applicable to the area covered under the Lendi Major Interstate Project. Looking into the uncertain association of earthquakes and impoundment of water, there are little chances that the implementation of this particular scheme would result in earthquakes.

Also as per the seismic zones given in IS 1893 – 1984, the Lendi Major Interstate project lies in Zone II. However post Killari earthquake (1993), the design was planned for next higher zone i.e. Zone III, for which the basic seismic co-efficient is 0.03 and the same is adopted during the dam design. Keeping the security assurance the design horizontal seismic co-efficient 'H' is calculated considering IF = 2 m. It is also in the view that the site is located in the Marathwada region and 100km radial distances from the Killari, where seismic activities are noted. Accordingly the seismic forces in the dam are calculated, assuming triangular variation of horizontal seismic force of 0.06 g at the top and zero at bottom, the vertical seismic force is 0.03 g and hydrodynamic forces due to earthquake are also considered.

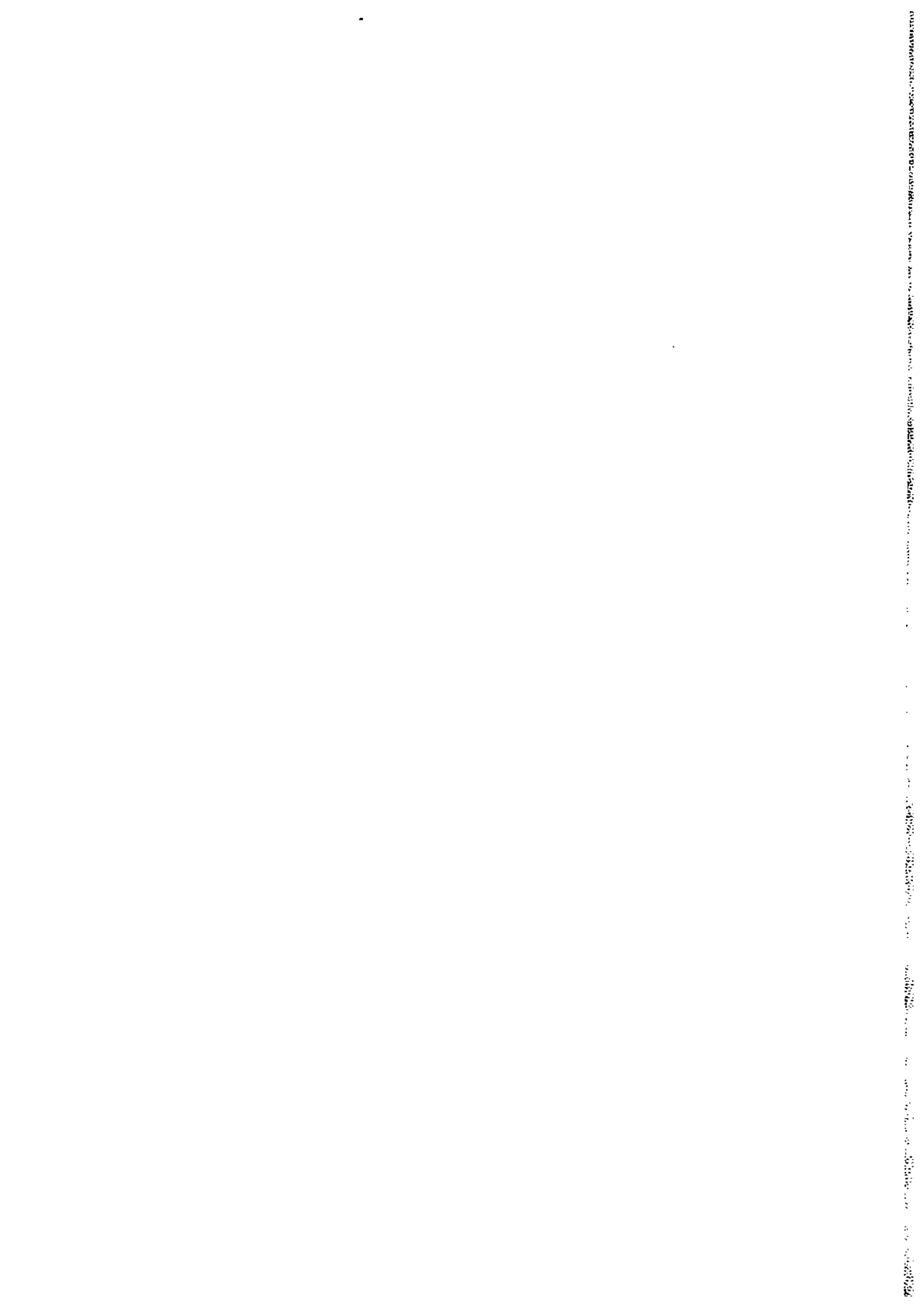
Figure 7.1 Seismic Zoning Map-100 yrs Exposure



Probabilistic seismic zoning maps of Maharashtra state for an exposure period of 100 years and confidence level equal to 0.50 and 0.84.

CHAPTER – 8

HYDROLOGY AND WATER PLANNING



CHAPTER 8.0 HYDROLOGY AND WATER PLANNING

8.1 Introduction

The most important river of the Nanded district is the Godavari. It enters the district from the west and flows eastwards through the central part of the district. It controls almost the entire drainage system of the district. Other rivers are the Manjra, Manar, Saraswati, Penganga, Ashna, Sita and Lendi. The largest tributary of the Godavari is Manjra, which flows from south to north forming the boundary between the district and Andhra Pradesh. Manar flows through Kandhar tehsil from west to east and forms the natural boundary between Mukhed, Deglur and Biloli tehsils. Saraswati takes its course in Wakhad hill, flows from north to south through the eastern portion of the district and finally meets the Godavari. The Lendi Major Interstate Project is situated after the confluence of Tiru and Lendi River. The available water from the Lendi river basin is not fully utilized except for some of the minor schemes and two medium irrigation projects. Hence it is proposed to have a storage reservoir by constructing dam across this river.

8.2 Hydrology

The river Lendi with its two main tributaries Tiru and Kundrala originates at an altitude of 650m, near Udgir in the Latur district of Maharashtra State. It flows 85 kms in the eastern direction and joins Manjara River at an altitude of 362m. The river flows through hilly area with an average bed fall of 11m per km initially for the 15km from its origin. Thereafter it flows with an average bed fall of 4 m per km for about 21 km up to the confluence with Tiru river tributary. Finally it joins the Manjra river with a bed fall of 1m per km for the remaining length of 49km. thus the overall bed slope of the Lendi river is 3.11m per km from the origin to the dam site the river length counts to be 78.89km

8.3 Water Availability and Planning

The rainfall series 1914 to 1965 of Ahmedpur, Kandhar, Degloor & Udgir rain gauge stations in the influence of Lendi Catchment area were considered in the report. The

yield on the project was worked out to be 210.164 Mm^3 (7.423 TMC). While working out this yield post monsoon flow was restricted to 5% as per the C.W.C. suggestions given in September 1969. The 75% dependable design year was 1964. The yield was exclusive of upstream reservations 68.714 Mm^3 (2.427 TMC) intercepted by Tiru, Kundral medium projects and some M.I. schemes

The 75% dependable yield at project site is 314.28 Mm^3 . Considering upstream utilization of 68.714 Mm^3 (2.427 TMC) and 28.31 Mm^3 (1 TMC) reservation for Udgir tehsil, the net yield thus available for this project is 244.90 Mm^3 (8.65 TMC) as against the requirement of 180.11 Mm^3 (6.36 TMC).

Table 8.1 Yield of Lendi Major Project (From 1949 to 2004)

Statement showing Monsoon Yield at Lendi Project from 1949 to 2004.							
			75 % dep monsoon virgin yield			314.28	Mcum.
Sr. No	Total Virgin Monsoon yield at Lendi Project site						
	Year	June	July	August	Sept	Oct	Total
		Runoff in MCM					
1	1949	44.18	105.22	33.83	108.16	35.06	326.46
2	1950	62.16	155.09	62.96	169.84	29.09	479.14
3	1951	50.64	124.08	37.68	136.35	26.01	374.76
4	1952	76.60	195.85	90.51	210.11	30.99	604.06
5	1953	40.20	104.83	75.50	235.59	52.82	508.94
6	1954	98.75	80.96	76.14	242.57	141.78	640.21
7	1955	79.46	129.62	343.55	228.74	42.94	824.30
8	1956	56.77	341.80	28.69	104.57	68.70	600.53
9	1957	37.21	149.94	227.89	112.88	46.75	574.68
10	1958	10.54	48.24	85.38	33.33	15.05	192.54
11	1959	54.10	92.57	136.61	124.73	56.14	464.15
12	1960	66.68	76.84	0.00	158.64	10.59	312.76
13	1961	52.09	153.00	87.41	54.48	142.93	489.91
14	1962	21.40	46.51	145.17	301.53	54.64	569.24
15	1963	81.53	60.90	231.89	35.51	124.18	534.01
16	1964	20.08	102.12	70.89	189.57	26.95	409.62
17	1965	51.70	113.12	87.53	103.84	0.00	356.19
18	1966	21.94	61.63	29.98	149.25	0.00	262.79
19	1967	19.31	69.75	17.55	76.47	2.83	185.91
20	1968	15.39	92.04	1.71	177.99	26.24	313.37
21	1969	12.92	118.12	78.12	190.16	4.61	403.94
22	1970	49.64	64.12	291.76	235.42	0.00	640.93
23	1971	26.50	0.00	81.70	43.83	86.29	238.32
24	1972	17.70	0.00	27.45	5.62	3.12	53.89

25	1973	32.25	61.35	215.10	89.06	119.71	517.47
26	1974	48.88	53.95	106.62	144.67	168.15	522.28
27	1975	11.13	192.18	159.99	225.60	125.99	714.89
28	1976	21.53	114.08	103.59	56.63	0.00	295.83
29	1977	23.36	94.59	73.36	56.98	33.23	281.52
30	1978	55.82	157.52	78.23	84.62	50.55	426.74
31	1979	47.50	45.05	25.08	237.82	0.00	355.46
32	1980	45.75	29.52	190.91	141.24	0.00	407.42
33	1981	20.72	55.34	72.42	247.72	45.09	441.29
34	1982	15.31	116.83	35.51	145.96	28.83	342.44
35	1983	9.15	139.78	282.05	358.84	213.84	1003.65
36	1984	34.80	77.37	11.61	120.56	69.94	314.28
37	1985	52.44	105.14	29.81	93.50	75.85	356.74
38	1986	26.72	47.40	106.04	21.62	0.00	201.78
39	1987	37.57	59.92	115.52	4.34	52.59	269.96
40	1988	38.51	154.47	247.57	450.77	7.31	898.62
41	1989	62.71	231.96	141.12	141.74	23.35	600.88
42	1990	61.41	30.18	225.85	39.36	174.37	531.17
43	1991	40.05	148.06	18.94	0.00	0.00	207.05
44	1992	42.02	0.00	110.83	71.82	42.21	266.88
45	1993	20.87	91.96	97.12	66.79	87.38	364.12
46	1994	17.26	37.19	92.80	26.77	69.07	243.08
47	1995	49.66	109.07	75.32	42.04	197.70	473.78
48	1996	3.15	107.96	154.92	235.41	129.27	630.70
49	1997	9.53	50.60	99.52	91.06	84.16	334.87
50	1998	36.33	160.70	154.71	243.33	112.49	707.56
51	1999	17.33	74.43	105.61	138.62	84.59	420.58
52	2000	51.28	90.15	277.53	30.32	14.48	463.76
53	2001	65.46	0.00	183.80	30.37	150.17	429.80
54	2002	34.94	17.66	153.44	114.42	32.25	352.71
55	2003	31.90	180.49	108.73	74.12	17.22	412.46
56	2004	33.41	160.63	36.57	187.71	54.55	472.87
Average		38.68	97.89	111.43	132.91	58.79	439.70

Table 8.2 Storage (existing and planning) upstream of proposed Lendi Dam

Name of Project	Taluka	District	U/S Gross Storage in M Cum.	U/S Storage up to Project M cum.
COMPLETED PROJECT				
Major Project.			0	0
Medium Project			0	0
Minor Project				
Nedgir	Udgir	Latur.	1.78	1.78
Haldwatona	Jalkoot	Latur.	3.68	3.68
Degaon	Mukhed	Nanded	1.98	1.98
Hunmanhipperga	Degloor	Nanded	0.99	0.00
Nideben	Udgir	Latur.	1.36	1.36
Dhonwadi	Jalkoot	Latur.	1.05	1.05
Gudsor	Udgir	Latur.	1.93	1.93
Downhipperga	Udgir	Latur.	4.05	4.05
Gupti	Jalkoot	Latur.	3.09	3.09
Sonada	Jalkoot	Latur.	5.49	5.49
wejegphd	Udgir	Latur.	1.10	1.10
Hanihipperga	Udgir	Latur.	0.96	0.96
Bagentakdi	Degloor	Nanded	0.91	0.00
		Total	28.37	26.47
PROJECT IN PROGRESS				
Major Project.			0.00	0.00
Medium Project			0.00	0.00
Minor Project				
Khrebwadi	Ahmedpur	Latur	2.57	2.57
Rohini	Chakur	Latur	1.08	1.08
Mandorki		Latur	1.33	1.33
Kodli		Latur	1.72	1.72
Dongergaon		Latur	4.17	4.17
Gotti -II		Latur	1.41	1.41
Rawenkoda		Latur	1.27	1.27
Dapkaraja	Mukhed	Nanded	1.84	1.84
Undrimangri	Mukhed	Nanded	1.65	1.65
Increase hight of Tiru Project	Udgir	Latur	4.50	4.50
Chandegaon		Latur	4.53	4.53
Tondchir		Latur	1.33	1.33
Madhipperga		Latur	4.08	4.08
Mangri		Latur	2.73	2.73
		Total	34.21	34.21
PROJECT UNDER EXPLORATION				
Major Project.			0.00	0.00

Medium Project			0.00	0.00
Minor Project				
Bamajichiwadi		Latur	1.14	1.14
Dongerkonali		Latur	4.13	4.13
Awelkonda		Latur	2.23	2.23
Dhongitanda		Latur	1.17	1.17
Shirnade			1.65	1.65
Wazer	Degloor	Nanded	1.62	0.00
Sherngi	Degloor	Nanded	2.03	0.00
Tumberphadi	Degloor	Nanded	2.10	0.00
Loonitanda	Degloor	Nanded	1.15	0.00
		Total	17.22	10.32

Table 8.3 Existing utilization in catchments area of Lendi Project

Sr. No.	Name of Project	Taluka	District	U/S Gross utilisation up to Gauging Site in Mcft.	U/S Storage up to Project Mcft.
COMPLETED PROJECT					
A)	Major Project.			0	0
B)	Medium Project				
1)	Tiru Project	Udgir	Latur.	938.0	938.0
2)	Kerdkhed Project.	Degloor	Nanded	600.0	0.0
3)	Kundrala Project.	Mukhed	Nanded	657.0	657.0
			Total	2195.0	1595.0
C)	Minor Irrigation (S.S.) (A)				
1)	Pimpri	Udgir	Latur	130.000	130.000
2)	Kallur	Udgir	Latur	51.000	51.000
3)	Ekurka.	Udgir	Latur	68.000	68.000
4)	Nagatgaon	Udgir	Latur	66.000	66.000
5)	Wasur	Mukhed	Nanded	43.000	43.000
6)	Dhorsangvi	Ahmedpur	Latur	93.000	93.000
7)	Degloor	Degloor	Nanded	47.000	0.000
8)	Ambutga	Degloor	Nanded	96.000	0.000
9)	Hanegaon	Degloor	Nanded	59.000	0.000
10)	Hanegaon II	Degloor	Nanded	42.000	0.000
				695.000	451.000
D)	Minor Irrigation (S.S.) (A)				
1)	Janapur	Udgir	Latur	26.000	26.000
2)	walkonda	Udgir	Latur	26.000	26.000
3)	Dongarshelki	Udgir	Latur	26.000	26.000
4)	Jamb (Bk)	Mukhed	Nanded	23.000	23.000
5)	Bapethwadi	Mukhed	Nanded	19.000	19.000
6)	Gojegaon	Mukhed	Nanded	14.000	14.000

7)	Kamjatga	Mukhed	Nanded	9.000	9.000
8)	Konali	Udgir	Latur	18.000	18.000
9)	Dawangiri	Udgir	Latur	14.000	14.000
				175.000	175.000
E)	Lift Irrigation Scheme				
1)	Hanuman Hipparga	Degloor	Nanded.	167.000	0.000
2)	Mujalga	Degloor	Nanded.	62.000	0.000
3)	Temlur	Degloor	Nanded.	58.000	0.000
4)	Penar Scheme	Dgloor	Nanded	0.000	0.000
				287.000	0.000
F)	LARGE MINOR				
1)	Rechannwadi	Udgir	Latur	180.000	180.000
2)	Sangamawadi	Udgir	Latur	269.000	269.000
3)	Gurdghal	Udgir	Latur	141.000	141.000
				590.000	590.000
G)	M.I.S.S.				
1)	Keskrwadi	Udgir	Latur	66.000	66.000
2)	Jagamwadi	Udgir	Latur	39.000	39.000
3)	Hawarga	Ahmedpur	Latur	62.000	62.000
4)	Bothi	Udgir	Latur	72.000	72.000
5)	Deogaon	Mukhed	Nanded	55.000	55.000
				294.000	294.000
			G. Total	4236.000	3020.000
				119.949	85.516

Table 8.4 Summary of the yield versus utilisation

LENDI MAJOR PROJECT					
Statement showing monthly U/S Utilisation of Medium and Minor projects.					
75 % Virgin Monsoon yield at the project site =		314.28		MCM	
Total Upstream utilization =					
Utilization	Utilization up to Gauging site.	MCM	Utilization up to Project site.		
Completed					
Medium	119.949		85.516		
Minor	28.37		26.47		
Under construction					
Medium	0		0		
Minor	34.21		34.21		
Administrative approved					
Medium	0		0		
Minor	17.22		10.32		

Total	119.749	156.516
PM flow 3%		
Monsoon	193.76	151.82
Regeneration	10%	
In MCM	19.975	15.652

Crop water Requirement:

In the administratively approved report the crop water requirement is calculated by considering the following points:

i)	Methodology adopted	Charisitansons's method.
ii)	Climatological data	Nizamabad station
iii)	Overall efficiency	65.52%
	a) Conveyance efficiency	90%
	b) Distribution system efficiency.	91%
	c) Field application efficiency.	80%
iv)	Lining up to 5/8 hector block	
v)	Chance of rain fall occurrence	80%

However, as per the CWC Directorate Guidelines (CWC Booklet T 5 series), the system efficiencies suggested are as below:

a) Conveyance efficiency: Lining of main canal and distribution upto 5 to 8 ha block (as in case of the Lendi Project)	75%
b) Field application efficiency (field canal to root zone of crop)	65%
c) Pre sowing water depth for all crops	75 mm
d) Occurrence of effective rainfall	80%
Overall efficiency = Conveyance efficiency *field application efficiency *100	48.75% say 50 %

Considering all factors mentioned in the above table, a fresh crop-water requirements for various crops to be harvested in Maharashtra and Andhra Pradesh are worked out, which are also prepared duly applying the modified penman method. Thus the overall efficiency considered for design of the Canal System of the Lendi project is 50%.

Table No 8.5 The crop water requirement calculated accordingly is presented below:

Water requirement per 1000 Ha. (Maharashtra portion as per Modified Pan men method)

As per T - 5 series (in M. Cum.)

As per 1 - 5 Series (in M. Cum.)																			
Sr. No.	Crops.	%	Area In Ha.	Kharif					Rabi.					Hot. Weather.					
				Jul	Aug	Sep	Oct	Total.	Oct	Nov.	Dec	Jan	Feb	Total.	Mar.	Apr	May	Jun	Total.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	<u>Perennials.</u>																		
1	Sugarcane.	4	40	0.020	0.017	0.019	0.022	0.078	0.022	0.044	0.039	0.063	0.041	0.209	0.054	0.071	0.094	0.050	0.269
	Over lap 30% Kh., 40% Rabi., HW, 10%.			0.006	0.005	0.006	0.007	0.024	0.008	0.018	0.016	0.025	0.016	0.083	0.005	0.007	0.009	0.005	0.026
				0.026	0.022	0.024	0.029	0.101	0.030	0.062	0.055	0.088	0.058	0.292	0.060	0.078	0.103	0.055	0.295
2	<u>Two Seasonal.</u>																		
1	Chillies.	10	100	0.015	0.020	0.032	0.094	0.161	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.080	0.080
2	L.S. Cotton.	20	200	0.038	0.070	0.096	0.104	0.308	0.102	0.186	0.000	0.000	0.000	0.289	0.000	0.000	0.184	0.028	0.212
	<u>Kharif.</u>																		
	Hy. Jawar	15	150	0.009	0.009	0.033	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.030
	Maize.	10	100	0.007	0.012	0.025	0.016	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.016
	Paddy.	10	100	0.011	0.018	0.042	0.053	0.124	0.053	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.000	0.013	0.013
	<u>Rabi.</u>																		
	Jawar.	15	150	0.000	0.000	0.000	0.000	0.000	0.071	0.111	0.174	0.086	0.000	0.441	0.000	0.000	0.000	0.000	0.000
	Gram.	10	100	0.000	0.000	0.000	0.000	0.000	0.035	0.023	0.089	0.115	0.000	0.262	0.000	0.000	0.000	0.000	0.000
	Wheat.	25	250	0.000	0.000	0.000	0.000	0.000	0.073	0.148	0.283	0.300	0.225	1.029	0.000	0.000	0.000	0.000	0.000
	<u>Hot. Weather.</u>																		
	Ground Nut.	5	50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044	0.021	0.065	0.067	0.101	0.045	0.000	0.213
								0.901						2.723					1.153
	50% Efficiency							1.802						5.446					2.306

Source: Approved Water Planning Booklet Vide CE Letter No. T.S.5/File 21/2610 dt; 20.03.2009

Lendi Major Project R.B. Canal, Madnur Taluka, Nizamabad District.

Abstract Of Demands In M.Cum.

Sr. No.	Month.	Khariff Season.					Rabi Season			From canal water for irrigation M.Cum.	Canal water for Drinking water M.Cum.	Total canal water reuirement M.Cum.	From wells ground water M.Cum.	Total requirement in M.Cum.	Remarks.
		G. Nut. 5000 Ac.	Chillies 2000 Ac.	Paddy 4000 Ac.	Cotton 9000 Ac.	Pulses 2000 Ac.	Pulses 4000 Ac.	Jawar 1700 Ac.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	June	0.6395	0	0.5084	2.3022	0.7998	0	0	3.2499	0	3.2499	1.0000	4.2499	14.3556+	
2	July	0.8215	0	5.1600	1.4787	0.5018	0	0	5.9620	0	5.9620	2.0000	7.9620	1.4355=15.7911	
3	August	1.2205	0	3.4860	3.996	0.888	0	0	7.5905	0	7.5905	2.0000	9.5905	for rush irrigation	
4	September	1.3275	0.1328	3.2400	5.8437	0.3254	0	0	8.8694	0	8.8694	2.0000	10.8694	=577.66 Mcft. =	
5	October	0	1.3722	5.3984	9.585	0	0	0	14.3556	0	14.3556	2.0000	16.3556	208.20 Cusecs.	
6	November	0	1.9900	0	0	0	2.0916	0.8889	2.9500	1.2960	4.2460	2.0205	6.2665	Say 5.90 Cumces.	
7	December	0	1.6654	0	0	0	3.2636	1.3464	2.5722	1.5000	4.0722	3.7024	7.7746		
8	January	0	0	0	0	0	4.6428	1.8809	3.3000	2.0000	5.3000	3.2237	8.5237		
9	February	0	0	0	0	0	3.4416	1.6896	1.0000	2.0000	3.0000	4.1312	7.1312		
	Total.	4.0090	5.1604	17.7928	23.2056	2.5150	13.4396	5.8058	49.8496	6.7960	56.6436	22.0786	78.7242		

Ground water Table:

The data on the groundwater level is available for the study area for sixteen years and summarised given below in the table 8.6.

Table 8.6 Ground Water Level Data Report at Rajura 8k

State	Maharashtra														
District	Nanded														
Tehsil	Mukhed														
Block	Mukhed														
Ground water level (mbgl)															
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
May	3.5	4.4	5.3	5.35	5.3	5.35	3.45	5.1	5.35	3.5	5.35	3.9	5.3	5.35	5.34
Oct	2.1	3.8	3.7	4.5	3.5	1	2.2	4.1	1.45	1.25	1.3	1.8	2.8	2.9	1.2

(Source: Letter No.1210/06 from Ground Water Survey and Development Department, Aurangabad to Executive Engineer, Vishnupuri Project Div.1, Nanded)

Table 8.7 Ground Water Level Data Report at Narangal Bk

State	Maharashtra														
District	Nanded														
Tehsil	Mukhed														
Block	Mukhed														
	Ground water level (mbgl)														
Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	2001
May	2.70	8.45	3.30	4.75	4.1	5.70	7.70	6.70	9.70	8.00	7.95	7.35	6.5	9.70	9.70
Oct	2.70	8.45	3.30	4.75	4.1	5.70	7.70	6.70	9.70	8.00	7.95	7.35	6.5	9.70	9.70

(Source: Letter No.1210/06 from Ground Water Survey and Development Department, Aurangabad to Executive Engineer, Vishnupuri Project Div.1, Nanded)

Table 8.8 Ground Water Level Data Report at Tadkhel

State	Maharashtra												
District	Nanded												
Tehsil	Mukhed												
Block	Mukhed												
Ground water level (mbgl)													
Oct	May	Year											
3.50	7.25	1990											
4.40	6.20	1991											
6.45	7.30	1992											
3.60	7.30	1993											
4.70	7.30	1994											
1.50	7.30	1995											
0.20	6.80	1996											
6.40	7.30	1997											
1.60	5.85	1998											
1.55	7	1999											
1.50	5.80	2000											
1.4	7.30	2001											
3.20	6.40	2002											
2.50	7	2003											
6.90	7	2004											
1.30	7.30	2005											

(Source: Letter No.1210/06 from Ground Water Survey and Development Department, Aurangabad to Executive Engineer, Vishnupuri Project Div.1, Nanded)

The above data indicates that in the month of May, the average ground water level is 6.43 m below the ground level. While in the month of October, i.e. immediately after the monsoon, the average range is 3.4 m below the ground. Among the stations sampled, Rajura (bk) has shown the shallow water table while, Narangal (bk) has shown deep water table.

Table No 8.9 Ground water table in command area of project (year 2006 to 2010)

Village Name		Tadkhel	Narangel	Amdapur	Bagantakali	Chainpur	Rajura Bk	kotgyal	Mukramabad	Avearge
Type of well		Dug well								
Depth in mts bgl	Season	7.3	9.7	18.75	13.45	17.05	5.35	6.3	7.6	
SWL in Year 2006	Pre monsoon	7.3	9.7	18.76	13.45	17.05	5.35	5.14	6.1	10.35
	Post Monsoon	4	9.7	5.8	5.8	17.05	2.15	2.3	2.8	6.2
SWL in Year 2007	Pre monsoon	7.3	9.7	18.75	13.45	17.05	5.35	5.14	7.2	10.49
	Post Monsoon	3.2	9.7	6.5	11.8	17.05	2.1	2.2	2.6	6.89
SWL in Year 2008	Pre monsoon	7.3	9.7	14.9	13.45	17.05	5.35	5.14	6.1	9.87
	Past Monsoon	4.5	9.7	11	12.9	17.05	3.8	2.2	3.8	8.11
SWL in Year 2009	Pre monsoon	7.3	9.7	13.2	13.45	17.05	5.1	5.14	6.5	9.68
	Post Monsoon	6.2	9.7	11	13.45	17.05	4.2	6.3	4.9	9.1
SWL in Year 2010	Pre monsoon	7.3	9.7	13	13.45	17.05	5.35	5.14	7.6	9.82
	Post Monsoon	1.8	9.7	3.6	4.2	17.05	1.4	1.6	0.1	4.93

Source: GSDA, Nanded

Above table, average ground water table in various locations in command area of proposed project is ranges from 4.93 to 10.49m. It means that ground water table in project area is very low.

Water table rise due to low efficiency of surface water system: This can be addressed by knowing the interaction between surface and ground water:

Rise of water table: In the long-term, one of the most frequent problems of irrigation scheme is the rise in the local water-table resulting in waterlogging. Low irrigation efficiency (as low as 20 to 30% in some areas) is one of the main reasons for the rise in the water table. Poor water distribution systems, poor main system management and archaic in-field irrigation practices are the main reason. The ICID recommendation to increase field application efficiency to even 50% could significantly reduce the rise in the groundwater. The groundwater level rise can be spectacularly fast in flat areas where the water table has a low hydraulic gradient. The critical water table depth is between 3 m below ground level and is acceptable. Ground water depth between 2-3 m below ground level before irrigation is prone to waterlogging. Water table less than 2 m below ground level is already waterlogged in Indian scenario.

Groundwater rising under capillary action will evaporate, leaving salts in the soil. The problem is of particular concern in arid and semi-arid areas with major salinity problems. A high water table also makes the soil difficult to work.

Good irrigation management, closely matching irrigation demands and supply, can reduce seepage and increase irrigation efficiency, thereby reducing the groundwater recharge. The provision of drainage will alleviate the problem locally but may create problems if the disposed water is of a poor quality. Apart from measures to improve water management, two options to reduce seepage are to line canals in highly permeable areas and to design the irrigation infrastructure to reduce wastage. Waterlogging also implies increased health risks in many parts of the world.

Classification of soils from the command area of Lendi project the based on textural characteristics is given below:

Textural classes of the soils from the command area

Type of Soil	Soil Depth in cms.	Fine Soil Sandy Clay & Finer	Medium Textured i.e. Loamy Soils	Coarse Soils
Deep	15 – 30	80.43%	19.57%	-
	90 – 120	84.78%	15.22%	-
	210 – 250	83.95%	16.06%	-
Medium	15 – 30	50%	50%	-
	90 – 120	100%	-	-

It is seen that the proportion of fine soils is considerable, in deep soil areas, even closer to the surface. But medium soils differ in fine texture at lower depths. The coarse type of soil texture is totally absent from the both medium and deep soils.

Land drainage is an accepted important corollary to irrigation systems. The old canal systems in the Deccan areas have amply demonstrated this. The State Government has also accepted principally to provide drainage for the commands of canals.

The classes I-VI are the initial classification based on primarily natural drainage factor and other soil characteristics revealed during the soil survey. A continuous watch on the behaviour of sub soil water table will be necessary before and after irrigation to consider the requirement of artificial drainage. However following anticipatory measures required to be undertaken:

- ❖ Provision of Surface drains required to be made so as to collect and carry away extra irrigation water,
- ❖ All the natural nallas and sub nallas will be improved in their drainage capacity by removing the obstructions such as rock bars, etc. Steeper gradients will be provided wherever necessary,
- ❖ Some nallas will be dependent fully throughout the percolating substrata to improve the internal drainage considerably,
- ❖ Maintenance of the canals / distributaries, field channels and drains in the command area is very important and required to be undertaken,

- ❖ The annual running and maintenance estimates are to be prepared for the upkeep of the system functional,
- ❖ Encouraging farmers to resort to ground water abstraction, which will reduce water logging and drainage situations,
- ❖ Extension and training programmes are extremely important to prepare the farmers for any environmental eventuality and hence required to be undertaken,
- ❖ Ayacut development work which is expected to provide surface drains to collect and carry away extra irrigation water. These surface drains will empty in the natural drains and finally extra water will flow into the river i.e. the main drain. Similar activities required to be extended to the areas that are likely to be waterlogged.

Table No 8.10 The number of wells and area irrigated across sub areas.

Sub-area No.	Number of open wells	Area irrigated (ha)	Area under various crops irrigated by well									
			Sugarcane	Banana	Orange	Wheat	vegetable	Jowar	Cotton	Chillies	Rice	Other crops
1	2	3	4	5	6	7	8	9	10	11	12	13
1						NIL						
2						NIL						
3						NIL						
4	8	13.55	-	-	2.77	2.03	3.15	4.07	-	0.05	-	1.48
5	4	0.90	0.56	-	-	0.04	0.30	-	-	-	-	-
6	5	1.62	-	0.10	-	0.46	0.46	-	-	-	-	0.60
7						NIL						
8	27	17.40	0.93	0.05	0.18	0.47	4.27	0.45	-	1.35	-	9.70
Total	44	33.47	1.49	0.15	2.95	3.0	8.18	4.52	-	1.40	-	11.78

(Source: Letter No.1210/06 from Ground Water Survey and Development Department, Aurangabad to Executive Engineer, Vishnupuri

Project Div.1, Nanded)

The above table indicates that, 44 wells irrigated around 33.47 ha of command area

Downstream Users:

The detailed survey of downstream areas was undertaken records of existing Kolhapur Type (KT) Weirs and water storage structures were undertaken. In addition to this, data on the proposed KT Weirs and water conservation structures was obtained.

Table 8.11 List of existing and proposed K T Weirs on the downstream of the proposed dam site

Sr. No.	Name of the water conservation structure	Revised govt. approval (amount in Lakh)	Irrigation capacity	Storage capacity (MCUM)	Live storage	Remark
1	Balegaon K T Weir	34.44	82	0.559	0.559	Constructed
2	Dhosani K T Weir	47.66	100	0.491	0.491	Constructed
3	Degaon K T Weir	64.90	52	0.457	0.457	Constructed
4	Patalganga K T Weir	6.00	29	0.189	0.189	Constructed
5	*Havara K T Weir	64.00	130	0.585	0.585	Constructed
6	Hanuman Hipperga K T Weir	52.50	85	0.474	0.474	Constructed
7	Achegaon K T Weir	43.20	62	0.353	0.353	Constructed
8	Kurudagi K T Weir	102.00	224	0.795	0.795	Constructed
	Total		794	3.903	3.903	

* 100 to 250 ha

Legend

- Spot Height
- ▲ Bench Mark
- Contour
- Canal
- Village
- Triangulation Point
- Major Metalled Road
- Major Unmetalled Road
- Pucca Track
- Cart Track
- Power Line
- Telephone Line
- Stream
- Waterbody Perennial
- Waterbody Non-perennial
- Submergence
- River
- State Boundary
- Taluk Boundary
- Dum Site
- Island
- Surface Water
- Ground Water

Scale

0 1 2 4 6 8 km

Prepared by
The Executive Engineer,
Irrigation Division,
Godavari Marathwada Irrigation
Development Corporation

Prepared by
Science and Technology Park,
University of Pune, Pune.

Prepared by
Science and Technology Park,
University of Pune, Pune.



Figure 8.1 Details of existing and proposed K T Weirs on the downstream of the proposed dam site

The following facts indicates that the impact of the downstream will be minimum

- a. Lendi is a seasonal river and flow is up to November only.
- b. Due to the construction of Lendi dam across the River Lendi, downstream flow will be affected. To enhance the aquatic life mitigation measures has been proposed to maintain minimum flow in the river. Downstream lean flow to the extent of 0.504cumecs will be released in river fortnightly to maintain aquatic biodiversity.
- c. Release of water from reservoir beyond November will give rise to stream flow beyond November. Proposed impoundment and controlled release will extend the life of the seasonal river,
- d. Provision of releasing of impounded water to the downstream has been made, thereby it not only satisfies the need of the downstream people but also for extends the life of flora and fauna
- e. A few K T weirs exist in the downstream. These are serving the downstream people at present and will continue to serve even after the construction of Lendi Dam. K T weirs also would help to meet the requirements of the downstream people
- f. In addition to the above, there are wells in the downstream that will be serving the need of the individual farmers
- g. Even with high application efficiency, deep percolation leading to ground water accretion and leading to ground water build up in command area. Ground water will be exploited for irrigation, drinking water supply in the nearby villages.

- h. Also, the provision of sluice of capacity 1Cumec at pier number 14 at a level of 381.50 m (FRL 396 m, MDDL 389.50, Sill level 388 m) is made to ensure release of drinking water needs of the downstream. This sluice is as per govt. letter (No. LND/1090/9336(253/90) Maj-2 Dt. 19.12.92) which have directed to propose river sluices for depletion and release of water at lower levels in the river. Accordingly, the general layout of this project was finalized. As per C.D.O. standards, one river sluice is proposed; at pier no. 14 with sill at RL 382.50 m. Necessary provision for the same is made in the estimate of Masonry Spillway.

Sr. No.	Particulars.	Levels in M. as per 5 th revision.
1)	River bed level.	373.12
2)	Sill level.	388.00
3)	M.D.D.L.	389.50
4)	Crest level.	388.00
5)	F.R.L.	396.00
6)	M.W.L.	398.50
7)	T.B.L.	401.00
8)	Free board.	2.50
9)	Sill of river sluice	
	a) In pier No.14	382.50
II)	STORAGE DETAILS:	
1)	Capacity at MDDL	28.098 M.Cum
2)	Capacity at FRL	145.62 M Cum
3)	Capacity @ Crest RL 388.00	11.545 M cum.
4)	Area after providing river sluice at RL 382.50	2.51 mm ²
5)	Area at F.R.L.	29.27 mm ²

8.4 Water Quality

8.4.1 Secondary data

The surface and ground water quality of the project area may get affected due to various factors. In the present case, an attempt was made to predict impacts of additional water availability in the command area.

Available secondary data was compiled for the project area. The Report by the Directorate of Irrigation Research & Development (DIRD) Pune, on Lendi Irrigation Project, was utilised for the present study. In addition to this data various primary surveys were undertaken to assess the water quality of the project area.

Table 8.12 Results of pH and Electrical Conductivity of Water Samples from Lendi and Manar River

Sr. No.	Water Sampling Stations	pH	EC in dS/m
1	Water sample of lendi river at Idigyal	8.60	0.70
2	Water sample of lendi river at village Lingapur	8.30	0.80
3	Manar river at Lakha village	8.50	0.60

(Source: Report of Directorate of Irrigation Research & Development Pune on Lendi Irrigation Project, Dist. Nanded)

8.4.2 Ground Water Quality in the Project area

Villages from the project area were selected and observations on the ground water levels were recorded. Water samples from wells were collected and analyzed for pH and electrical conductivity.

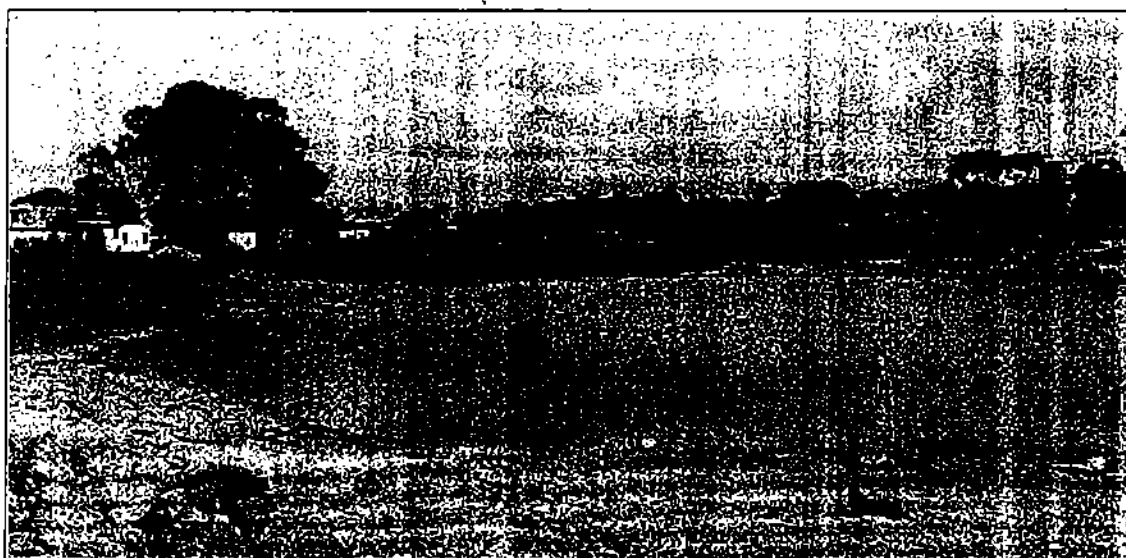


Table 8.13 Table depicting observed number of Wells / village

Sr. No	Name of Villages	Number of Wells observed
1	Rajur KD	1
2	Degaon	1
3	Kanapur	1
4	Antapur	3
5	Haumn Hiparga	7
6	Madan kallur	4
7	Ibrahimpur	3
8	Babnoli	4
9	Sahapur	10
10	Alur	2
11	Tamblur	38
12	Shelgaon	7
		81

(Source: Report of Directorate of Irrigation Research & Development, Pune on Lendi Irrigation Project, Dist. Nanded).

Total 81 numbers of wells were surveyed from the project area. The status of ground water table in the command area is summarised as under:

Table 8.14 Status of Ground Water Table in Command Area

Sr. No.	Village	Survey No	Ground Water table in meters BGL	Electrical Conductivity dS/m	pH
1	Rajur KD	6	2.35		-
2	Degaon	191	8.10		-
3	Kanapur	24	0.00		-
4	Antapur	9	5.10		--
		50	5.15	0.9	8.60
		33	4.20	0.8	8.40
5	Haumn Hiparga	4	5.55	1.4	8.10
		36	4.20	1.3	8.90
		37	5.17	1.8	8.60
		76	5.70	1.4	8.20
		78	6.00	0	-
		39	6.66	1.6	8.60
		35	5.55	1.4	8.00
6	Madan kallur	25	6.15		-
		4	5.25		-
		7	4.36	0.9	8.90
		7	5.55	1.45	8.70
7	Ibrahimpur	9	6.60		-
		7	4.00		-

		12	2.40		-
8	Babnoli	33	3.20		-
		140	5.40		-
		19	6.95	1	8.10
		8	1050	1.4	8.00
9	Sahapur	4	5.50		-
		94	3.30		-
		207	4.35	0.85	8.00
		VS	4.20		-
		211	3.00	0.8	8.60
		217	2.30	1	8.70
		6	5.70		-
		143	6.30	0.75	8.50
		153	4.50	7	8.00
		210	3.30		-
10	Alur	30	6.00	2.5	8.10
		51	6.60		-
11	Tamblur	172	5.90		-
		74	5.70		-
		69	2.70		-
		57	7.20		
		32	5.70		
		99	4.00	0.55	8.80
		68	5.70		
		119	5.70		
		293	7.50	3.5	8.30
		67	6.30		
		4	5.40	2.1	8.60
		1	5.40	2.7	8.20
		297	6.30	1.6	8.00
		296	5.40		
		8	5.70	3.5	8.20
		107	5.40	1.2	8.40
		78	5.10	0.9	8.10
		79	5.03		
		100/4	5.40	1.4	8.40
		80	5.40	1	8.70
		V.S	5.40	3	8.50
		141	3.00		
		144	3.00	1.4	8.50
		140	5.30	1.3	8.50
		148	5.40		
		147	5.60		
		158	5.40		

		154	5.30	2.8	8.10
		167	5.40	16	8.10
		103	4.80	1.6	8.30
		201	5.25	16	8.30
		197	7.50	6	8.30
		171	4.30		
		140	4.70		
		136	3.00		
		123	7.50	2.3	8.00
		82	5.40		
12	Shelgaon	219	2.85	3.4	8.40
		126	3.90		
		57	5.40		
		1	6.40	2.5	8.10
		218	5.95	2.1	8.30
		120	5.30		

(Source: Report of Directorate of Irrigation Research & Development, Pune on Lendi Irrigation Project)

Ground Water table in metre, BGL	No. of Wells
0 to 1.2 m	1
1.2 to 3 m	5
Below 3 m	75
Total	81

(Source: Report of Directorate of Irrigation Research & Development, Pune on Lendi Irrigation Project)

Out of 81 wells, 75 wells have water table 3 m below ground level (BGL) or deep, and only 5 wells have water table shallow than 3 m, BGL. Water samples from 14 wells were collected and analysed for pH and electrical conductivity. The pH and EC of all wells were observed. The pH values range from 8 to 8.90 and electrical conductivity ranges from 0.55 to 7.0 dSm⁻¹. These results indicate higher salt concentration in the water. This is because of the overexploitation of ground water as indicated by deep ground water levels and less groundwater recharge.

Water utilisation (conjunctive use of water)

State	G.C.A. ha	C.C.A. ha	Total I.C.A.	G.W. Use ha	I.C.A. (Surface water)
Maharashtra	19050	16950	15710 (surface water 11000 and Ground water 4710)	4710	11000
Andhra Pradesh	13360	11336	11214 (surface 8907, Ground 2307)	2307	8907
Total	32410	28286	26924	7017	19907

Drinking Water Provision: In the planning, 1.5 Mcum drinking water has been allocated for Udgir Taluka of Latur District of Maharashtra while, for Andhra Pradesh around 6 Mcum water is reserved for the drinking water. Additionally once the project is operational, many small water supply schemes will be undertaken for the villages in the periphery of the reservoir.

8.4.3 Primary Data

Water is the most important input required for crop growth. Irrigation can be defined as replenishment of soil water storage in plant root zone through methods other than natural precipitation. Water sources used in irrigation contain impurities and dissolved salts irrespective of whether they are surface or underground water. The ability of water to dissolve minerals, determines the physical and chemical nature of the surface and ground water.

The surface and ground water quality of the project area may get affected due to various factors. In the present case attempts are made to predict the impacts on available water and on irrigation in the command area.

Accordingly in the study area of proposed Lendi Project, surface and ground water samples in command area were analyzed as per the approved TOR. Various physical, chemical and biological parameters were determined using Standard Methods.

Methodology: The surface and ground water sampling was carried as per Central Pollution Control Board (CPCB) guidelines. The sample containers were properly cleaned and rinsed with sample for three times before it filled. Sample containers were labelled properly and sample code, sampling date was clearly marked on container. Sample identification form was filled at the time of sampling.

- ❖ Surface water samples were collected from well-mixed section of stream about 30 cm below the water surface using a weighted bottle.
- ❖ Ground water samples were collected from two types of wells.
 - *Open dug wells* in use for domestic or irrigation water supply,

- Tube wells fitted with a hand pump or a power-driven pump for domestic water supply or irrigation
- ❖ Weighed sample bottle was used to collect sample from an open well about 30 cm below the surface of the water
- ❖ Samples from the production tube wells were collected after running the well for about 5 minutes
- ❖ For bacteriological samples, when collected from tube wells/hand pump, the spout/outlet of the tube well was sterilized under flame by spirit lamp before collection of sample in container.

The water sampling was conducted at different locations in the command area of the proposed project. The project area has acute water scarcity. The surface and ground sampling was carried out for two seasons.

As a part of primary data collection, sampling stations for surface and ground water were selected and survey was conducted for Pre & Post monsoon season in 2008. The parameters for which the samples were assessed are provided in table 8.15.

Table 8.15 List of Sampling Stations for Ground Water Quality

Sr. No.	Code	Name of sampling Station	Description
1	GW 1	Makani – Command (MH)	Water used for drinking and other utility.
2	GW 2	Unhali – Command (MH)	Bore well water. Regularly used for drinking purpose.
3	GW 3	Chainpur – Command (MH)	Bore well water. Regularly used for drinking purpose.
4	GW 4	Tamlur – Command (MH)	Bore well water used for drinking purpose.
5	GW 5	Shahpur – Command (MH)	Bore well water used for drinking purpose
6	GW 6	Magha – Command (MH)	Bore well water used for drinking purpose
7	GW 7	Khadgaon – Command (MH)	Bore well water used for drinking purpose
8	GW 8	Sonala – Command (AP)	Hand Pump
9	GW 9	Limbur – Command (AP)	Bore well
10	GW 10	Hasan Takli – Command (AP)	Bore well
11	GW 11	Shirpur – Command (AP)	Bore well
12	GW 12	Hipparga – Command (AP)	Hand pump

13	GW 13	Yelgaon – Command (AP)	Bore well
14	GW 14	Dongali – Command (AP)	Bore well
15	GW 15	Khatgaon – Command (AP)	Bore well
16	GW 16	Shetloor – Command (AP)	Bore well
17	GW 17	Hasgul – Command (AP)	Bore well
18	GW 18	Dhoti – Command (AP)	Bore well
19	GW 19	Mallapur – Command (AP)	Bore well
20	GW 20	Sulthan Peth – Command (AP)	Bore well
21	GW 21	Mogha – Command (AP)	Bore well

The surface water was collected from 10 sampling stations; details are provided in the table below.

Table 8.16 List of Sampling Stations for Surface Water Quality

Sr. No.	Sampling Stations Code	Name of Sampling Station	Description
1	SW1	Barhali - Catchment (MH)	Small stream, lot of anthropogenic activities observed.
2	SW 2	Hatral - Catchment (MH)	Medium stream, lot of anthropogenic activities observed.
3	SW3	Lendi River – Catchment (MH)	Stagnant river water, lot of anthropogenic activities observed.
4	SW 4	Khambalwadi – Command (MH)	Small stream, tributary of Tiru river. Water clear with less of anthropogenic activities.
5	SW 5	Chainpur – Command (AP)	Minor Irrigation tank
6	SW6	Tamlur – Command (MH)	Small stream flowing along the agricultural fields
7	SW 7	Shahpur – Command (MH)	Small stream flowing along the agricultural fields
8	SW8	Menoor – Command (AP)	Minor irrigation tank, Small stream flowing along the agricultural fields; lot of anthropogenic activities observed.
9	SW 9	Sultanpeth – Command (AP)	Small irrigation tank, lot of anthropogenic activities observed
10	SW 10	Unhali Command (MH)	MI tank

MH – Maharashtra, AP – Andhra Pradesh



GENERAL NOTES			CATCHMENT AREA 1594 Sq Km.		LEGEND	
COMMAND AREA IN	MAHARASHTRA	ANDHRA	TOTAL	CANAL	1. DAM LINE	
State	STATE	PRADESH		a. MAHARASHTRA	2. RESERVOIR	
CA CANAL	11,000 Ha	8,907 Ha	19,907 Ha	b. ANDHRA PRADESH	3. STATE BORDER	
G.W.	4,710 Ha	2,307 Ha	7,017 Ha		4. PACCA ROAD	
TOTAL	15,710 Ha	11,214 Ha	26,924 Ha		5. LEFT CANAL (MAH)	
					6. RIGHT CANAL (AP)	
					7. COMMAND AREA (MAH)	
					8. COMMAND AREA (AP)	
					9. K.T. WARE	
					10. COMMON CARRIER CANAL	

Figure 8.2 Sampling Stations of Surface and Ground Water Quality

Table 8.17 Parameters for Surface and Ground Water Quality Assessment

Sr. No.	Parameter
Parameters for Surface Water Quality Assessment	
1	pH
2	Electrical Conductivity
3	Chlorides (Cl)
6	Sulphates (SO ₄)
7	Sodium (as Na)
8	Potassium (as K)
9	Nitrate as NO ₃ ⁻
10	Iron (as Fe)
11	Manganese (as Mn)
12	Copper (as Cu)
13	Zinc (as Zn)
14	Boron(as B)
Parameters for Ground Water Quality Assessment	
1	pH
2	Color
3	Electrical Conductivity
4	Total Hardness (as CaCO ₃)
5	Sodium (as Na ⁺)
6	Potassium (as K)
7	Calcium (as Ca ⁺⁺)
8	Magnesium (as Mg ⁺⁺)
9	Chlorides (as Cl ⁻)
10	Sulphate (as SO ₄ ⁻⁻)
11	Manganese (as Mn)
12	Copper (as Cu)
13	Iron (as Fe)
14	Zinc (as Zn)
15	Boron (as B)

Table 8.18 Ground Water Analysis Report of Post monsoon season

Sample code	Village Name	pH	EC (dSm ⁻¹)	Calcium (meq/Lit)	Magnesium (meq/Lit)	Ca : Mg	Sodium (meq/Lit)	Potassium (meq/Lit)	CO ₃ (meq/Lit)	HCO ₃ (meq/Lit)	Chlorides (meq/Lit)	Sulphate (meq/Lit)	SAR	RSC (meq/Lit)
GW-1	Makhani	7.08	0.96	2.00	3.00	5.00	6.10	0.100	0	6.4	6.0	5.50	3.86	1.4
GW-2	Unhali	7.62	0.76	1.40	2.80	4.20	5.60	0.005	0	6.0	6.0	6.80	3.88	1.8
GW-3	Chainpur	7.46	0.65	1.60	2.60	4.20	5.60	0.005	0	7.2	7.2	7.50	3.88	3.0
GW-4	Tamlur	7.45	0.87	2.00	3.00	5.00	6.10	0.005	0	7.0	6.0	5.90	3.86	2.0
GW-5	Shahpur	7.20	0.98	2.00	5.60	5.60	6.10	0.100	0	8.0	8.4	6.45	3.65	2.4
GW-6	Magha	7.49	0.90	2.00	4.60	6.60	5.90	0.100	0	8.8	8.2	7.20	3.25	2.2
GW-7	Khadgaon	7.61	0.85	1.60	2.80	4.40	5.60	0.100	0	6.0	8.4	6.25	3.78	1.6

Sample Code	Village Name	Fe (mgL ⁻¹)	Mn (mgL ⁻¹)	Zn (mgL ⁻¹)	Cu (mgL ⁻¹)
GW-1	Makhani	1.9	0.3	0.2	0.1
GW-2	Unhali	1.3	0.4	Trace	0.1
GW-3	Chainpur	1.1	0.5	Trace	0.1
GW-4	Tamlur	1.9	0.2	0.1	0.2
GW-5	Shahpur	1.5	0.4	Trace	0.2
GW-6	Magha	1.8	0.4	0.1	0.3
GW-7	Khadgaon	1.8	0.4	Trace	0.4

Table 8.19 Ground Water Analysis Report of summer season

Sample code	Village Name	pH	EC (dSm ⁻¹)	Calcium (meq/Lit)	Magnesium (meq/Lit)	Ca : Mg	Sodium (meq/Lit)	Potassium (meq/Lit)	CO ₃ (meq/Lit)	HCO ₃ (meq/Lit)	Chlorides (meq/Lit)	Sulphate (meq/Lit)	SAR	RSC meq /Lit)
GW1	Makhani	7.85	1.25	8.5	2.5	0.29	28.75	1.31	0	8.6	4	5	4.33	2.4
GW2	Unhali	7.82	1.34	7.0	4.2	0.6	31.25	1.18	0	5.8	5.2	4.97	4.19	3.4
GW3	Chainpur	7.52	0.76	2.7	2.1	0.78	30	0.03	0	5.8	2.8	5.34	4.3	1.0
GW4	Tamlur	7.75	1.9	5.7	6.5	1.14	150	0.22	0	8	9.2	5	3.98	4.2
GW5	Shahpur	7.76	2.19	4.8	0.6	0.13	16.25	0.04	0	6	2	5.14	3.91	0.6
GW6	Magha	8.20	0.94	2.8	1.8	0.64	67.5	0.31	0	7.8	2.6	5	4.41	3.2
GW7	Khadgaon	7.59	0.67	2.7	1.7	0.63	42.5	0.1	0	6.4	2	5	4.72	2.0

Sample Code	Village Name	Fe (mgL ⁻¹)	Mn (mgL ⁻¹)	Zn (mgL ⁻¹)	Cu (mgL ⁻¹)
GW-1	Makhani	1.5	0.25	Trace	0.1
GW-2	Unhali	1.3	0.30	Trace	0.1
GW-3	Chainpur	1.1	0.45	Trace	0.1
GW-4	Tamlur	1.9	0.20	0.1	0.2
GW-5	Shahpur	1.5	0.30	Trace	0.2
GW-6	Magha	1.8	0.30	0.1	0.3
GW-7	Khadgaon	1.8	0.30	Trace	0.4

Table 8.20 Water Quality Standards in India (Source IS 2296:1992)

Characteristics	Irrigation, Industrial Cooling, Controlled Waste disposal
Dissolved Oxygen (DO)mg/l, min	-
Biochemical Oxygen demand (BOD)mg/l, max	-
Total coli form organisms MPN/100ml, max	-
pH value	6.0-8.5
Colour, Hazen units, max.	-
Odour	-
Taste	-
Total dissolved solids, mg/l, max.	2,100
Total hardness (as CaCO ₃), mg/l, max.	-
Calcium hardness (as CaCO ₃), mg/l, max.	-
Magnesium hardness (as CaCO ₃), mg/l, max.	-
Copper (as Cu), mg/l, max.	-
Iron (as Fe), mg/l, max.	-
Manganese (as Mn), mg/l, max.	-
Chlorides (as Cu), mg/l, max.	600
Sulphates (as SO ₄), mg/l, max.	1,000
Nitrates (as NO ₃), mg/l, max.	-
Fluorides (as F), mg/l, max.	-
Phenolic compounds (as C ₂ H ₅ OH), mg/l, max.	-
Mercury (as Hg), mg/l, max.	-
Cadmium (as Cd), mg/l, max.	-
Salenium (as Se), mg/l, max.	-
Arsenic (as As), mg/l, max.	-
Cyanide (as Pb), mg/l, max.	-
Lead (as Pb), mg/l, max.	-
Zinc (as Zn), mg/l, max.	-
Chromium (as Cr ⁶⁺), mg/l, max.	-
Anionic detergents (as MBAS), mg/l, max.	-
Barium (as Ba), mg/l, max.	-
Free Ammonia (as N), mg/l, max	-
Electrical conductivity, micro-mhos/cm, max	2,250
Sodium adsorption ratio, max	26
Boron, mg/l, max	2

Table 8.21 FAO Guidelines for Evaluating the Quality of Water for Irrigation

Water class	Sodium (Na) %	Electrical conductivity (dS/m)	SAR	RSC Meq/l
Excellent	< 20	0.25	< 10	< 1.25
Good	20 - 40	0.25-0.75	10 - 18	1.25 - 2.0
Medium	40 - 60	0.75-2.250	18 - 26	2.0 - 2.5
Bad	60 - 80	2.250-4.0	> 26	2.5 - 3.0
Very bad	> 80	> 4.0	> 26	> 3.0

SR. NO.	QUALITY FACTOR	DEGREE OF RESTRICTION OF USE		
		None	Slight to Moderate	Severe
1	Electrical Conductivity in dS/m	< 0.7	0.7 - 3.0	> 3.0
2	Total Dissolved Solids in mg/L	< 450	450 - 2000	> 2000
3	Sodium Adsorption Ratio (SAR)	< 3	3 - 9	> 9
4	Chloride in me/L	< 4	4 - 10	> 10
5	Boron in mg/L	< 0.7	0.7 - 3.0	> 3.0
6	Nitrogen (NO ₃ - N) in mg/L	< 5	5 - 30	> 30
7	Bicarbonate (HCO ₃) in me/L	< 1.5	1.5 - 8.5	> 8.5
8	pH	Normal Range 6.5 - 8.4		

8.4.4 Ground Water Quality

pH: pH of ground water indicates that the water is slightly alkaline though the values are within the prescribed limit (6.0 -8.5). The values recorded during the post monsoon season were in the range of 7.2 to 7.61 while the values for the summer season range from 7.52 to 8.2. Slightly higher pH values were observed in summer season over the post monsoon season.

The higher pH values are normally associated with the presence of carbonate, and bicarbonates and salts of calcium and magnesium in the ground water. Areas that have shown increase in the pH levels are situated at slightly lower elevations, and include the villages Unhali, Khadgaon, Makhani, Tamlur, Magha, Shahpur etc.

Electrical Conductivity (EC): Electrical conductivity measures the ionic concentration of water. Electrical conductivity of ground water was observed for two seasons (Post

monsoon and summer season). The observations indicated that the conductivity levels were higher in summer season as compared to the post monsoon. The values of EC during the post monsoon season were ranging from 0.65 to 0.96 (dSm^{-1}) while the values recorded for summer season were in the range of 0.67 to 2.19 (dSm^{-1}). The electrical conductivity of ground water samples are found to be in range of medium water class (ref: CPCB), though among the sites, Shapur for both the seasons and Chainpur in post-monsoon while Tamlur in summer have recorded higher levels. This may be due to the depleted ground water table in these areas.

Cationic constituents

Calcium (Ca): Calcium concentration in the ground water is dependent on the solubility of CaCO_3 , calcium sulphate (CaSO_4) and very rarely chlorides. The calcium levels were examined for two seasons. The values of for the post monsoon season range from 1.4 to 2.0 (meq/Lit). The observed values are well within the prescribed limits. However, there is increase in the levels during the summer season (2.7 to 8.5 meq/Lit). The higher levels in summer may indicate presence of calcium carbonate in the ground water. However the observed values are well within the BIS drinking water standards.

Magnesium: The values of Magnesium were observed in post monsoon season range from 2.6 to 5.6 (meq/Lit). The highest magnesium value recorded at village Shanpur and lowest at village Chainpur. The average values of magnesium observed were 3.4 meq/Lit and 2.7 meq/Lit in post monsoon and summer season respectively. For the magnesium, higher values were recorded in post monsoon as compared to summer. However the observed values are well within the BIS drinking water standards.

Sodium: The sodium concentration in ground water ranges from 5.6 to 6.1 meq/Lit in post monsoon and 16.25 to 150 meq/Lit in summer. Higher Sodium concentration is reported in summer. Higher sodium levels are found in water samples collected from Tamlur, Magha and Khadgaon sampling stations. This is possibly due to the depleted ground water table and stagnation or low discharge. In such situations, sodium levels are known to build up.

Potassium: The potassium concentration in ground water ranges from 0.005 to 0.100 meq/Lit and 0.03 to 1.31 meq/Lit for the post monsoon and summer seasons respectively. The potassium level in ground water is very low.

Anionic constituents:

Bicarbonates: Reported pH values that are greater than the 7, indicates presence of carbonate in the form of bicarbonate ions. The bicarbonate concentration in ground water ranges from 5.8 to 8.6 meq/Lit and 6.0 to 8.8 meq/Lit in summer and post monsoon season respectively. This Bicarbonate concentration is well within the limit. The highest recorded level was 8.8 meq/Lit at village Magha which is considered to be moderate.

Chlorides: The chloride in the ground water originates from chloride bearing minerals such as sodalite and chlorapatite. These minerals are minor constituents of igneous and metamorphic rocks. Chlorides levels up to 10 meq/Lit are considered as moderate. The recorded level ranges from 6.0 to 8.4 meq/Lit and 2 to 9.2 meq/Lit in post monsoon and summer season respectively. Higher chlorides are normally associated with anthropogenic activities.

Sulfates: Recorded values of sulphates ranges from 4.97 to 5.14 meq/Lit and 5.5 to 7.5 meq/Lit in post monsoon and summer season respectively. The higher sulphate concentration is observed in low lying areas that receives irrigation. Higher sulphate concentration in post the monsoon may be due to application of sulphate rich chemical fertilizers in the soil. All the values recorded are within the prescribed limits of FAO (1000mg/Lit).

The water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. Sodium adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

Sodium adsorption Ratio (SAR): Sodium Adsorption Ratio (SAR) is an expression pertaining to cation make up of water and soil solution and is used for characterizing the

sodium hazard of irrigation water. SAR value is used to calculate the degree to which irrigation water tends to enter into cation exchange section in the soil. The main problem with high sodium concentration is its effect on soil permeability. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicates soil structure damage.

Values of SAR recorded for the study area ranges from 3.25 to 3.88 and 3.91 to 4.72 in post monsoon and summer season respectively. The observed SAR values for both the seasons are well below the desired levels. All results show the excellent ground water quality for irrigation use.

Residual Sodium carbonate: Residual Sodium Carbonate (RSC) is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels. The classification of ground water samples based on SAR and RSC values for its suitability for irrigation purpose is shown below

The quantity of bicarbonate and carbonate in excess of alkaline earth influences the suitability of water for irrigation purposes. The results show the RSC concentration ranges from 1.4 to 3.0 and 3.2 to 4.2 in post monsoon and summer season respectively. The higher RSC (3.2) concentration recorded at Magha village in summer season.

Micronutrients: In the present study, all the results of ground water samples shows the iron concentration ranges from 1.1 to 1.9 mgL^{-1} and 1.2 to 1.5 mgL^{-1} in post monsoon and summer season respectively. The recorded Iron concentration in ground water is within the prescribed limit of FAO (5.0 mgL^{-1}).

Copper ranges from 0.1 to 0.4 and 0.1 to 0.4 mgL^{-1} in post monsoon and summer season respectively. Copper concentration in ground water is slightly higher.

Manganese ranges from 0.2 to 0.5 and 0.25 to 0.45 mgL^{-1} in post monsoon and summer season respectively. Some samples have shown higher manganese concentration in ground water.

Ground water samples have shown Zinc in trace quantity.

8.4.5 Surface Water Quality

Table No. 8.22 Results of surface water quality in post monsoon season

Sr. No	Sample Code	Village Name	Parameters											
			pH	EC (dSm ⁻¹)	CO ₃ ²⁻ (meqL ⁻¹)	HCO ₃ ⁻ (meqL ⁻¹)	Ca ²⁺ (meqL ⁻¹)	Mg ²⁺ (meqL ⁻¹)	Cl ⁻ (meqL ⁻¹)	Na ⁺ (meqL ⁻¹)	K ⁺ (meqL ⁻¹)	RSC (meqL ⁻¹)	SAR	Mg : Ca
1	SW1	Barhali	7.72	0.71	Absent	7.20	3.50	3.30	5.80	18.75	0.06	0.40	10.19	0.94
2	SW2	Hatral	7.79	0.37	Absent	4.00	1.70	1.70	1.80	15.00	0.10	0.60	11.54	1.00
3	SW3	Lendi river	7.71	0.54	Absent	4.10	1.70	2.30	2.20	28.75	0.31	0.10	20.39	1.35
4	SW4	Khambalwadi	7.44	0.50	Absent	7.80	2.80	1.80	2.00	15.00	0.18	3.20	9.93	0.64
5	SW5	Chainpur	7.60	0.90	Absent	6.20	1.10	1.50	8.00	85.00	2.23	3.60	74.56	1.36
6	SW6	Tamlur	8.03	1.02	Absent	6.00	4.30	2.50	5.60	77.50	0.51	-0.80	42.12	0.58
7	SW7	Shahpur	7.81	0.64	Absent	4.40	1.90	1.50	3.80	40.00	1.15	1.00	30.17	0.79
8	SW8	Menoar	6.99	0.49	Absent	2.80	1.10	2.90	6.60	42.50	0.67	1.20	30.14	2.64
9	SW9	Sultanpeth	7.66	0.54	Absent	6.40	1.30	1.30	2.20	51.25	0.28	3.80	44.96	1.00
10	SW10	Unhali	7.32	2.60	Absent	9.00	2.50	5.50	8.80	87.50	0.06	1.00	29.17	6.20

Sr. No.	Sample Code	Village Name	Parameters			
			Fe (mgL ⁻¹)	Mn (mgL ⁻¹)	Zn (mgL ⁻¹)	Cu (mgL ⁻¹)
1	SW1	Barhali	0.8	0.2	Trace	0.4
2	SW2	Hatral	0.9	0.6	Trace	0.3
3	SW3	Lendi river	1.0	0.6	Trace	0.3
4	SW4	Khambalwadi	1.4	0.6	Trace	0.2
5	SW5	Chainpur	1.1	0.3	Trace	0.1
6	SW6	Tamlur	1.1	0.5	Trace	0.3
7	SW7	Shahpur	1.8	0.4	Trace	0.2
8	SW8	Menoar	15.5	0.5	Trace	0.1
9	SW9	Sultanpeth	0.8	0.5	Trace	0.1
	SW10	Unhali	0.8	0.6	Trace	0.2

Table No.8.23 Results of surface water quality in summer season

Sr. No.	Parameters	Menoor	Unhali	Rec. max conc. by FAO use continuously*	Rec. max conc. by FAO, use up to 20 years*
1	pH	7.40	7.60	6.5-8.4 (1-14)	
2	EC (dSm-1)	0.55	0.67	<0.75 (0-3)	
3	CO ₃ - - (meqL-1)	Nil	Nil	(0-1.0)	
4	HCO ₃ -(meqL-1)	6.50	7.40	<1.5(0-10)	
5	Ca++ (meqL-1)	1.40	1.40	(0-20)	
6	Mg++ (meqL-1)	4.40	6.80	(0-5)	
7	Cl- (meqL-1)	6.00	6.15	<4 (0-30)	
8	Na+ (meqL-1)	6.20	7.20	<3 (0-40)	
9	K+ (meqL-1)	0.15	0.15	(0-2)	
10	RSC (meqL-1)	0.70	-0.8	<1.25	
11	SAR	3.6	8.13	<0-10 (0-15)	
12	Mg : Ca	4.30	7.33		
13	Fe (mgL ⁻¹)	0.25	0.3	<5.0	20.0
14	Mn (mgL ⁻¹)	0.52	0.65	<0.2	10.0
15	Zn (mgL ⁻¹)	Trace	Trace	<2.0	10.0
16	Cu (mgL ⁻¹)	0.12	0.25	<0.2	5.0

*Ayers and Westcot-1976: Water quality for agriculture: Irrigation and Drainage paper-FAO, Rome; Values in parenthesis indicate normal range in irrigation water.

Surface water quality –Post Monsoon: Although quality of water was observed good for many parameters for continuous use, for some parameters, it was only suitable for a period up to 20 years. The levels of carbonates, ca, mg, K, Zn and Cu were good for all the sites. While Sodium levels were higher for all sites and HCO₃ were slightly higher for all the sites.

Among other parameters EC levels were higher for Tamlur and Unhali, chlorides for all except for the Hatral, RSC slightly higher for Chainpur, Khambalwadi and Sultanpeth and SAR all the sites except Khambalwadi were observed higher.

Among the trace elements Cu and Zn was within the limits while Mn was higher for all the sites except for the Barhali and Fe was within the limits except for Menoor.

Surface water quality –Summer Season: During summer, water was only available in Menoor and Unhali and thus data was presented only on these sites.

Although quality of water was observed good for many parameters for continuous use, for some parameters, it was only suitable for a period up to 20 years. The levels of EC, carbonates, ca, K, RSC, SAR, Fe, and Zn were good for all the sites.

While bicarbonates, Chlorides, Mn and Na were higher for both the sites, only Unhali has recorded higher values of Sodium, Magnesium, and Cu levels.

8.5 Conclusion

8.5.1 Ground Water Quality: Ground water level in the command area is deeper than 3 m below the ground which indicates that the command area is suitable for irrigation. However some areas, where in the groundwater level is shallow, require undertaking of specific measures as illustrated in earlier sections. Over the years, the groundwater level is getting deeper and was a cause of concern.

The pH of all ground water samples is normal and water is found to be potable after adequate disinfection measures. The levels of Sodium and Fe observed to be higher, indicating anthropogenic activities.

8.5.2 Surface Water Quality: Though the water is slightly hard, pH and EC are within the normal limits. Water is found suitable for continuous irrigation, though for some parameters its use up to 20 years is advised. Accumulation of salt and slightly higher mineral level is may be due to the extremely dry conditions prevailing in the region. Water quality is likely to improve by the process of dilution, which is likely to occur after the inception of additional water.

CHAPTER – 9

ECOLOGICAL STUDIES

CHAPTER 9.0 ECOLOGICAL STUDIES

9.1 Introduction

This Chapter covers the terrestrial and aquatic ecological status of the area. The floral and faunal studies were conducted for the entire catchment, submergence and command area. Additionally it documents species of ethno-botanical importance and species of conservation concern as per Wildlife Protection Act and IUCN Red-list.

Ecological studies helps in evaluation of impacts viz. deforestation/ tree cutting and shrinkage of animal habitat, impact on flora and fauna (terrestrial and aquatic) due to the interventions of the proposed project. This involves identification of rare and endangered species, endemic species and migratory path/ route of animals and status on breeding and nesting.

The sites for terrestrial and aquatic ecology sampling were identified during the reconnaissance survey and sampling was carried out thereafter. The detailed sampling was undertaken for assessing the baseline status of terrestrial and aquatic ecology.



Antelope cervicapra (Linnaeus, 1758) (Blackbuck) in the project area

9.2 Vegetation Studies

To obtain the baseline information of the vegetation, detailed phytosociological studies were undertaken covering sampling stations spread across the command and the catchment area of the proposed project.

Sampling Season: The studies were carried out in monsoon, post monsoon and winter seasons. The available secondary data was incorporated in the report.

9.2.1 Terrestrial Ecology - Phytosociological Studies

Methods: For the vegetation study, stratified quadrat sampling method is used across the submergence, catchment and command area. The vegetation sampling was carried out at 7 different locations. And each location 8 to 10 quadrat of size 10 X 10 m was taken. The qualitative and Quantitative information such as species richness and diversity, abundance and density and diversity indices were obtained from the transect method.

Table 9.1 Characteristics of Sampling Stations for Terrestrial Ecology

Sr. No.	Sampling Stations Code	Name of Sampling Stations	Description
1	TE1	Submergence	Submergence area, highly degraded vegetation
2	TE 2	Halni – Udgir Road – Command (MH)	Ghat section, upper reaches of Catchment
3	TE 3	Unhali – Khanapur road (MH)	Vegetation at the hill slopes and foot hills along the road.
4	TE 4	Dabka Raja – Catchment (MH)	Catchment area
5	TE 5	Hatral – Catchment (MH)	Hilly terrain, represents high elevation vegetation of the catchment
6	TE 6	Marapalli (AP)	Old check dam, silted, command area of Andhra Pradesh (AP)
7	TE 7	Madnoor (AP)	Command of Andhra Pradesh (AP)

The detailed analyses of terrestrial ecological sampling data are given below:

1. Submergence: The submergence region shows much degraded vegetation. Species diversity is moderate with 16 species reported from the region. The most abundant species in the region are *Butea* sp. and *Prosopis cineraria*, which occur in the frequency class E. The next abundant species in the frequency class D are *Acacia nilotica*, *Calotropis* sp, *Ipomoea* sp. and *Vitex negundo*. These species show uniform distribution. Species occupying less abundant class (B) are *Ailanthus excelsa*, *Azadirachta indica*, *Mangifera indica* and *Morinda citrifolia*. *Azadirachta indica*, *Acacia nilotica* are often observed along the borders of agricultural area.

The presence of invasive weed like *Lantana camara* in the frequency class C indicates degraded vegetation cover in the area. Other abundant species like *Azadirachta indica*, *Acacia nilotica*, *Calotropis gigantea*, and *Pongamia pinnata* represent common species with no rare elements. *Prosopis cineraria* occurring in the most abundant frequency class is a tree which grows in dry and arid regions. In areas of its natural distribution, the climate is characterised by extremes of temperature the plains or gently undulating ground and ravine country and seldom extends into the hills. The present plant species indicate moisture deficient conditioning. It is seen at their growth of trees on alluvial soil is better.

Some of the species are used as timber for homes, and promotes soil conservation and is of considerable medicinal use. *Butea* is most abundant frequency class E. *Vitex negundo* which occurs in the next abundant frequency class D is a large aromatic shrub. The leaves possess discutient properties and are used in rheumatic swellings of the joints and in sprains. They show anti-inflammatory, antibacterial, antifungal and analgesic activities.

Table 9.2 Phytosociological Study of the Submergence

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia nilotica</i> (L.) Delile.	80	15.02	8.00	D
<i>Ailanthus excelsa</i> Roxb.	40	2.58	2.75	B
<i>Azadirachta indica</i> Juss.	30	1.17	1.67	B
<i>Butea monosperma</i> L.	90	7.28	3.44	E
<i>Calotropis gigantea</i> (L.) Ait.	70	3.52	2.14	D
<i>Cassia auriculata</i> L.	60	3.76	2.67	C
<i>Ficus hispida</i> L.	20	2.35	5.00	A
<i>Ipomoea carnea</i> Jacq.	80	12.91	6.88	D

<i>Jatropha gossypifolia</i> L.	20	2.35	5.00	A
<i>Lantana camara</i> L.	50	4.93	4.20	C
<i>Mangifera indica</i> L.	30	1.64	2.33	B
<i>Morinda citrifolia</i> L.	40	5.16	5.50	B
<i>Pongamia paniculata</i> Wight ex Benth.	90	9.15	4.33	E
<i>Prosopis cineraria</i> Druce.	90	21.13	10.00	E
<i>Solanum xanthocarpum</i>	20	2.82	6.00	A
<i>Vitex negundo</i> L.	80	4.23	2.25	D

2. Command MH- Halni: The area shows uniform distribution of *Anona squamosa*, *Azadirachta indica*, *Morinda citrifolia* and *Tectona grandis* in the frequency class E. *Morinda citrifolia* is indicative of highly disturbed scrub vegetation. *Butea* species occur in fairly uniform distribution in the frequency class D. Species like *Acacia arabica*, *Acacia concinna*, *Acacia nilotica* occur in the next abundant class C. *Cassia auriculata* and *Gloriosa superba* occur in the frequency class C. The species diversity is poor with only 12 species reported from the area. *Anona squamosa* is a tree of about 20 feet height, which is being cultivated, and becoming naturalized throughout India. The bruised leaves are used for destroying worms found breeding in sores. *Azadirachta indica* is a tree of about 40-50 feet height with a straight trunk and is cultivated throughout the region and self propagating. This plant has got various medicinal, bactericidal and insecticidal properties. Almost the whole plant is being utilized some way or the other. *Morinda citrifolia* occurs as a small glabrous tree. These are cultivated widely in many places throughout the project area but not truly wild. The roots furnish a valuable red dye. *Tectona grandis* is a large deciduous tree. It is the well-known teak tree. It grows abundantly along the slopes of the Western Ghats. The *Acacia* species are found throughout the region except in moist regions near the coast and widely planted in the region in tropical climatic conditions. *Acacia concinna* is an extensive climbing shrub armed with numerous small hooked prickles. This is common in moist forests of the region. The pods are used for washing hair and feature significantly as a trading commodity. Species like *Cassia auriculata*, *Acacia nilotica* and *Azadirachta indica* are typical representatives of water scarce region. Species diversity is poor with 12 species recorded in the region.

Table 9.3 Phytosociological Study of the Command MH- Halni

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia arabica</i> (Lam.) Muhl. ex	60	4.02	2.33	C
<i>Acacia concinna</i> DC.	60	4.02	2.33	C
<i>Acacia nilotica</i> (L.) Delile.	60	4.60	2.67	C
<i>Anona squamosa</i> L.	100	17.24	6.00	E
<i>Azadirachta indica</i> Juss.	100	21.84	7.60	E
<i>Butea monosperma</i> L.	80	10.34	4.50	D
<i>Cassia auriculata</i> L.	40	1.72	1.50	B
<i>Cassia fistula</i> L.	20	0.57	1.00	A
<i>Gloriosa superba</i> L.	40	5.75	5.00	B
<i>Gymnosporia montana</i> Roth	20	0.57	1.00	A
<i>Morinda citrifolia</i> L.	100	15.52	5.40	E
<i>Tectona grandis</i> L.	100	13.79	4.80	E

3. Command MH -- Unhali -- Khanapur: The plant diversity in Khanapur is moderate with 17 species. *Acacia nilotica*, *Cassia auriculata*, *Prosopis juliflora*, *Tectona grandis* in the frequency class E show uniform distribution. Species like *Azadirachta indica*, *Prosopis cineraria* in the frequency class D and *Butea* sp, *Dalbergia sissoo*, *Ficus bengalensis* in the frequency class C also show moderately uniform distribution in the region. *Ailanthus excelsa* in the frequency class A show a scattered distribution. This is a lofty deciduous tree found generally around villages and broken grounds but is seldom found in forests. It is able to adapt itself to a variety of soils from loamy to sandy soils. It prefers well-drained soil and avoids clayey and waterlogged soils. This plant grows well in semi-arid and semi-moist regions and has been found suitable for planting in dry areas with annual rainfall of about 400 mm. It is a relatively salt-tolerant species. *A. excelsa* is grown as a shade and avenue tree throughout most of the hotter parts of India. The trees serve as shelterbelts along borders of fields. *Acacia nilotica* and *Azadirachta indica* are often observed along the borders of agricultural fields. *Azadirachta indica* shows its presence widely in the project area. This species is common in the villages of the command area. A tall much branched shrub like *Cassia auriculata* occurs in the region in the abundant class E. It is very common in the dry regions. The bark is a most valuable tanning material and the seeds are used medicinally. *Tamarindus indica* is observed throughout the tropical region. It is fairly common in the command area as well. It is a large tree cultivated or self-sown throughout the region. The tree is of great value with almost all its parts being useful.

Zizyphus jujuba occurs as a small tree or a large shrub. It is extensively cultivated in the region for its edible fruit and for its timber. *Cocos nucifera* is found in tropical shore-lines. Coconut is one of the ten most useful trees in the world is being cultivated by farmers & houses providing food for millions of people, especially in the tropics. *Dalbergia sissoo*, which occurs fairly uniformly in the command area, is typical representative of water scarce region. *Prosopis juliflora* is an evergreen tree with a large crown and an open canopy, growing to a height of 5-10 m. It occurs naturally in dry areas. *Tectona grandis* or, sagon is a large deciduous tree well known for its high-grade timber. *Ficus bengalensis* is a very large tree and is widely planted often near temples and shrines. It is universally planted but not wild in the region. These trees are held in great veneration by the Hindus.

Table 9.4 Phytosociological Study of the Command MH -- Unhali – Khanapur

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia nilotica</i> (L.) Delile.	100	25.52	14.60	E
<i>Ailanthus excelsa</i> Roxb.	20	0.70	2.00	A
<i>Azadirachta indica</i> Juss.	80	4.55	3.25	D
<i>Bauhinia racemosa</i> Lam.	20	1.05	3.00	A
<i>Butea monosperma</i> L.	60	7.34	7.00	C
<i>Cassia auriculata</i> L.	100	15.73	9.00	E
<i>Cocos nucifera</i> L.	20	1.05	3.00	A
<i>Dalbergia sissoo</i> Roxb.	60	6.29	6.00	C
<i>Eucalyptus</i> sp.	40	1.75	2.50	B
<i>Ficus bengalensis</i> L.	60	2.80	2.67	C
<i>Ficus religiosa</i> L.	40	1.75	2.50	B
<i>Mangifera indica</i> L.	20	1.75	5.00	A
<i>Prosopis cineraria</i> Druce.	80	9.79	7.00	D
<i>Prosopis juliflora</i> (Sw.) DC.	100	4.55	2.60	E
<i>Tamarindus indica</i> L.	40	4.20	6.00	B
<i>Tectona grandis</i> L.	100	9.79	5.60	E
<i>Zizyphus jujube</i> Lam.	40	1.40	2.00	B

4. Catchment MH - Dabka Raja: Dabka Raja region shows that all the species like *Azadirachta indica*, *Caesalpinia pulcherrima*, *Cassia auriculata*, *Ipomoea* sp, *Jatropha* sp, *Euphorbia* sp, *Tamarindus indica*, *Acacia leucophloea*, *Acacia nilotica*, *Anona squamosa*, *Gymnosporia* sp, *Mangifera indica*, have a uniform distribution with frequency classes E, D and C respectively. Flora of this area is similar to the previous

survey area. Among large trees *Azadirachta indica* shows its presence widely in the project area

Table 9.5 Phytosociological Study of the Catchment MH - Dabka Raja

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia leucophloea</i> Willd.	60	3.56	4.00	C
<i>Acacia nilotica</i> (L.) Delile.	60	6.23	7.00	C
<i>Anona squamosa</i> L.	60	4.45	5.00	C
<i>Azadirachta indica</i> Juss.	100	8.90	6.00	E
<i>Caesalpinia bonduc</i> (L.) Roxb.	20	0.89	3.00	A
<i>Caesalpinia pulcherrima</i> (L.) Sw.	100	7.42	5.00	E
<i>Capparis deciduas</i> (Forssk.) Edg.	20	0.30	1.00	A
<i>Cassia auriculata</i> L.	100	8.31	5.60	E
<i>Cassia javanica</i> L.	20	0.59	2.00	A
<i>Dalbergia sissoo</i> Roxb.	20	0.59	2.00	A
<i>Euphorbia</i> sp.	80	8.90	7.50	D
<i>Gymnosporia montana</i> Roth	60	3.26	3.67	C
<i>Acaccia leucophloea</i> (Roxb.)	20	0.59	2.00	A
<i>Ipomoea carnea</i> Jacq.	100	13.35	9.00	E
<i>Jatropha gossypifolia</i> L.	100	9.50	6.40	E
<i>Mangifera indica</i> , L.	60	4.45	5.00	C
<i>Martynia annua</i> L.	20	1.48	5.00	A
<i>Oogenia jambulina</i>	20	0.59	2.00	A
<i>Phoenix sylvestris</i> Roxb.	20	0.59	2.00	A
<i>Prosopis cineraria</i> Druce.	20	2.67	9.00	A
<i>Solanum album</i> Larranaga.	40	1.78	3.00	B
<i>Tamarindus indica</i> L.	80	9.50	8.00	D
<i>Terminalia arjuna</i> Wight & Arn.	20	0.59	2.00	A
<i>Terminalia bellerica</i> Roxb.	20	1.48	5.00	A

5. Catchment MH – Hatral: As compare to the previous sites, this region shows poor species diversity as only eight species were reported from the area. *Butea frondosa* is the most abundant species in the frequency class E. When in full flower this tree is a conspicuous and handsome object throughout the jungles. A gum called Bengal Kino is obtained from the bark and the flowers furnish a brilliant but fleeting dye. The vegetation in the area is of dry deciduous type. Vegetation is very sparse and highly degraded with very few woody species represented. 75% of the vegetation occurs in the frequency class A.

Table 9.6 Phytosociological Study of the Catchment MH – Hatral

Species	Frequency	Density	Abundance	Frequency Class
<i>Anona squamosa</i> L.	40	11.63	2.50	B
<i>Azadirachta indica</i> Juss.	20	2.33	1.00	A
<i>Butea frondosa</i> Konig.	100	65.12	5.60	E
<i>Cassia fistula</i> L.	20	2.33	1.00	A
<i>Gymnosporia montana</i> Roth	20	4.65	2.00	A
<i>Madhuca longifolia</i> (L.)	20	4.65	2.00	A
<i>Morinda citrifolia</i> L.	20	6.98	3.00	A
<i>Wrightia tinctoria</i> R.Br.	20	2.33	1.00	A

6. Command AP – Marapalli: Marapalli area shows uniform distribution of *Acacia nilotica*, *Calotropis* sp, *Dalbergia sissoo*, *Prosopis cineraria*, *Vitex negundo* in the frequency class E. *Anona squamosa* occurs in the next abundant frequency class D.

Other abundant species are *Azadirachta indica*, *Cassia siamea* and *Samanea saman*, which occur as moderately abundant species with frequency class C. The species diversity is fairly moderate with 16 species reported in the command area of Andhra Pradesh. All these represent common species in the area with no rare elements.

Table 9.7 Phytosociological Study of the Command AP – Marapalli

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia nilotica</i> (L.) Delile.	100	14.52	23.00	E
<i>Anona squamosa</i> L.	80	1.89	3.75	D
<i>Azadirachta indica</i> Juss.	60	3.28	8.67	C
<i>Balanites aegyptiaca</i> Sands.	20	0.38	3.00	A
<i>Calotropis gigantea</i> (L.) Ait.	100	16.79	26.60	E
<i>Anacardium occidentale</i>	20	1.14	9.00	A
<i>Cassia siamea</i> Lam.	60	2.27	6.00	C
<i>Celastrus paniculatus</i> Willd.	20	0.25	2.00	A
<i>Dalbergia sissoo</i> Roxb.	100	5.18	8.20	E
<i>Mangifera indica</i> L.	20	0.76	6.00	A
<i>Prosopis cineraria</i> Druce.	100	41.67	66.00	E
<i>Samanea saman</i> (Jacq.) Merr.	60	3.66	9.67	C
<i>Tamarindus indica</i> L.	20	0.63	5.00	A
<i>Terminalia tomentosa</i> (Roxb.)	20	0.38	3.00	A
<i>Vitex negundo</i> L.	100	5.30	8.40	E
<i>Zizyphus jujuba</i> Lam.	40	1.89	7.50	B

7. Command AP – Madnoor: Madnoor lying in the command area of the project shows the presence of *Acacia nilotica*, *Albizzia lebbek*, *Azadirachta indica* and *Prosopis cineraria* in the frequency class E which indicates that these species show a

uniform distribution throughout the region. The region shows a low species diversity with only 15 species reported from the aforesaid area. Among large trees *Azadirachta indica* shows its presence widely in the project area. This species is common in the villages of the command area. It grows mainly in hot climatic conditions.

Table 9.8 Phytosociological Study of the Command AP – Madnoor

Species	Frequency	Density	Abundance	Frequency Class
<i>Acacia arabica</i> (Lam.) Willd.	80	11.06	6.25	D
<i>Acacia auriculiformis</i> Benth.	20	0.88	2.00	A
<i>Acacia nilotica</i> (L.) Delile.	100	15.49	7.00	E
<i>Albizia lebbek</i> (L.) Benth.	100	8.85	4.00	E
<i>Azadirachta indica</i> Juss.	100	14.16	6.40	E
<i>Cassia javanica</i> L.	20	0.44	1.00	A
<i>Cassia siamea</i> Lam.	60	5.75	4.33	C
<i>Dalbergia sissoo</i> Roxb.	40	2.21	2.50	B
<i>Eucalyptus</i> sp.	60	6.64	5.00	C
<i>Ficus religiosa</i> L.	20	0.44	1.00	A
<i>Ipomoea carnea</i> Jacq.	80	15.49	8.75	D
<i>Pongamia paniculata</i> Wight ex	40	3.10	3.50	B
<i>Prosopis cineraria</i> Druce.	100	7.52	3.40	E
<i>Samanea saman</i> Merr.	20	2.65	6.00	A
<i>Zizyphus jujuba</i> Lam.	100	5.31	2.40	E

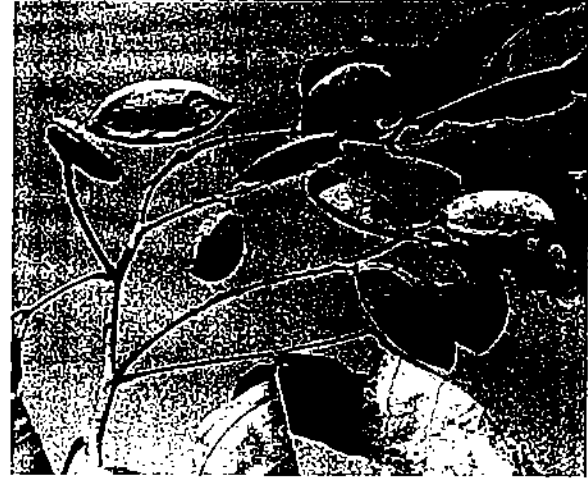
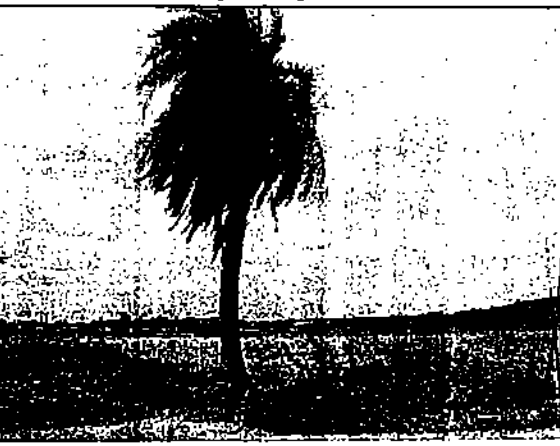
Diversity Indices

Sr. No	Diversity Indices	TE1	TE2	TE3	TE4	TE5	TE6	TE7
1	Simpson 1-D	0.8918	0.8586	0.8713	0.9226	0.5516	0.7677	0.889
2	Shannon H	2.462	2.12	2.359	2.755	1.263	1.9	2.36

Normally, the Shannon index range between 1.5 to 3.5 and rarely goes to 4.5. On the other hand Simpson's Index ranges from 0 to 1 wherein values near 0 indicates fewer species and higher abundance while values closer to 1 indicates many species with low abundances.

From the above table it is concluded that the Simpson Index is close to value 1 in all the locations. It indicates that few species & high abundance of species.

Glimpses of Floral Composition of the Study Area

	
<i>Zizyphus rugosa</i>	<i>Zizyphus jujuba</i>
	
<i>Pongamia pinnata</i>	<i>Woodfordia fruticosa</i>
	
<i>Opuntia mill</i>	<i>Phoenix sylvestris</i>

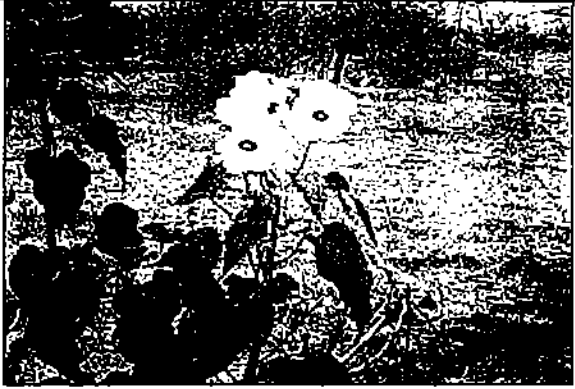
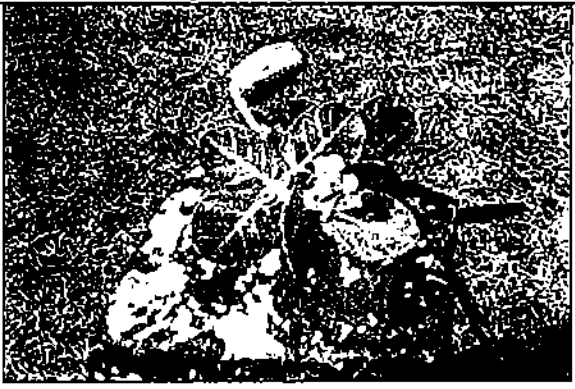
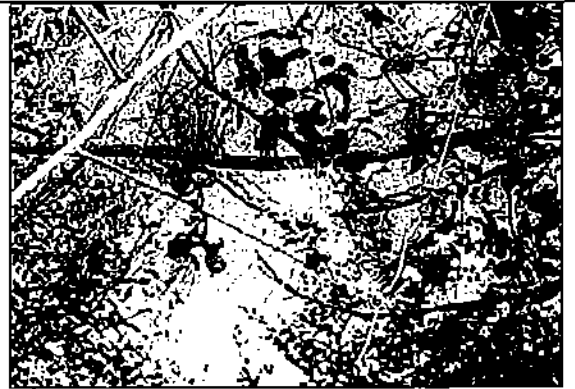
	
<i>Butea monosperma</i>	<i>Ipomoea fistulosa</i>
	
<i>Acacia sp.</i>	<i>Calotropis gigantea</i>
	
<i>Anona squamosa</i>	<i>Capparis sp.</i>
	
<i>Aristolochia indica</i>	<i>Anacardium occidentale</i>

Table 9.9 List of species recorded in the study area during the Study (Monsoon, Winter & Summer Season)

(Classification - as per Benthon & Hooker System)

I) CLASS		DICOTYLEDON			STATUS
A) SUBCLASS		POLYPETALAE			
Series I		Thalamiflorae			
Order 1		Ranales	Lendi List		
Family		Annonaceae			
	1	<i>Annona squamosa</i> L.	Sitaphal	Tree	
	2	<i>Minosa tomentosa</i> (Roxb)		Tree	
Family		Menispermaceae			
	1	<i>Cissampelos pareira</i> L.	Pahad wel	Twining	
	2	<i>Cocculus hirsutus</i> (L.) Thcob	Jaljamni, Vasan Vel	Shrub	
	3	<i>Tinospora cordifolia</i> Miers.	Gulvel	Twining	
Family		Nymphaeaceae			
	1	<i>Nymphaea nouchali</i> Burm.f.	Neel Kamal	Herb	
	2	<i>Nymphaea pubescens</i> Willd	Kamal	Perennial Herb	
Family		Nelumbonaceae			
	1	<i>Nelumbo nucifera</i> Gaertn. Fruct. Sem	Kamal	Aquatic Herb	
Order 2		Paricetales			
Family		Papaveraceae			
	1	<i>Argemone mexicana</i> L.	Pivala Dhotra	Herb	
	2	<i>Fumaria indica</i> (Haussk)		Herb	
Family		Brassicaceae (Cruciferae)			
	1	<i>Brassica juncea</i> (L.) Czern.	Mohari	Herb	

	2	<i>Brassica nigra</i> (L)		Mohri	Herb	
	3	<i>Lepidium sativum</i> L		Aliv	Herb	
Family		Capparaceae				
	1	<i>Capparis deciduas</i> (Forsk.) Edg.		Nepti Karil	Shrub	
	2	<i>Capparis divaricata</i> Lam.		Toaratti	Shrub	
	3	<i>Capparis grandis</i> L.f.		Pachunda	Tree	
	4	<i>Capparis spinosa</i> L.		Wagati	Shrub	
	5	<i>Capparis zeylanica</i> L.		Waghathi	Shrub	
	6	<i>Cadaba fruticosa</i> (L)			Shrub	
Family		Capparaceae (Cleomaceae)				
	1	<i>Cleome chelidonii</i> L.f.			Herb	
	2	<i>Cleome gynandra</i> L. Sp. Pl. ed.		Pandhari Tilwan	Pubescent Herb	
	3	<i>Cleome simplicifolia</i> (Camb.)			Herb	Lower Risk (LR)
	4	<i>Cleome viscosa</i> L. Sp. Pl.		Pivali tilvan	Erect Herb	
Family		Cochlospermaceae				
	1	<i>Cochlospermum religiosum</i> (L)		Ganer	Small Tree	
Family		Flacourtiaceae				
	1	<i>Casearia ovata</i> Roxb.			Tree	
	2	<i>Flacourtia indica</i> (Burm.f.) Merr.		Tambat	Shrub	
Order 3		Polygalineae				
Family		Polygalaceae				
	1	<i>Polygala arvensis</i> Willd			Herb	
	2	<i>Polygala erioptera</i> DC. Prodr.			Herb	
Order 4		Caryophyllaceae				
Family		Caryophyllaceae				
	1	<i>Polycarpaea corymbosa</i> (L.)			Herb	Endemic

	2	<i>Polycarpon prostratum</i> (Forsk.)					
	3	<i>Spergula arvensis</i> L.				Perennial Herb	
	4	<i>Vaccaria pyramidalata</i> Medik, Phil Bot.				Herb	
Family		Portulacaceae					
	1	<i>Portulaca oleracea</i> L.		Ghol		Herb	
Family		(Tamaricaceae) Tamariscineae					
Order 5	1	<i>Tamarix ericoides</i> Rottler		Shemi, Sarub, Sarat		Shrub	
Family		Guttiferales					
		(Elatinaceae) Elatinaceae					
Order 6	1	<i>Bergia ammannioides</i> Roxb. Ex Roth				Annual Herb	
Family		Malvales					
		Malvaceae					
	1	<i>Abelmoschus manihot</i> (L.) Medik.		Raan Bhendi		Herb	Endemic
	2	<i>Abutilon hirtum</i> (Lamk.)				Woody annual	
	3	<i>Abutilon indicum</i> (L.) Sweet		Petari, Mudra		Shrub	
	4	<i>Fioria vitifolia</i> (L.)				Shrub	
	5	<i>Hibiscus cannabinus</i> Linn.		Ambadi		Crop	
	6	<i>Hibiscus esculentus</i> Linn.		Bhendi		Crop	
	7	<i>Hibiscus indicus</i> Burm. F. Hochr		Jasvand		Shrub	
	8	<i>Hibiscus panduriformis</i> Burm				Herb	
	9	<i>Hibiscus trionum</i> L.				Herb	
	10	<i>Kydia calycina</i> Roxb.		Warang		Tree	
	11	<i>Sida acuta</i> Burm. f.		Lahan Chikana,		Shrub	
	12	<i>Sida cordata</i> (Burm f.) Borss		Chikana		Herb	
	13	<i>Sida rhombifolia</i> L.		Jungli Methi		Herb	
Family		Sterculiaceae					

	1	<i>Eriolaena hookeriana</i> Wt. & Am.				
	2	<i>Helicteres isora</i> L.		Murud Shong		Shrub
	3	<i>Sterculia urens</i> Roxb.		Kandol		Tree
Family		Tiliaceae				
	1	<i>Corchorus fascicularis</i> Lamk.		Haran Khuri		Herb
	2	<i>Corchorus olitorius</i> L.		Banpat, Chichuria		Herb
	3	<i>Corchorus tridens</i> L.				Herb
	4	<i>Corchorus trilocularis</i> L.				Herb
	5	<i>Grewia aspera</i> Roxb.				shrub
	6	<i>Grewia hirsuta</i> Vahl. Symb				Shrub
	7	<i>Grewia polygama</i> Roxb.				shrub
	8	<i>Grewia rothii</i> DC. Prodr.				shrub
	9	<i>Grewia sclerophylla</i> Roxb. & G. Don				Shrub
	10	<i>Triumfetta malabarica</i> Koen. Ex Rottb.		Mendul		Herb
	11	<i>Triumfetta pentandra</i> A. Rich.				Herb
	12	<i>Triumfetta rhomboidea</i> Jacq.		Thinjhira		Herb
	13	<i>Triumfetta rotundifolia</i> Lamk.				Undershrub
Series 2		Disciflorae				
Order 7		Geraniales				
Family		Malpighiaceae				
Family	1	<i>Aspidopterys cordata</i> (Heyne ex Wall.)				Slender twinner
		Zygophyllaceae				Endemic
	1	<i>Tribulus lanuginosus</i> L.		Gokharu , Sarata		Herb
	2	<i>Tribulus rajasthanensis</i> Bhandari & Sharma		Sarata		Herb
	3	<i>Tribulus terrestris</i> L.		Gokharu , Sarata		Herb
Family		Oxalidaceae				Endemic

	1	<i>Biophytum reinwardtii</i> (zucc.)			
	2	<i>Biophytum sensitivum</i> (L.) DC.	Lajalu		Herb
	3	<i>Oxalis corniculata</i> L.	Ambushi		Herb
	4	<i>Oxalis corymbosa</i> DC. Prodr.			Herb
	5	<i>Oxalis richardiana</i> Babu.			Herb
Family		Balsaminaceae			
Family	1	<i>Impatiens balsanina</i> L.	Terda, Gauri		Annual Herb
		Rutaceae			
	1	<i>Aegle marmelos</i> (L.) Corr.	Bel		Tree
	2	<i>Limonia acidissima</i> L.	Kavath		Tree
	3	<i>Murraya koenigii</i> (L.) Spreng.	Kadipatta		Tree
Family		(Simaroubaceae) Simarubaceae			
	1	<i>Ailanthus excelsa</i> Roxb.	Ghod-limb, Maharukh		Tree
Family		Balanitaceae			
	1	<i>Balanites aegyptiaca</i> (L.) Del	Hingan		Tree
Family		Burseraceae			
	1	<i>Boswellia serrata</i> Roxb	Salai, Salphali, Sarphal		Tree
Family		Meliaceae			Endemic
	1	<i>Azadirachta indica</i> Linn.	Neem		Tree
Order 8		Olacales			
Family		(Olacaceae) Olacineae			
	1	<i>Olex psittacorum</i> (Willd)			Shrub
Order 9		Celastrales			
Family		Celastraceae (Celastrineae)			
	1	<i>Cassine albens</i> (Retz)	Dhamoda, Bhoot Keshi		Glabrous Tree
	2	<i>Celastrus paniculatus</i> Willd.	Malkanguni		Shrub

	3	<i>Gymnosporia montana</i> Roth	Yenkal	Shrub	
Family		(Rhamnaceae) Rhamnaceae			
	1	<i>Ziziphus glabrata</i> Heyne ex Roth		Tree	
	2	<i>Ziziphus jujuba</i> L.	Bor	Tree	
	3	<i>Ziziphus rotundifolia</i> Lamk.	Bor	Small Tree	
	4	<i>Ziziphus rugosa</i> Lamk.	Toran	Shrub	Endemic
	5	<i>Ziziphus xylopyrus</i> (Retz.) Willd.	Ghati Bor	Tree	
Family		Leeaceae			
	1	<i>Leea asiatica</i> (L.)		Shrub	
Order 10		Sapindales			
Family		Sapindaceae			
	1	<i>Cardiospermum helicacabum</i> L.	Kapalphuti	Annual Herb	
	2	<i>Sapindus laurifolius</i> Vahl.	Ritha	Tree	
Family		Anacardiaceae			
	1	<i>Anacardium occidentale</i> L.	Kaju	Tree	
	2	<i>Buchanania lanzan</i> Spreng. J. Bot	Charoli	Tree	
	3	<i>Lannea coromandelica</i> Merr	Moya, Shimti, Moi	Tree	
	4	<i>Mangifera indica</i> L.	Amba	Tree	
	5	<i>Rhus mysorensis</i> G. Don, Gen, Syst.	Amani, Amboni	Shrub	
	6	<i>Semecarpus anacardium</i> L.f.	Bibba	Tree	
	7	<i>Spondias pinnata</i> (L.f.)	Ambada	Glabrous Tree	
Family		(Moringaceae) Moringaceae			
	1	<i>Moringa oleifera</i> Lam	Shevaga	Tree	
Series 3		Calyciflorae			
Order 11		Rosales			
Family		Fabaceae (Leguminosae)			

1	<i>Abrus precatorius</i> L.	Gunj	Glabrous, Perennial twinner	
2	<i>Alysicarpus bupleurifolius</i> (L.) A.DC.		Herb	Endemic
3	<i>Alysicarpus heyneanus</i> Wt. & Arn.		Annual Herb	
4	<i>Alysicarpus longifolius</i> Wt. & Arn.		Annual Herb	
5	<i>Alysicarpus procumbens</i> (Roxb.)		Procumbet Herb	
6	<i>Alysicarpus vaginalis</i> (L.)		Prostrate Herb	
7	<i>Arachis hypogaea</i> Linn.	Bhuimug	Herb	
8	<i>Butea monosperma</i> L.	Palas	Tree	
9	<i>Butea superba</i> Roxb.	Palas Vel	Lianas	
10	<i>Cajanus cajan</i> spreng.	Tur	Crop	
11	<i>Canavalia cathartica</i> Thouars.	Gowara	Annual Herb	
12	<i>Cicer arietinum</i> L.	Harbhara	Herb	
13	<i>Clitoria ternatea</i> L.	Pandhara Gokarna	Shrub	Endemic
14	<i>Crotalaria albida</i> Heyne ex Roth		Undershrub	
15	<i>Crotalaria ferruginea</i> Grah. Ex Benth		Annual Herb	
16	<i>Crotalaria hirta</i> Willd		Annual Herb	
17	<i>Crotalaria huillensis</i> Taub		Undershrub	
18	<i>Crotalaria naikiana</i> Zate		Herb	Endemic
19	<i>Crotalaria notonii</i> Wight & Arn.		Herb	Endemic
20	<i>Crotalaria orixensis</i> Willd.		Perennial Herb	
21	<i>Crotalaria prostrata</i> Rottler		Annual Herb	
22	<i>Crotalaria pusilla</i> B.Heyne ex Roth		Herb	Endemic
23	<i>Crotalaria retusa</i> L.	Khulkhula	Annual Herb	
24	<i>Crotalaria spectabilis</i> Roth.		Undershrub	
25	<i>Crotalaria verrucosa</i> L.		Annual Herb	

26	<i>Dalbergia lanceolaria</i> L.f.			Tree	
27	<i>Dalbergia latifolia</i> Roxb.		Black Rose Wood	Tree	
28	<i>Dalbergia paniculata</i> Roxb.			Tree	
29	<i>Dalbergia sissoo</i> Roxb.		Indian Rose Wood	Tree	
30	<i>Desmodium gangeticum</i> (L.) DC		Salwan	Undershrub	
31	<i>Desmodium oojenensis</i> (Roxb)		Tiwas	Tree	
32	<i>Desmodium triflorum</i> (L.) DC.		Raanmethi	Herb	
33	<i>Dolichos lablab</i> Linn.		Wal	Twinner	
34	<i>Indigofera cassioides</i> Rottl. ex.		Neel	Shrub	
35	<i>Indigofera coerulea</i> Roxb.			Erect Shrub	
36	<i>Indigofera cordifolia</i> Heyne ex Roth			Procumbet Herb	
37	<i>Indigofera hirsuta</i> L.			Undershrub	
38	<i>Indigofera pulchella</i> Roxb.			Shrub	
39	<i>Indigofera tinctoria</i> L.			Shrub	
40	<i>Lablab purpureus</i> (L.)		Wal, Papdi	Twinnings	
41	<i>Melilotus albus</i> Medik.			Annual Herb	
42	<i>Mucuna minima</i> Haines			Annual Herb	
43	<i>Mucuna pruriens</i> L.		Khajkari	Climber	
44	<i>Paracalyx scariosa</i> (Roxb.)		Ghewada	Undershrub	
45	<i>Phaseolus mungo</i> Linn.		Udid	Herb	
46	<i>Phaseolus radiatus</i> Linn.		Mug	Herb	
47	<i>Pongamia pinnata</i> (L.) Pierre		Karanj	Tree	
48	<i>Pueraria tuberosa</i> (Roxb. ex. Willd)		Bhui Kohala	Shrub	
49	<i>Rhynchosia bracteata</i> Benth ex Baker			Woody Twinner	
50	<i>Sesbania bispinosa</i> (Jacq)		Raan Shevari	Annual Herb	
51	<i>Tephrosia pentaphylla</i> Sweet			Undershrub	

52	<i>Tephrosia pumila</i> (Lamk.)			
53	<i>Tephrosia purpurea</i> (L.) Pers.	Unhali		Procumbent Herb
54	<i>Tephrosia villosa</i> (L.)			Undershrub
55	<i>Uraria arborea</i> (D.Don.)			Undershrub
56	<i>Uraria picta</i> (Jacq)	Pithawan		Undershrub
57	<i>Vigna catjang</i> Walp.	Chavali		Crop
58	<i>Vigna radiata</i> (L.) Wilczek	Moog		Climber
59	<i>Vigna trilobata</i> (L.) Verdc.	Moogi		Herb
60	<i>Vigna umbellata</i> (Thunb)			Herb
61	<i>Vigna vexillata</i> (L.) A. Rich.			Climber
62	<i>Alysicarpus pubescens</i> Law			Annual Herb
63	<i>Goniogyna hirta</i> (Willd.)			Annual Herb
64	<i>Pongamia paniculata</i> Wight.			Woody Twinner
65	<i>Taverniera cuneifolia</i> (Roth.)	Jethmadh		Undershrub
66	<i>Teramnus mollis</i> Bth. In J. Linn			Herb
	Fabaceae (Caesalpinaceae)			
1	<i>Bauhinia malabarica</i> Roxb. Fl.			Tree
2	<i>Bauhinia purpuria</i> L.	Rakta Kanchan		Tree
3	<i>Bauhinia racemosa</i> Lam.	Apta		Tree
4	<i>Caesalpinia bonduc</i> (L.) Roxb.	Gajaga, Sagargota		Scandant shrub
5	<i>Caesalpinia pulcherrima</i> (L.) Sw.	Shankasur		Tree
6	<i>Cassia auriculata</i> L.	Tarvad		Undershrub
7	<i>Cassia fistula</i> L.	Bahava, Amaltaj		Tree
8	<i>Cassia javanica</i> L.			Tree
9	<i>Cassia obtusifolia</i> L.	Tarvad		Herb
10	<i>Cassia pumila</i> Lamk			Annual Herb

	11	<i>Cassia renigera</i> Wall ex Bth.			Tree	
	12	<i>Cassia siamea</i> Lamk.	Kashid		Tree	
	13	<i>Cassia sophora</i> L. Sp. Pl.	Jangali Takla,		Undershrub	
	14	<i>Cassia tora</i> L.	Sickle Pod, Takala		Herb	
	15	<i>Tamarindus indica</i> L.	Chinch		Tree	
Family		Fabaceae (Mimosaceae)				
	1	<i>Acacia arabica</i> L.	Babul		Tree	
	2	<i>Acacia auriculiformis</i> Benth.	Australian Babul		Tree	
	3	<i>Acacia catechu</i> (L.f.) Willd.	Khair		Tree	
	4	<i>Acacia concinna</i> (Willd.) DC.	Sikakai		Shrub	
	5	<i>Acacia ferruginea</i> DC. Prodr.	Phadndra Khair		Tree	
	6	<i>Acacia leucophloea</i> (Roxb.) Willd.	Hivar		Tree	
	7	<i>Acacia nilotica</i> (L.) Willd.	Babul		Tree	
	8	<i>Acacia torta</i> (Roxb.) Craib.	Chilar		Shrub	
	9	<i>Albizia lebbek</i> (L.) Bth.	Shirish		Tree	
	10	<i>Leucaena latifolia</i> (L.)	Subhabul		Tree	
	11	<i>Prosopis cineraria</i> (L.) Druce	Shami		Tree	
	12	<i>Prosopis juliflora</i> (SW.) DC.	Vedi Babul		Tree	
	13	<i>Samanea saman</i> (Jacq.) Merr.	Rain Tree		Tree	
	14	<i>Acacia farnesiana</i> (L.)	Dev Bhabal		Tree	
	15	<i>Mimosa indica</i> Pers.			shrub	
Order 12		Myrtales				
Family		Combretaceae				
	1	<i>Anogeissus latifolia</i> (Roxb. Ex DC)	Dhavada		Tree	
	2	<i>Combretum albidum</i> Roxb.	Shendri		Shrub	
	3	<i>Terminalia arjuna</i> (Roxb. DC.) Wight. & Arn.	Arjun		Tree	

	4	<i>Terminalia bellirica</i> Roxb.	Behada	Tree	
	5	<i>Terminalia catappa</i> L.	Badam	Tree	
	6	<i>Terminalia elliptica</i> Willd	Ain	Tree	
	7	<i>Terminalia paniculata</i> Roth	Kinjal	Tree	Endemic
Family		Myrtaceae			
	1	<i>Syzygium cumini</i> (L.) Skeels	Jambhul	Tree	
Family		Lythraceae			
	1	<i>Lagerstroemia parviflora</i> Roxb.	Nana	Tree	
	2	<i>Rotala densiflora</i> (Roth ex R.S.) Kohne.		Herb	
	3	<i>Rotala rotundifolia</i> (Buch - Ham)		Perennial Herb	
	4	<i>Rotala serpyllifolia</i> (Roth)		Annual Herb	
	5	<i>Woodfordia fruticosa</i> (L.) Kurz	Dhayati	Shrub	
Family		Punicaceae			
	1	<i>Punica granatum</i> L.	Dalimb	Tree	
Family		Onagraceae (Onagrarieae)			
	1	<i>Ludwigia hyssopifolia</i> (G. Don) Exell	Panlavanga	Shrub	
	2	<i>Ludwigia perennis</i> L.	Panlavang	Herb	
Order 13		Passiflorales			
Family		Cucurbitaceae			
	1	<i>Citrullus colocynthis</i> (L.)	Indrayan	Perennial Herb	
	2	<i>Corallocarpus epigaeus</i> (Rottl. & Willd)	Mirchi Kand	Climbing Herb	
	3	<i>Cucumis melo</i> L.	Kharbooz, Shendad	Herb	
	4	<i>Cucumis sativus</i> Linn.	Kakdi	Herb	
	5	<i>Lagenaria leucantha</i> Rusby.	Dudhya Bhopala		
	6	<i>Luffa acutangula</i> Roxb.	Dodaka	Crop	
	7	<i>Luffa aegyptiaca</i> Mill	Ghosale	Crop	

	8	<i>Momordica charantia</i> Linn.	Karle	Crop	
	9	<i>Momordica dioica</i> Roxb. Ex. Willd.	Kartoli	Climber	
Order 14		Ficoidales			
Family		Cactaceae (Cactaceae)			
	1	<i>Eriocereus bonplandii</i> (Parn.)		Clambering Shrub	
	2	<i>Opuntia elatior</i> Mill	Nivdung	Tree	
Family		Alzooaceae			
	1	<i>Zaleya decandra</i> (L.)		Subsucculent Herb	
B) SUBCLASS		GAMOPETALAE			
Series 4		Inferae			
Order 16		Rubiales			
Family		Rubiaceae			
	1	<i>Catunaregum spinosa</i> (Thumb). Triveng.	Gel	Tree	
	2	<i>Ceriscoides turgida</i> (Roxb.)		Tree	
	3	<i>Dentella repens</i> Forst.		Herb	
	4	<i>Gardenia latifolia</i> Ait. in . Hort		Tree	
	5	<i>Haldina cordifolia</i> (Roxb.) Ridsd.	Haldu	Tree	
	6	<i>Hedyotis affinis</i> Roem. & Schult.		Annual Herb	
	7	<i>Hedyotis aspera</i> Heyne ex. Roth.		Annual Herb	
	8	<i>Hedyotis corymbosa</i> (L.)	Pitta Papda	Annual Herb	
	9	<i>Hedyotis herbacea</i> L.	Paripath	Annual Herb	
	10	<i>Hedyotis nagporensis</i> (Brace ex Haines)		Annual Herb	
	11	<i>Hedyotis ovatifolia</i> Cav. Icon		Herb	
	12	<i>Hedyotis puberula</i> (G.Don)		Annual Herb	
	13	<i>Hedyotis pumila</i> L.f. Suppl.		Annual Herb	
	14	<i>Hedyotis scabrida</i> (DC)		Herb	

15	<i>Hymenodictyon obovatum</i> Wall.				
16	<i>Ixora brachiata</i> Roxb.		Lokhanidi	Tree	Endemic
17	<i>Ixora coccinea</i> L.		Iswari	Shrub	
18	<i>Ixora pavetta</i> Andr. Bot. Rep.		Lokhandi, Raikuda	Shrub	
19	<i>Knoxia sumatrensis</i> (Retz.)			Annual Herb	
20	<i>Mitragyna parvifolia</i> (Roxb.) Korth.		Kadam	Tree	
21	<i>Morinda citrifolia</i> L.		Bartondi	Tree	
22	<i>Neanotis hohenackeri</i> Daniel et Vajr.			Annual Herb	
23	<i>Neanotis montholoni</i> (Hook. f.) W.H. Lewis			Herb	Lower Risk (LR), Endemic
24	<i>Rubia cordifolia</i> L.		Manjishtha	Herb	
Order 17					
Family					
	Asteraceae (Compositae)				
1	<i>Amberbosa ramosa</i> (Roxb.)			Annual Herb	
2	<i>Bidens biternata</i> (Lour.)			Annual Herb	
3	<i>Blumea belangeriana</i> DC			Herb	Endemic
4	<i>Blumea bifoliata</i> (L.)			Herb	
5	<i>Blumea eriantha</i> DC			Herb	Endemic
6	<i>Blumea fistulosa</i> (Roxb)			Herb	
7	<i>Blumea jacquemontii</i> Hook.			Herb	
8	<i>Blumea malcolmii</i> Hook.f.			Herb	Endemic
9	<i>Blumea membranacea</i> DC.			Herb	
10	<i>Blumea obliqua</i> (L.) Druce			Herb	
11	<i>Blumea sinuata</i> (Lour)			Herb	
12	<i>Emilia sonchifolia</i> (L.) DC.		Dhamapam, Sadamandi	Herb	
13	<i>Epaltes divaricata</i> (L.)			Annual Herb	

14	<i>Flaveria trinervia</i> (Spreng.)			Herb	
15	<i>Guizotia abyssinica</i> (L.F.) Cass.		Khurasani, Karale	Twinners	
16	<i>Lagascea mollis</i> Cav.		Tharvad	Herb	
17	<i>Launaea procumbens</i> (Roxb.) Ramayya & Rajgopal		Pathri	Herb	
18	<i>Parthenium hysterophorus</i> L.		Gajargavat	Herb	
19	<i>Pluchea tomentosa</i> DC.			Herb	
20	<i>Pulicaria angustifolia</i> DC			Herb	
21	<i>Pulicarpa foliolosa</i> DC			Herb	
22	<i>Sonchus asper</i> (L)		Mhatra	Herb	
23	<i>Sonchus oleraceus</i> L.		Mhatari	Herb	
24	<i>Sphaeranthus senegalensis</i> DC.		Gorakh Mendi	Herb	
25	<i>Spilanthes calva</i> DC.		Akkalkara	Herb	
26	<i>Tridax procumbens</i> L.		Dagdi Pala	Herb	
27	<i>Vernonia cinerea</i> Lees		Sahadevi	Herb	
28	<i>Vicoa indica</i> (L.)		Sone Kadi	Erect herb	
29	<i>Xanthium strumarium</i> L.Sp.		Landga,	Undershrub	
Order 18	Campanales				
Family	Lobeliaceae				
1	<i>Lobelia alsinoides</i> Lamk.			Annual Herb	
Series 5	Heteromerae				
Order 20	Primulales				
Family	Plumbaginaceae (Plumbaginaceae)				
1	<i>Plumbago zeylanica</i> L.		Pandhra Chitrak	Undershrub	
Family	Primulaceae				
1	<i>Anagallis arvensis</i> L.		Jokmari	Herb	

	2	<i>Anagallis punila</i> Sw.		Jokhari		Annual Herb	
Family		Myrsinaceae (Myrsineae)					
	1	<i>Embelia basaal</i> (R & S) DC.		Wavding		Scadent Shrub	
Order 21		Ebenales					
Family		Sapotaceae					
	1	<i>Achras zapota</i> L.		Chiku		Tree	
	2	<i>Madhuca longifolia</i> (Koen.) Mac.		Mahua		Tree	
Family		Ebenaceae					
	1	<i>Diospyros chloroxylon</i> Roxb.				Small Tree	
	2	<i>Diospyros exculpta</i> Buch-Ham.in		Tendu		Tree	
	3	<i>Diospyros melanoxylon</i> Roxb. Pl. Corom		Tembhumi		Tree	
Series 6		Bicarpellatae					
Order 22		Gentianales					
Family		Oleaceae					
	1	<i>Jasminum malabaricum</i> Wright		Kusar		Shrub	Endemic
Family		Apocynaceae					
	1	<i>Holarrhena pubescens</i> (Buch.-Ham) Wall		Pandhara Kuda		Shrub	
	2	<i>Wrightia tinctoria</i> R.Br.		Kala Kuda		Shrub	
Family		Asclepiadaceae					
	1	<i>Calotropis gigantea</i> (L.) Ait.		Rui		Shrub	
	2	<i>Caralluma adscandens</i> (Roxb.) R. Br.		Makad shing, Shingoli		Herb	
	3	<i>Ceropegia bulbosa</i> Roxb.		Khartundi, Kharpudi		Twinning herb	Lower Risk (LR)
	4	<i>Ceropegia hirsuta</i> Wight. & Arn.		Kandilpushpa		Climber	
	5	<i>Cryptolepis buchanani</i> Roem & Schult.		Kavali		Climber	
	6	<i>Cryptostegia grandiflora</i> R.Br.		Vilayati Vakundi		Shrub	
	7	<i>Dregea angustifolia</i> (Hook.f.)				Undershrub	

8	<i>Dregea volubilis</i> (L.f.)	Hiran Dodi	Twinning shrub	
9	<i>Gymnema sylvestre</i> (Retz) R. Br. ex Schultes.	Bedki	Climber	
10	<i>Holostemma ada-kodien</i> Schult	Shindodi	Twinning shrub	
11	<i>Leptadenia reticulata</i> (Retz.)	Shinguti	Twinning shrub	
12	<i>Pergularia daemia</i> (Forsk.)	Utaran	Undershrub	
13	<i>Telosma cordata</i> Burm.f.		Twinning Undershrub	
14	<i>Tylophora fasciculata</i> Ham		Undershrub	
15	<i>Tylophora indica</i> (Burm. f.) Merr.	Pitmari	Climber	
	Periplocaceae			
1	<i>Hemidesmus indicus</i> (L.)Schult.	Anantmul	Climber	
	Gentianaceae			
1	<i>Canscora decurrens</i> Dalz. in Kew		Annual Herb	Endemic
2	<i>Canscora diffusa</i> (Vahl.) R. Br. ex R. & S.		Annual Herb	
3	<i>Canscora heteroclita</i> (L.)		Annual Herb	
4	<i>Centaurium centaurioides</i> (Roxb.)		Annual Herb	
5	<i>Exacum pedunculatum</i> L.		Annual Herb	
6	<i>Hoppea dichotoma</i> Willd.		Annual Herb	
7	<i>Hoppea fastigiata</i> Clarke in Hook		Herb	
	Menyanthaceae			
1	<i>Nymphoides cristatum</i> (Roxb)		Herb	
2	<i>Nymphoides indica</i> (L.) Kuntze		Herb	
	Polemoniales			
	Boraginaceae			
1	<i>Carmona retusa</i> (Vahl)		Shrub	
2	<i>Cordia dichotoma</i> Forst.	Bhokar	Tree	

3	<i>Trichodesma africanum</i> (L.)			Annual Herb	
4	<i>Trichodesma indicum</i> Lehm.			Herb	
5	<i>Trichodesma sedgwickianum</i> Banerjee in Bull			Herb	
6	<i>Trichodesma zeylanicum</i> (Burm.f.)			Herb	
	Convolvulaceae				
1	<i>Argyrea capitata</i> (Vahl)			Twinnings	
2	<i>Cressa cretica</i> L.			Herb	
3	<i>Ipomoea carnea</i> Jacq.	Beshram		Shrub	
4	<i>Ipomoea purpurea</i> L.			Herb	
	Solanaceae				
1	<i>Capsicum annuum</i> L.	Mirchi		Herb	
2	<i>Datura metel</i> L.	Kala Dhotra		Herb	
3	<i>Lycopersicon esculentum</i> Mill	Tomato		Crop	
4	<i>Solanum album</i> Larranaga.				
5	<i>Solanum melongena</i> L.	Wanga		Shrub	
6	<i>Solanum virginianum</i> L.	Bhui Ringani		Undershrub	
	Personales				
	Scrophulariaceae				
1	<i>Bacopa monnieri</i> (L.)	Neer Brahmi		Herb	
2	<i>Buchnera hispida</i> Buch-Ham. ex D.Don.			Herb	
3	<i>Centranthera nepalensis</i> D.Don			Annual Herb	
4	<i>Dopatrium junceum</i> (Roxb.)			Annual Herb	
5	<i>Glossostigma diandrum</i> (L.)			Herb	
6	<i>Kickxia ramosissima</i> (Wall.)			Perennial Herb	
7	<i>Linnophila indica</i> (L.)	Turti		Herb	
8	<i>Lindernia antipoda</i> (L.)			Annual Herb	

9	<i>Lindernia ciliata</i> (Colsm)			Annual Herb	
10	<i>Lindernia crustacea</i> (L.) F. Muell.			Herb	
11	<i>Lindernia molluginoides</i> (Benth)			Annual Herb	
12	<i>Lindernia multiflora</i> (Roxb)			Annual Herb	
13	<i>Lindernia parviflora</i> (Roxb.)			Annual Herb	
14	<i>Sopubia delphinifolia</i> (L.) G. Don			Herb	
15	<i>Stemodia viscosa</i> Roxb.			Herb	
16	<i>Striga angustifolia</i> (D. Don)			Herb	
17	<i>Striga asiatica</i> (L.)	Talakh		Annual Herb	
18	<i>Striga densiflora</i> (Bth.)	Talakh		Herb	
19	<i>Sutera dissecta</i> (Del.) Walp.	Bhul		Herb	
20	<i>Verbascum chinense</i> (L.) Sant.	Kutki		Herb	
21	<i>Veronica anagallis-aquatica</i> L.			Herb	
Family	Lentibulariaceae				
	1 <i>Utricularia baouleanensis</i> A. Chev.			Annual Herb	
	2 <i>Utricularia bifida</i> L.			Annual Herb	
	3 <i>Utricularia polygaloides</i> Edgew			Annual Herb	
Family	Bignoniaceae				
	1 <i>Dolichandrone falcata</i> (Wall. ex DC.)	Medh Shingi		Tree	
	2 <i>Stereospermum chelenoides</i> DC.	Paral		Tree	
	3 <i>Stereospermum colais</i> (Buch. Ham. ex Dillw)	Paral		Tree	
Family	Pedaliaceae				
	1 <i>Sesamum orientale</i> L.	Teel		Herb	
Family	Martyniaceae				
	1 <i>Martynia annua</i> L.	Wagh Nakhi		Herb	
Family	Acanthaceae				

1	<i>Adhatoda zaylanica</i> Medic.	Adulsa	Shrub	
2	<i>Andrographis echitoides</i> (L.)		Herb	
3	<i>Andrographis paniculata</i> (Burm.f.)		Annual Herb	
4	<i>Asystasia dalzelliana</i> Santapau		Undershrub	Endemic
5	<i>Barleria cristata</i> L.	Nili Koranti	Undershrub	
6	<i>Barleria gibsonii</i> Dalzell		Undershrub	Vulnerable (VU), Endemic
7	<i>Barleria prinoitis</i> L.	Kate Koranti	Shrub	
8	<i>Blepharis repens</i> (Vahl)	Hadsan	Undershrub	
9	<i>Dicliptera verticillata</i> (Forsk)		Undershrub	
10	<i>Dipteracanthus patulus</i> (Jacq.)		Undershrub	
11	<i>Dipteracanthus prostratus</i> (poir)		Undershrub	
12	<i>Ecobolium viride</i> (forsk.)		Shrub	
13	<i>Elytraria acaulis</i> (L.f.)		Herb	
14	<i>Eranthemum roseum</i> (Vahl.) R.Br.		Herb	Endemic
15	<i>Hygrophila schulli</i> (Buch.) Almeida	Talimkhana	Herb	
16	<i>Justicia glauca</i> Rottl.		Herb	
17	<i>Justicia japonica</i> Thunb. Fl.		Herb	
18	<i>Justicia latispica</i> (Clarke)		Annual Herb	
19	<i>Justicia quinqueangularis</i> Wall.		Herb	
20	<i>Lepidagathis subarmata</i> (Clarke)	Gundra	Undershrub	
Order 25	Lamiales			
Family	Verbenaceae			
1	<i>Gmelina arborea</i> Roxb.	Shivan	Tree	
2	<i>Gmelina asiatica</i> L.	Kali Shivan	Tree	
3	<i>Lantana camara</i> L.	Ghaneri, Tantani	Shrub	
4	<i>Phyla nudiflora</i> (L.) Greene	Adali, Gour Mundi	Herb	

Family	5	<i>Tectona grandis</i> L.f.	Sag	Tree	
		Lamiaceae (Labiatae)			
	1	<i>Anisochilus carnosus</i> (L.f.)	Kapurli	Herb	
	2	<i>Anisomeles indica</i> (L.)		Herb	
	3	<i>Anisomeles malabarica</i> R.Br.	Kapuri-Madhuri	Herb	
	4	<i>Clerodendrum inerme</i> (L.)	Kadu Mehendi	Shrub	
	5	<i>Clerodendrum multiflorum</i> (Burm.f.)	Taklan	Shrub	
	6	<i>Clerodendrum serratum</i> (L.)	Bharang	Undershrub	
	7	<i>Leonotis nepetifolia</i> (L.) R.Br.	Matisul, Deepmal	Herb	
	8	<i>Leucas aspera</i> (Willd)	Shankroba	Herb	
	9	<i>Leucas biflora</i> (Vahl.)		Herb	
	10	<i>Leucas cephalotes</i> (Roth)	Tumba	Herb	
	11	<i>Leucas diffusa</i> Benth.		Annual Herb	
	12	<i>Leucas longifolia</i> Benth		Herb	
	13	<i>Leucas martinicensis</i> (Jacq.)		Annual Herb	
	14	<i>Leucas nutans</i> (Roth)		Annual Herb	
	15	<i>Leucas stricta</i> Benth.		Herb	
	16	<i>Leucas wightiana</i> Benth.		Annual Herb	
	17	<i>Ocimum americanum</i> L.	Ran Tulsi	Herb	
	18	<i>Ocimum basilicum</i> L		Herb	
	19	<i>Ocimum gratissimum</i> L.	Ram Tulas	Herb	
	20	<i>Ocimum sanctum</i> L.	Tulas	Herb	
	21	<i>Pogostemon purpurascens</i> Dalzell		Herb	Endemic
	22	<i>Vitex negundo</i> L.	Nirgudi	Shrub	
C) SUBCLASS		MONOCHLAMYDEAE			
Series 7		Curvembryaceae			

Family		Nyctaginaceae (Nyctagineae)			
	1	<i>Boerhaavia diffusa</i> L.	Punarnava	Herb	
Family		Amaranthaceae			
	1	<i>Achyranthes aspera</i> L.	Aghada	Shrub	
	2	<i>Alternanthera sessilis</i> (L.) R. Br. DC.	Sessile Joyweed	Herb	
	3	<i>Amaranthus spinosus</i> L.	Katamath	Herb	
	4	<i>Celosia argentea</i> L.	Kurdu	Herb	
Family		Chenopodiaceae			
	1	<i>Chenopodium album</i> L.	Chakwat	Herb	
Family		Polygonaceae			
	1	<i>Polygonum barbatum</i> L.		Perennial Herb	
	2	<i>Polygonum glabrum</i> Willd	Sheral	Herb	
	3	<i>Rumex dentatus</i> L.	Chuka	Herb	
Series 9		Multiovulatae terrestres			
Family		Aristolochiaceae			
	1	<i>Aristolochia bracteolata</i> Lamk.		Perennial Herb	
	2	<i>Aristolochia indica</i> L.		Perennial Herb	
Series 12		Achlamydoxporaceae			
Family		Santalaceae			
	1	<i>Santalum album</i> L.	Chandan	Tree	
Series 13		Unisexuales			
Family		Euphorbiaceae			
	1	<i>Acalypha ciliata</i> Forsk.		Annual Herb	
	2	<i>Acalypha indica</i> L.	Kapi, Khokali	Herb	
	3	<i>Chrozophora prostrata</i> Dalz.		Herb	
	4	<i>Euphorbia barnhartii</i> Crozat	Tridhari, Nivdung	Shrub	

5	<i>Euphorbia caducifolia</i> Haines			Shrub	
6	<i>Euphorbia chamaesyce</i> L.			Annual Herb	
7	<i>Euphorbia cyathopora</i> Murr.			Annual Herb	
8	<i>Euphorbia dracunculoides</i> Lamk.	Pisola		Herb	
9	<i>Euphorbia heyneana</i> Spreng			Herb	
10	<i>Euphorbia hirta</i> L.			Herb	
11	<i>Euphorbia nerifolia</i> L.			Tree	
12	<i>Euphorbia nivulia</i> Buch.-Ham			Tree	
13	<i>Euphorbia pruinifolia</i> Jacq. Hort			Annual Herb	
14	<i>Euphorbia pulcherrima</i> Willd.	Lal Patti		Shrub	
15	<i>Euphorbia rothiana</i> Spreng.	Pisola		Annual Herb	
16	<i>Euphorbia thymifolia</i> L.			Annual Herb	
17	<i>Euphorbia tirucalli</i> (Boiss.) Benth. & Hook.f.	Sher		Shrub	
18	<i>Jatropha curcas</i> L.	Erand		Shrub	
19	<i>Jatropha glandulifera</i> Roxb.	Jangli Erand		Shrub	
20	<i>Jatropha gossypifolia</i> L.	Mogli Erand		Shrub	
21	<i>Mallotus philippensis</i> (Lam.) Muell. Arg.	Kum-Kum		Tree	
22	<i>Phyllanthus emblica</i> L.	Avala		Tree	
23	<i>Phyllanthus lawii</i> Grah.			Shrub	
24	<i>Phyllanthus niruri</i> L.			Herb	
25	<i>Phyllanthus reticulatus</i> Poir.	Datwan		Shrub	
26	<i>Phyllanthus scabrisolius</i> Hook.f.			Herb	Endemic
27	<i>Phyllanthus urinaria</i> L.			Herb	
28	<i>Phyllanthus virgatus</i> Forsk.			Perennial Herb	
29	<i>Ricinus communis</i> L.	Erand		Tree	
30	<i>Sebestiana chamaelea</i> (L.)	Bhui Erandi		Herb	

	31	<i>Securinega virosa</i> (Roxb. ex Willd.) Baill.	Kamati,	Tree	
	32	<i>Tragia plukenetii</i> A.R.	Khaj Koili	Undershrub	
Family		Ulmaceae			
	1	<i>Holoptelea integrifolia</i> (Roxb)	Wavali, Papada	Tree	
	2	<i>Trema politoria</i> Planch.		Tree	
Family		Moraceae			
	1	<i>Ficus arnotiana</i> (Miq)		Tree	
	2	<i>Ficus benghalensis</i> L.	Wad	Tree	
	3	<i>Ficus glomerata</i> Roxb	Umbar	Tree	
	4	<i>Ficus hispida</i> L.f.	Kala Umbar	Tree	
	5	<i>Ficus racemosa</i> L.	Umbar	Tree	
	6	<i>Ficus religiosa</i> L.	Pimpal	Tree	
ID CLASS		MONOCOTYLEDONS			
Series 15		Microspermae			
Family		Hydrocharitaceae			
	1	<i>Hydrilla verticillata</i> Royle	Kendal	Aquatic Herb	
	2	<i>Nechamandra alternifolia</i> (Roxb)		Aquatic Herb	
	3	<i>Ottelia alismodes</i> (L.)		Aquatic Herb	
	4	<i>Vallisneria spiralis</i> (Lour)		Aquatic Herb	
Family		Orchidaceae (Orchideae)			
	1	<i>Habenaria gibsonii</i> Hook.f.		Perennial Herb	
	2	<i>Habenaria marginata</i> Coleb.		Herb	
	3	<i>Habenaria roxburghii</i> Nicolson		Perennial Herb	Endemic
	4	<i>Zeuxine strateumatica</i> (L.)		Herb	
Series 16		Epigynae			
Family		Zingiberaceae			

	1	<i>Curcuma aungustifolia</i> Roxb.					
	2	<i>Curcuma decipiens</i> Dalzell				Perennial Herb	Vulnerable (VU), Endemic
Family		Musaceae					
	1	<i>Musa acuminata</i> Colla		Banana		Herb	
Family		Hypoxidaceae					
	1	<i>Curculigo orchitoides</i> Gaertn.		Kali Musali		Herb	
Family		Agavaceae					
	1	<i>Agave cantula</i> Roxb		Ghayapat		Undershrub	
Family		Anthericaceae					
	1	<i>Chlorophytum glaucum</i> Dalz.		Kalui		Herb	Vulnerable (VU), Endemic
	2	<i>Chlorophytum laxum</i> R.Br. Prodr.				Herb	
Series 17		Coronarieae					
Family		Hyacinthaceae					
	1	<i>Drimys indica</i> (Roxb.) Jessop.		Rankanda		Herb	
	2	<i>Drimys polyantha</i> Ansari & Sundararagh.				Herb	Vulnerable (VU), Endemic
Family		Commelinaceae					
	1	<i>Commelina attenuata</i> Koen. ex Vahl,				Annual Herb	Endemic
	2	<i>Commelina benghalensis</i> L.				Herb	
	3	<i>Commelina diffusa</i> Burn.				Annual Herb	
	4	<i>Commelina erecta</i> L.				Perennial Herb	
	5	<i>Commelina forsskalaei</i> Vahl.				Annual Herb	
	6	<i>Commelina jacobii</i> Fischer				Annual Herb	
	7	<i>Cyanotis fasciculata</i> J.A. & J.H. Schult.				Herb	Lower Risk (LR), Endemic
Series 18		Calycinae					
Family		Areaceae (Palmae)					

	1	<i>Cocos nucifera</i> L.	Naral	Tree	
	2	<i>Phoenix sylvestris</i> Roxb	Shindi	Tree	
Series 19		Nudiflorae			
Family		Pandanaceae (Pandaneae)			
	1	<i>Pandanus fasciculari</i> Lamk	Kewda	Scadent Shrub	
Family		Araceae			
	1	<i>Amorphophallus sylvaticus</i> Kunth	Jangli Suran	Perennial Herb	Lower Risk (LR)
	2	<i>Colocasia esculenta</i> (L.) Schott	Alu	Perennial Herb	
	3	<i>Theriophonum indicum</i> (Dalz)		Perennial Herb	
Series 21		Glumaceae			
Family		Eriocaulaceae (Eriocaulaeae)			
	1	<i>Eriocaulon quinqueangulare</i> L		Annual Herb	
	2	<i>Eriocaulon ritchieanum</i> Ruhl.		Annual Herb	
Family		Cyperaceae			
	1	<i>Bulbostylis barbata</i> (Rottb.) Cl.		Annual Herb	
	2	<i>Cyperus clarkei</i> Cooke Fl. Pres.		Perennial	
	3	<i>Cyperus compressus</i> L.	Lavala	Annual Herb	
	4	<i>Cyperus diaphanus</i> Schard ex Roem		Annual Herb	
	5	<i>Cyperus difformis</i> L.		Annual Herb	
	6	<i>Cyperus exaltatus</i> Retz.		Perennials	
	7	<i>Cyperus iria</i> L.	Wala	Herb	
	8	<i>Cyperus rotundus</i> L.	Nagarmotha	Herb	
Family		(Poaceae) Gramineae			
	1	<i>Aira caryophyllea</i> L		Annual Herb	
	2	<i>Alloteropsis cimicina</i> (L.)		Annual Herb	
	3	<i>Andropogon pumilus</i> Roxb.Fl.	lal Gavat	Annual Herb	

4	<i>Apluda mutica</i> L.			Annual Herb	
5	<i>Apocypis vaginata</i> Hack.			Annual Herb	Endemic
6	<i>Aristida depressa</i> Retz.			Annual Herb	
7	<i>Aristida funiculata</i> Trin. et. Rupr.			Annual Herb	
8	<i>Aristida hystrix</i> L.			Perennial Herb	
9	<i>Aristida redacta</i> Stapf		Kusali Gavat	Herb	Endemic
10	<i>Arthraxon hispidus</i> (Thunb.)			Annual Herb	Endemic
11	<i>Arthraxon lanceolatus</i> (Roxb.)			Perennial Herb	Lower Risk (LR), Endemic
12	<i>Brachiaria eruciformis</i> Griseb.		Shimpi	Annual Herb	
13	<i>Brachiaria ramosa</i> (L.)			Annual Herb	
14	<i>Brachiaria reptans</i> (L.) Gard.		Chamanchara	Annual Herb	
15	<i>Brachiaria setigera</i> (Retz.)			Annual Herb	
16	<i>Chionachne koenigii</i> (Spreng)		Kata Karvel	Perennial Herb	
17	<i>Chrysopogon fulvus</i> (Spreng.)		Gagar	Herb	
18	<i>Chrysopogon serrulatus</i> Trin			Perennial Herb	
19	<i>Coix gigantea</i> Roxb. Fl		Kasal	Annual Herb	
20	<i>Cymbopogon martinii</i> (Roxb.)		Surya Gawat	Perennial Herb	
21	<i>Cynodon barberi</i> Rangachari & Tadul.			Perennial Herb	Endemic
22	<i>Cynodon dactylon</i> (L.) Pers.		Harali	Herb	
23	<i>Dendrocalamus strictus</i> Nees		Velu	Herb	
24	<i>Dichanthium annulatum</i> (Forssk)			Herb	
25	<i>Dichanthium caricosum</i> (L.)		Marvel	Perennial Herb	
26	<i>Dichanthium glabrum</i> (Roxb.)		Ghanya Marvel	Perennial Herb	
27	<i>Dichanthium pertusum</i> (L.)			Perennial Herb	
28	<i>Digitaria abildens</i> (Roem. & Schult)			Annual Herb	
29	<i>Digitaria stricta</i> Roth. ex R. & S. Syst.			Herb	

30	<i>Eragrostis coarctata</i> Staf apud Hook		Perennial Herb	
31	<i>Eragrostis gangetica</i> (Roxb)		Annual Herb	
32	<i>Eragrostis japonica</i> (Thunb)		Annual Herb	
33	<i>Eriochloa procera</i> (Retz)		Perennials	
34	<i>Eulalia staintonii</i> Bor in Kew Bull		Perennial Herb	
35	<i>Hemarthra compressa</i> (L.f.)		Perennial Herb	
36	<i>Heteropogon triticeus</i> (R.Br.)	Kusali	Perennials	
37	<i>Imperata cylindrica</i> (L.)		Perennial Herb	
38	<i>Oryza sativa</i> Linn.	Tandul	Herb	
39	<i>Panicum decanense</i> Naik & Patunkar		Herb	Endemic
40	<i>Panicum miliaceum</i> Linn.	Varai Bhagar	Annual Herb	
41	<i>Panicum paludosum</i> Roxb. Fl. Ind		Perennial Herb	
42	<i>Panicum phoinclados</i> Naik & Patunkar		Perennial Herb	
43	<i>Panicum repens</i> L.		Perennial Herb	
44	<i>Paspalum flavidum</i> A. Camus	Burad, Shedy	Herb	
45	<i>Paspalum vaginatum</i> Sw.		Annual Herb	
46	<i>Pennisetum americanum</i> (L.)	Bajara	Herb	
47	<i>Pennisetum hohenackeri</i> Hochst. ex Steud		Perennial Herb	
48	<i>Pennisetum polystachyon</i> (L.)		Perennial Herb	
49	<i>Saccharum officinarum</i> L.	Sugarcane	Herb	
50	<i>Setaria italica</i> (L.)	Bhagar, Wari	Annual Herb	
51	<i>Setaria verticillata</i> (L.)	Kutra	Annual Herb	
52	<i>Sorghum bicolor</i> (L.) Moench	Jwari, Jondhla	Herb	
53	<i>Spondiopogon rhizophorus</i> (Steud.) Pilg.			
54	<i>Sporobolus capillaris</i> Miq. in Verh.		Annual Herb	
55	<i>Sporobolus coromandelianus</i> (Retz.)		Annual Herb	

56	<i>Sporobolus indicus</i> (L.)			Perennial Herb	
57	<i>Thelepogon elegans</i> Roth ex Roem			Perennial Herb	
58	<i>Tripogon pungens</i> C.E.C.			Perennial Herb	Endemic
59	<i>Urochloa panicoides</i> P.Beauv			Annual Herb	
60	<i>Vetiveria zizanioides</i> (L.)		Wala, Khus	Perennial Herb	

Source: Flora of Marathwada, Vol. I & II, V.N. Naik & Associates and Primary Survey

Table 9.10 List of Cultivated Species in Study Area (based on actual survey)

Botanical Name	Season	Local Name	Uses	Remark
Cereals				
<i>Oryza sativa</i> Linn.	Kharif	Tandul	Food	Mostly in the command area of AP
Millets				
<i>Pennisetum typhoides</i>	Rabi	Bajra		Catchment and command areas of Maharashtra
<i>Sorghum bicolor</i>	Kharif	Jowar		Catchment and command areas of Maharashtra
Pulses				
<i>Cajanus cajan</i> spreng.	Kharif	Tur	Food	Catchment and command areas of Maharashtra and AP
<i>Cicer arietinum</i> Linn.	Rabi	Gram	Food	Command areas of Maharashtra and AP
<i>Dolichos lablab</i> Linn.	Kharif	Wal	Food	Occasional in Catchment and command areas of Maharashtra and AP
<i>Phaseolus mungo</i> Linn.	Kharif	Udid	Food	Occasional in Catchment and command areas of Maharashtra and AP
<i>Phaseolus radiatus</i> Linn.	Kharif	Mug	Food	Common in Catchment and command areas of Maharashtra and AP
<i>Vigna catjang</i> Walp.	Kharif	Chavali	Food	Occasional in Catchment and command areas of Maharashtra and AP

Botanical Name	Season	Local Name	Uses	Remark
Vegetables				
<i>Capsicum annum</i> Linn.	Kharif	Mirchi	Spice	Occasional in submergence area of Maharashtra
<i>Cucumis sativus</i> Linn.	Kharif	Kakdi	Food	Occasional in submergence area of Maharashtra
<i>Hibiscus cannabinus</i> Linn.	Kharif	Ambadi	Food	Occasional in Catchment and command areas of Maharashtra and AP
<i>Hibiscus esculentus</i> Linn.	Rabi	Bhendi	Food	Occasional in submergence area of Maharashtra
<i>Lagenaria leucantha</i> Rusby.	Kharif	Dudhya Bhopala	Food	Occasional in submergence area of Maharashtra
<i>Luffa acutangula</i> Roxb.	Kharif	Dodaka	Food	Occasional in submergence area of Maharashtra
<i>Luffa aegyptiaca</i> Mill	Rabi	Ghosale	Food	Occasional in submergence area of Maharashtra
<i>Momordica charantia</i> Linn.	Kharif	Karle	Food	Occasional in submergence area of Maharashtra
<i>Solanum melongena</i> Linn.	Kharif	Wangi	Food	Occasional in Catchment and command areas of Maharashtra and AP
Oil Seeds				
<i>Arachis hypogea</i> Linn.	Kharif	Bhuimug	Oil seed	Occasional in Catchment and command areas of Maharashtra and AP
<i>Guizotia abyssinica</i> (L.F.) Cass.	Kharif	Khurasani, Karale	Oil seed	Common in Catchment and command areas of Maharashtra and AP
Cash Crops				
<i>Saccharum officinarum</i>		Sugarcane		Common in submergence zone and occasional in command area
<i>Lycopersicon esculentum</i>		Tomato		Occasional in submergence zone
<i>Musa acuminata</i> Colla		Banana		Occasional in submergence zone

Table 9.11 Ethno botanical Information

Sr. No.	Botanical Name	Family	Local Name	Habit	Brief use
1	<i>Abelmoschus manihot</i> (L.) Medik.	Malvaceae	Ranbhendi	Herb	Fruits: as vegetable; Leaves: for swellings.
2	<i>Acacia concinna</i> (Willd.) DC.	Mimosaceae	Sikakai	Shrub	Pods: hair washing
3	<i>Acacia torta</i> (Roxb.) Craib.	Mimosaceae	Chilar	Shrub	Fruit: powder as purgative
4	<i>Achyranthes prophyristachya</i> (Wall & Moq.) Hook	Amaranthaceae	Aghada	Herb	Leaves: extract in eye disorders
5	<i>Aegle marmelos</i> L.	Rutaceae	Bel	Tree	Fruit: pulp edible and juice given in fever
6	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Kate math.	Herb	Leaves: as vegetable
7	<i>Annona squamosa</i> L.	Annonaceae	Sitaphal	Shrub	Fruits: edible; Bark: in cough
8	<i>Argemone mexicana</i> L.	Papaveraceae	Pivala dhotra	Herb	Leaf Juice: in eye disease.
9	<i>Asparagus racemosus</i> Willd.	Liliaceae	Shatavari	Climber	Roots: as diuretic
10	<i>Bauhinia racemosa</i> Lam.	Caesalpinaceae	Apta	Tree	Bark: powder on swellings
11	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	Palas	Tree	Flower: in urinary problems
12	<i>Calotropis gigantea</i> (L.) R. Br.	Asclepiadaceae	Rui	Shrub	Latex: on wounds
13	<i>Capparis spinosa</i> L.	Capparaceae	Wagati	Shrub	Root: extract as appetizer; Fruit: as vegetable
14	<i>Cassia fistula</i> L.	Caesalpinaceae	Bahawa	Tree	Bark: as purgative
15	<i>Celastrus paniculatus</i> Willd.	Celastraceae	Malkanguni	Shrub	Fruits: edible
16	<i>Celosia argentea</i> L.	Amaranthaceae	Kurdu	Herb	Leaves: as vegetable
17	<i>Ceropegia bulbosa</i> Roxb.	Asclepiadaceae	Kharpudi	Twinner	Rhizomes: as cat poison
18	<i>Chenopodium album</i> L.	Chenopodiaceae	Chakwat	Herb	Leaves: as vegetable.
19	<i>Chlorophytum glaucum</i> Dalz.	Liliaceae	Kalui	Herb	Leaves: as vegetable
20	<i>Cordia dichotoma</i> Forsl. f.	Boraginaceae	Bhokar	Tree	Fruits: edible, as pickles
21	<i>Cyperus iria</i> L.	Cyperaceae	Wala	Herb	Roots: water purification
22	<i>Desmodium triflorum</i> (L.) DC.	Fabaceae	Ran methi	Herb	Leaves: as vegetable
23	<i>Drimys indica</i> (Roxb.) Jessop.	Liliaceae	Rankanda	Herb	Leaves: as vegetable, bulbs in curry
24	<i>Embelia isyerian-cotton</i> (R. & S.)	Myrsinaceae	Wavding	Shrub	Seeds: in pediatric use
25	<i>Ficus racemosa</i> L.	Moraceae	Umber	Tree	Fruits: edible
26	<i>Gloriosa superba</i> L.	Liliaceae	Kallawi	Climber	Tubers: as anthelmintic

Sr. No.	Botanical Name	Family	Local Name	Habit	Brief use
27	<i>Hemidesmus indicus</i> (L.) Schult.	Periplocaceae	Anantmul	Climber	Roots: aromatic and used as tonic.
28	<i>Holarrhena pubescens</i> (Buch Ham.) Wall	Apocynaceae	Pandhara kuda	Tree	Leaves, bark & pods: in dysentery
29	<i>Ixora brachiata</i> Roxb.	Rubiaceae	Lokhanidi	Tree	Bark: in dental problems
30	<i>Jasminum malabaricum</i> Weight.	Oleaceae	Ranjil	Climber	Leaves: in mouth ulcers; seeds: famine food
31	<i>Madhuca longifolia</i> (Koen.) Mac. Bridd.	Sapotaceae	Mohava.	Tree	Flowers: beverages, and roti preparation
32	<i>Mangifera indica</i> L.	Anacardiaceae	Amba	Tree	Fruits: edible, used as pickle
33	<i>Momordica dioica</i> Roxb. Ex. Willd.	Cucurbitaceae	Kartoli	Climber	Fruits: as vegetable, juice for diabetic patients
34	<i>Mucuna pruriens</i> L.	Fabaceae	Khajkari	Climber	Fruits: medicinal
35	<i>Murraya koenigii</i> (L.) Spr.	Rutaceae	Kadhi patta	Shrub	Leaves: in curry preparation
36	<i>Ocimum santum</i> L.	Lamiaceae	Ran tulus.	Herb	Leaves: extract used in cough and fever
37	<i>Phyllanthus emblica</i> L.	Euphorbiaceae	Awala	Tree	Fruits: edible, pickles
38	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Chitrak	Shrub	Roots: as purgative
39	<i>Pongamia pinnata</i> L.	Fabaceae	Karanj	Tree	Seed: oil used for massage
40	<i>Portulaca oleracea</i> L.	Portulacaceae	Ghole	Herb	Leaves: as vegetable
41	<i>Rubia cordifolia</i> L.	Rubiaceae	Manjishtha	Herb	Leaves: extract used in skin disorders
42	<i>Sapindus laurifolius</i> Vahl.	Sapindaceae	Ritha	Tree	Fruits: for hair cleaning
43	<i>Sida cordata</i> (Burn f.) Bors	Malvaceae	Chikana	Herb	Leaves: as vegetable
44	<i>Sida rhombifolia</i> L.	Malvaceae	Jangali Methi	Herb	Leaves: as vegetables
45	<i>Syzygium cumini</i> (L.) Skeels.	Myrtaceae	Jambhal	Tree	Fruits: edible
46	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Behda	Tree	Fruits: edible used in bronchitis
47	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Gokhru	Herb	Fruits: in urinary disorders
48	<i>Vitex negundo</i> L.	Verbenaceae	Nirgudi.	Shrub	Leaves: swelling of joints

Table 9.12 List of plant species with their number recorded from the Submergence zone

Sr. No.	Village Name	Trees (No.)														Mob	Chiku	Cattapa	Karanj	Butea	Shindi	Jambhui
		Neem	Acacia	Mango	Dalimb	Shami	Biba	Umbar	Bartondi	Hirda	Tamarind	Teak	Stiphal	Bor	Coconut							
1	Itgyal	1584	789	514	162	0	0	0	0	0	0	383	112	29	290	0	0	0	69	0	0	0
2	Lakhmapur	131	435	165	38	60	49	67	62	26	271	79	63	26	40	9	0	0	30	20	48	71
3	Bamni	85	219	30	4	5	43	1	0	0	0	28	8	11	26	13	0	0	1	0	1	25
4	Kalambar	2	1	11	2	13	12	4	5	6	15	1	0	3	0	0	0	0	0	0	0	2
5	Ravi	52	33	18	16	17	7	6	6	6	8	1	1	0	3	3	0	0	0	4	0	0
6	Paratpur	97	65	5	0	0	0	20	0	0	175	0	4	100	0	0	0	0	0	0	0	0
7	Mukramabad	900	689	160	14	0	7	1	0	0	0	42	333	0	2553	83	17	59	0	0	0	0
8	Bhingoli	332	589	1984	44	93	20	14	86	15	64	75	71	100	488	159	0	0	2	14	14	82
9	Hasnal	155	480	180	23	36	11	11	12	24	10	70	39	219	267	26	0	0	6	28	12	39
10	Bhatapur	37	63	27	4	8	7	4	5	6	7	7	9	11	30	5	0	0	0	1	6	16
11	Kabnoor	108	23	31	7	5	7	2	0	2	0	31	12	2	5	1	0	0	0	0	3	1
12	Dornali	7	2	1	0	0	0	0	0	0	0	2	0	0	4	1	0	0	0	2	0	5
13	Bhendegeon (Bk)	155	88	80	29	8	6	6	7	19	8	15	24	11	5	11	0	0	8	7	10	33

Sr. No.	Village Name	Trees (No.)																				
		Neem	Acacia	Mango	Dalimb	Shami	Biba	Umbar	Bartondi	Hirda	Tamarind	Teak	Sitaphal	Bor	Coconut	Moh	Chiku	Cattapa	Karanj	Butea	Shindi	Jambhul
14	Bhaswadi	3216	670	226	4	5	23	5	78	1	27	105	18	305	97	4	0	0	0	1	0	37
15	Ravangaon	147	162	107	1	6	6	17	9	15	44	1	6	186	0	0	0	24	0	0	0	0
16	Marajwadi	657	712	175	0	0	32	0	0	0	48	343	131	117	46	2	0	0	0	0	0	0
17	Kolnur	870	260	540	37	35	28	18	23	30	14	219	359	496	315	26	0	0	3	17	15	281
18	Bhendegaon (Kh)	429	231	204	0	0	11	1	1	1	63	118	62	62	10	4	0	0	0	3	1	5
19	Walanki	543	549	176	6	15	19	13	6	7	3	100	39	1	124	5	0	0	5	15	1	1
	Total	9507	6060	4634	391	306	288	190	300	158	757	1620	1291	1679	4303	352	17	83	124	112	111	598

Trees

The Neem (*Azadirachta indica*), Acacia (*Acacia nilotica*), Mango (*Mangifera indica*), teak (*Tectona grandis*) and coconut (*Cocos nucifera*) are the common trees cultivated mostly along the borders of the agricultural land. On not so fertile land, Sitaphal (*Annona squamosa*) and Ber (*Zizyphus jujuba*) plants are cultivated. The compensation has been worked out for the loss of these trees and detailed are provided in Rehabilitation and Resettlement chapter.

9.2.2 Cryptogams; Lower Plants

Higher cryptogams mainly include Bryophytes & Pteridophytes. Bryophytes appear along with the monsoons. They complete life cycle by the end of the September of first week of October. Pteridophytes do occur during rainy season, grow and complete their life cycle by the end of November.

Cryptogams are shade loving and they require moisture. Many of them are terrestrial, found along the bank of streams, rivers; in rocky crevices and also on the tree trunks or on the branches.

Majority of the following genera of Bryophytes & Pteridophytes are observed in the study area.

Bryophytes

Ricciaceae

1. *Riccia cruciata*
2. *Riccia crystalline*

Targioniaceae

3. *Cyathodium tuberosum*
(Fern) **Fossombroniaceae**
ferns)

4. *Fossombronia indica*

Lejeuniaceae

5. *Lejeunia flava*

Anthocerotaceae

6. *Anthoceros erectus*

Funariaceae

7. *Funaria hygrometrica*

Pteridophytes

Selaginellaceae

1. *Selaginella minutospora*

Adiantaceae

2. *Adiantum lunulatum*

3. *Cheilanthes albo-marginata* (Silver
Marsileaceae (Semi aquatic

4. *Marsilea quadrifolia*

9.2.3 Conclusion

Terrestrial ecology: Project area, including the Catchment and command of both the States, highly degraded vegetation. Trees are observed only along the borders of the agricultural areas and along the already existing water bodies. The vegetation is predominantly dry deciduous scrub, with a few xerophytic elements. Tall trees have very sparse distribution and found either planted, present along the borders of agricultural land or along the water course.

Table 9.13 Status of the Species recorded in the project area

D) CLASS		DICOTYLEDON		Status
A) SUBCLASS		POLYPETALAE		
Series 1		Thalamiflorae		
Order 2		Parietales		
Family		Capparaceae (Cleomaceae)		
	1	<i>Cleome simplicifolia</i> (Camb.)	Herb	LR
Series 3		Calyciflorae		
Order 11		Rosales		
Family		Fabaceae (Leguminosae)		
	2	<i>Alysicarpus pubescens</i> Law	Annual Herb	VU
B) SUBCLASS		GAMOPETALAE		
Series 4		Inferae		
Order 16		Rubiales		
Family		Rubiaceae		
	3	<i>Neanotis montholoni</i> (Hook. f.)	Herb	LR
Series 6		Bicarpellatae		
Order 22		Gentianales		
Family		Asclepiadaceae		
	4	<i>Ceropegia bulbosa</i> Roxb.	Twinning herb	LR
Order 24		Personales		
Family		Acanthaceae		
	5	<i>Barleria gibsonii</i> Dalzell	Undershrub	VU
II) CLASS		MONOCOTYLEDONS		
Series 16		Epigynae		
Family		Zingiberaceae		
	6	<i>Curcuma decipiens</i> Dalzell	Perennial Herb	VU
Family		Anthericaceae		
	7	<i>Chlorophytum glaucum</i> Dalz.	Herb	VU
Series 17		Coronarieae		
Family		Hyacinthaceae		
	8	<i>Drimia polyantha</i> Ansari & Sundararagh	Herb	VU
	9	<i>Cyanotis fasciculata</i> J.A. & J.H. Schult.	Herb	LR
Series 19		Nudiflorae		
Family		Araceae		
	10	<i>Amorphophallus sylvaticus</i> Kunth	Perennial Herb	LR
Series 21		Glumaceae		
Family		(Poaceae) Gramineae		
	11	<i>Arthraxon lanceolatus</i> (Roxb.)	Perennial Herb	LR

LR: Lower Risk, VU: Vulnerable

Total 560 species, 92 Families & 315 Genuses are recorded from the study area. Out of these, six species are under class Lower Risk (LR) & five species are under class Vulnerable (VU) which is reported in the command area of the project.

9.3 Aquatic Ecology

A physico-chemical approach to monitor water pollution is most common and effective as plenty of information is available on these aspects. Such data usually provides a mosaic picture of the whole scenario. Chemical analysis is valuable and necessary, but does not provide all the information required for biological assessment. It is not only the contamination, which is of concern, but rather the effects of their concentrations on organism. Therefore, information on the status of biological quality of any water body is of much value. It ultimately helps in deciding alternatives towards its management. In the context of dam and irrigation projects, such indices reveal pollution status in terms of chlorophyll and non-chlorophyll containing organisms, faecal pollution, agricultural waste indicators, potable water indicators like *Desmids*, while presence of *Microcystis* indicates phosphate pollution. It is only by documenting their presence, impacts can be contemplated.

Biological indicators reveal the degree of ecological imbalance that has been caused. Just one or two parameters e.g. Biological Oxygen Demand (BOD) can describe only complex oxygen balance scenario and the organic load. However to obtain ecological insights, aquatic ecological studies are very useful.

Phytoplankton Studies: For aquatic ecological examination nine sampling sites were selected. The benthic and epiphytic algae were collected from their respective habitats by scraping the substratum. For phytoplankton analysis, 10 -15 litres of water sample was collected in clean plastic cans. To these cans, 4% formalin was added to facilitate sedimentation and preservation of the phytoplankton in them. The sample was filtered using plankton net. The qualitative analysis of the phytoplankton was done by microscopic observations. A single drop method was followed for quantitative estimations of the phytoplankton.

Other parameters recorded were the temperature and pH. Temperature was recorded in the field by thermometer while the pH was determined by using narrow range pH paper in the field. The measurement of salinity was carried out using the refractometer. The

list of the phytoplankton, benthic and epiphytic algae encountered is included in the section on aquatic ecology. The list of sampling stations is provided in the table 9.16.

Table 9.14 Sampling Stations for Aquatic Ecology

No.	Code	Stations	Description
1	AE1	Submergence	Submergence area, highly degraded vegetation
2	AE 2	Halni – Udgir Road – Command (MH)	Ghat section, upper reaches of catchment
3	AE 3	Unhali – Khanapur road (MH)	Vegetation at the hill slopes and foot hills along the road.
4	AE 4	Dabka Raja – Catchment (MH)	Catchment area
5	AE 5	Hatral – Catchment (MH)	Hilly terrain, represents high elevation vegetation of the catchment
6	AE 6	Marapalli (AP)	Old check dam, silted, command area of AP
7	AE 7	Madnoor (AP)	Command of AP

Findings and Discussion: During recent times, water bodies are becoming the victim of eutrophication due to increased anthropogenic pressure in their catchments. This is mainly because of increased runoff of agricultural wastes and fertilisers. Increased silt deposits often tend to restriction of growth of algae. The qualitative and quantitative analysis is summarized in the table below.

Table 9.15 Diversity and Distribution of Aquatic Ecological Elements in the Water Bodies of Proposed Lendi Project

Cells/ lit	AQ1	AQ2	AQ3	AQ4	AQ5
<i>Fragillaria</i>	198	99	-	198	-
<i>Netrium</i>	-	40	-	40	-
<i>Micrasterias</i>	-	-	-	-	495
<i>Pediastrum</i>	-	-	-	-	198
<i>Coelastrum</i>	-	-	-	149	40
<i>Chlorococcum</i>	-	40	-	-	-
<i>Merismopedia</i>	-	-	-	-	99
<i>Oscillatoria</i>	40	-	-	-	-
<i>Lyngbya</i>	40	-	-	40	99

The Phytoplankton population comprises of 2 species of Diatoms, 3 species of Blue Green Algae and 4 species of Green Algae. The aquatic ecological samples collected from the Lendi River Catchment area showed no presence of phytoplankton. Only zooplanktons and bacteria were found. Water appeared to be turbid.

Among the taxa encountered, *Fragillaria* is an indicator diatom taxa of Lake Acidification identified as target organisms during early phases of Lake Acidification (pH 6.0 to 5.0 ranges). So presence of this taxon in all the water bodies except in Menoor –command indicates slight acidic nature of the water. No indicators of organic pollution were encountered in the water samples, indicating less intensive agriculture.

Merismopedia is colonial blue green algal taxa associated with the recent drought conditions of that area. It is encountered only in Menoor – command area, indicating prevailing drier conditions.

Micrasterias indicates basic nature of the water body and associated with high concentration of carbonates. This taxon is found in Menoor –command area.

Among the *Cyanophyta*, the encountered genus *Oscillatoria* appear to have derived from its edaphic habitat. The genus has species belonging to toxic and nontoxic nature and some of them are also linked with eutrophication of the source.

All the water samples with more species of Diatoms indicate richness of silicates in water (Round, 1985). Overall the water samples are poor in phytoplanktons, due to high turbidity in water reducing light.

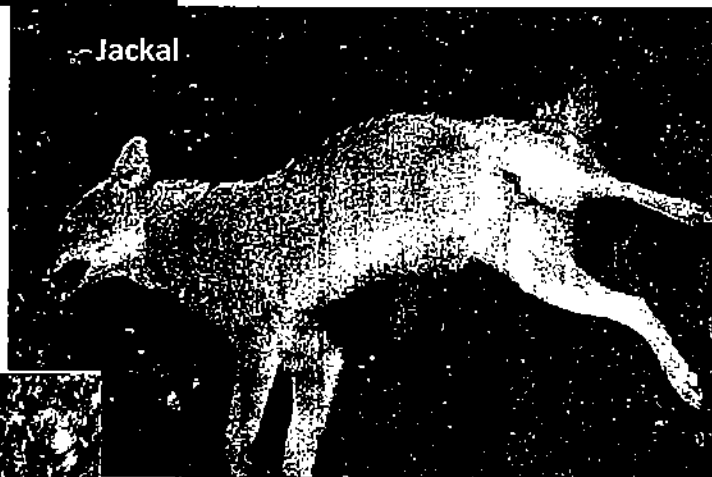
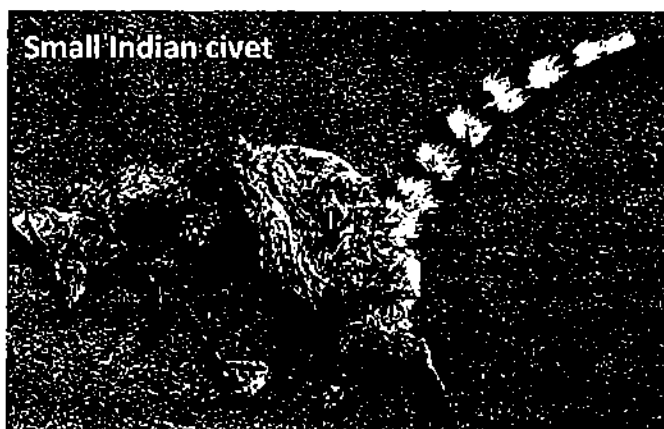
Absence of Desmids in all water samples indicates water may not be potable. Typical indicators of organic pollution as mentioned by Palmer (1962) such as flagellates and Blue greens are either absent or present in a negligible quantity.

Palmer's Algal Pollution Index: When we applied Palmer's algal pollution index, it was observed that only seven species were present and that too in low densities, indicating very low organic pollution. In general the water bodies analysed, appeared to be turbid, and free of organic and inorganic pollution. The prevalence of anthropogenic activities was observed in the area.

9.4 Faunal Studies

Faunal studies were restricted to major groups such as reptiles, birds, mammals and aquatic fauna. For preparation of the checklist of mammals, birds and reptiles of the project area, direct sightings during various baseline studies, interviews with local communities regarding presence or absence of species and forest department records & other relevant literature studies were taken into consideration. The areas reported for the presence of the species were visited during the day as well as night. Apart from the direct sightings of the animals during visits, indirect signs such as dry skin, pugmarks, calls, photographs and droppings were also considered as an indicator for the presence

of the species. During the ecological investigation it is observed that road kills are rare in the project area.



Beaked Blind Snake

A. Mammals: The checklists of mammals, which are present in the study area, are enumerated in the table below.

Table 9.16 Checklist of Prominent Mammals in the Study Area (Systematic Classification -Wilson & Reeder (2005))

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	Order - Scandentia			
	Family - Tupaiidae (Treeshrews)			
1	<i>Anathana ellioti</i> (Waterhouse, 1850)	Madras Treeshrew		LR-nt
	Order - Primates			
	Suborder - Haplorrhini			
	Family - Cercopithecidae (Old World Monkeys)			
	Subfamily - Cercopithecinae (Macaques)			
2	<i>Macaca radiata</i> (E. Geoffroy, 1812)	Bonnet Macaque	Schedule II Part - I	Least Concern
	Subfamily - Colobinae (Langurs and Leaf - monkeys)			
3	<i>Semnopithecus entellus</i> (Dufresne, 1797)	Northern Plains Gray Langur	Schedule II Part - I	Near Threatened
	ORDER: RODENTIA			
	SUBORDER: SCIUROMORPHA			
	Family: Sciuridae (Squirrels)			
	Subfamily: Callosciurinae			
4	<i>Funambulus palmarum</i> (Linnaeus, 1766)	Indian Palm Squirrel		Least Concern
5	<i>Funambulus pennantii</i> Wroughton, 1905	Northern Palm Squirrel	Schedule IV	Least Concern
	SUBORDER: MYOMORPHA			
	Family: Muridae			
	Subfamily: Gerbillinae (Gerbils, birds)			
6	<i>Tatera indica</i> (Hardwicke, 1807)	Indian Gerbil		Least Concern
	Subfamily: Muridae (Rats and Mice)			

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
7	<i>Bandicota bengalensis</i> (Gray, 1835)	Lesser Bandicoot-rat	Schedule V	Least Concern
8	<i>Bandicota indica</i> (Bechstein, 1800)	Greater Bandicoot-rat	Schedule V	Least Concern
9	<i>Bandicota maxima</i> Pradhan et al, 1993	Greater Bandicoot-rat	Schedule V	Least Concern
10	<i>Gohunda ellioti</i> Gray, 1837	Indian Bush Rat	Schedule V	Least Concern
11	<i>Madromys blanfordi</i> (Thomas, 1881)	Blanford's Madromys		Least Concern
12	<i>Millardia melitad</i> (Gray, 1837)	Common Metad		Least Concern
13	<i>Mus booduga</i> (Gray, 1837)	Little Indian Field Mouse	Schedule V	Least Concern
14	<i>Mus musculus</i> Linnaeus, 1758	House Mouse	Schedule V	Least Concern
15	<i>Mus phillipsi</i> Wroughton, 1912	Phillips's Mouse	Schedule V	Least Concern
16	<i>Mus platyhris</i> Bennett, 1832	Flat-haired Mouse	Schedule V	Least Concern
17	<i>Rattus rattus</i> (Linnaeus, 1758)	Roof Rat	Schedule V	Least Concern
18	<i>Vandeleuria oleracea</i> (Bennett, 1832)	Indomalayan Vandeleuria		Least Concern
	SUBORDER: HYSTRICOMORPHA			
	Family: Hystricidae (Old world porcupines)			
19	<i>Hystrix indica</i> Kerr, 1792	Indian Crested Porcupine	Schedule IV	Least Concern
	ORDER: LAGOMORPHA			
	Family: Leporidae (Hares and Rabbits)			
20	<i>Lepus nigricollis</i> F. Cuvier, 1823	Indian Hare	Schedule IV	Least Concern
	ORDER: SORICOMORPHA			
	Family: Soricidae (Shrews)			
	Subfamily: Crocidurinae Tribe: Anourosoricini			
21	<i>Suncus murinus</i> (Linnaeus, 1766)	Asian House Shrew		Least Concern
22	<i>Suncus stoliczkanus</i> (Anderson, 1877)	Anderson's Shrew		Least Concern
	ORDER: CHIROPTERA			

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	Family: Pteropodidae (Old-world fruit bats)			
	Subfamily: Pteropodinae (Fruit bats)			
23	<i>Cynopterus brachyotis</i> (Muller, 1838)	Lesser Short-nosed Fruit Bat	Schedule V	Least Concern
24	<i>Cynopterus sphinx</i> (Vahl, 1797)	Greater Short-nosed Fruit Bat	Schedule V	Least Concern
25	<i>Pteropus giganteus</i> (Brunnich, 1782)	Indian Flying Fox	Schedule V	Least Concern
26	<i>Rousettus leschenautii</i> (Desmarest, 1820)	Leschenault's Rousette	Schedule V	Least Concern
	Family: Megadermatidae (False-vampire bats)			
27	<i>Megaderma Tyra</i> E. Geoffroy, 1810	Greater False Vampire Bat		Least Concern
28	<i>Megaderma spasma</i> (Linnaeus, 1758)	Lesser False Vampire Bat		Least Concern
	Family: Emballonuridae (Sheath-tailed bats)			
	Subfamily: Taphozoinae (Tomb bats)			
29	<i>Taphozous longimanus</i> Hardwicke, 1825	Long-winged Tomb Bat		Least Concern
30	<i>Taphozous melanopogon</i> Temminck, 1841	Black-bearded Tomb Bat		Least Concern
31	<i>Taphozous nudiventris</i> Cretzschmar, 1830	Naked-rumped Tomb Bat		Least Concern
	Family: Vespertilionidae (Vesper bats)			
	Subfamily: Vespertilioninae			
	Tribe: Eptesicini			
32	<i>Hesperoptenus tickelli</i> (Blyth, 1851)	Tickell's Bat		Least Concern
	Tribe: Pipistrellini			
33	<i>Pipistrellus ceylonicus</i> (Kelaart, 1852)	Kelaart's Pipistrelle		Least Concern
34	<i>Pipistrellus coromandra</i> (Gray, 1838)	Indian Pipistrelle		Least Concern
35	<i>Pipistrellus tenuis</i> (Temminck, 1840)	Least Pipistrelle		Least Concern
36	<i>Scotozous dormeri</i> Dobson, 1875	Dormer's Pipistrelle		Least Concern
	Subfamily: Myotinae			

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
37	<i>Myotis horsfieldii</i> (Temminck, 1840)	Horsfield's Myotis		Least Concern
	Subfamily: Miniopterinae (Long-fingered bats, Bent-winged bat)			
38	<i>Miniopterus schreibersii</i> (Kuhl, 1817)	Schreibers's Long-fingered Bat		Least Concern
	ORDER: PHOLIDOTA			
	Family: Manidae (Pangolins)			
39	<i>Manis crassicaudata</i> E. Geoffroy, 1803	Indian Pangolin	Schedule I, Part- I	Vulnerable
	ORDER: CARNIVORA			
	SUBORDER: FELIORMIA			
	Family: Felidae (Cats)			
	Subfamily: Felinae (Cats)			
40	<i>Felis silvestris</i> Schreber, 1777	Wild cat	Schedule I, Part- I	LR-nt
	Subfamily: Pantherinae			
41	<i>Panthera pardus</i> (Linnaeus, 1758)	Leopard	Schedule I, Part- I	Vulnerable
	Family: Viverridae (Civets and Palm civets)			
	Subfamily: Paradoxurinae (Palm civets)			
42	<i>Paradoxurus hermaphroditus</i> (Pallas, 1777)	Asian Palm Civet	Schedule II Part - II	Least Concern
43	<i>Viverricula indica</i> (E. Geoffroy Saint-Hilaire, 1803)	Small Indian Civet	Schedule II Part - II	LR-nt
	Family: Herpestidae (Mongoose)			
	Subfamily: Herpestinae (Mongooses)			
44	<i>Herpestes edwardsii</i> (t. Geoffroy Saint-Hilaire, 1818)	Grey Mongoose	Schedule IV	LR-lc
	Family: Hyaenidae (Hyena)			
45	<i>Hyaena hyaena</i> (Linnaeus, 1758)	Striped Hyena	Schedule III	LR-nt
	SUBORDER: CANIFORMIA			

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	Family: Canidae (Dogs)			
46	<i>Canis aureus</i> Linnaeus, 1758	Golden Jackal	Schedule II Part - II	LR-lc
47	<i>Canis lupus</i> Linnaeus, 1758	Grey Wolf	Schedule I, Part- I	LR-nt
48	<i>Vulpes bengalensis</i> (Shaw, 1800)	Bengal Fox	Schedule II Part - II	LR-lc
	ORDER: ARTIODACTYLA			
	Family: Suidae (Pigs)			
49	<i>Sus scrofa</i> Linnaeus, 1758	Wild Boar	Schedule III	LR-nt
	Family: Bovidae (Cattle, Antelope, Sheep and Goat)			
	Subfamily: Antilopinae (Antelopes)			
50	<i>Antelope cervicapra</i> (Linnaeus, 1758)	Blackbuck	Schedule I, Part- I	LR-lc
51	<i>Gazella bennettii</i> (Sykes, 1831)	Indian Gazelle	Schedule I, Part- I	LR-lc

Table 9.17 Check List of Birds Observed in the Study Area (Systematic classification - Manakadan, R. and Pittie, A. 2001)

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
	Order - Podicipediformes				
	Family - Podicipedidae	Grebes			
1	<i>Tachybaptus ruficollis</i> (Pallas, 1764)		Little Grebe	Schedule IV	LC
	Order - Procellariiformes				
	Family - Phalacrocoracidae	Cormorants/Shags			
2	<i>Phalacrocorax niger</i> (Vieillot, 1817)		Little Cormorant	Schedule IV	LC
3	<i>Phalacrocorax fuscicollis</i> Stephens, 1826		Indian Shag	Schedule IV	LC

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
	Order - Pelecaniformes				
	Family - Anhingidae	Darters			
4	<i>Anhinga melanogaster</i> Pennant, 1769		Darter	Schedule IV	NT
	Order - Ciconiiformes				
	Family - Ardeidae	Heron, Egrets & Bitterns			
5	<i>Egretta garzetta</i> (Linnaeus, 1766)		Little Egret	Schedule IV	LC
6	<i>Ardea cinerea</i> Linnaeus, 1758		Grey Heron		LC
7	<i>Ardea purpurea</i> Linnaeus, 1766		Purple Heron	Schedule IV	LC
8	<i>Casmerodius albus</i> (Linnaeus, 1758)		Large Egret	Schedule IV	-
9	<i>Bubulcus ibis</i> (Linnaeus, 1758)		Cattle Egret	Schedule IV	LC
10	<i>Ardeola grayii</i> (Sykes, 1832)		Indian Pond-Heron	Schedule IV	LC
	Family - Ciconiidae	Storks			
11	<i>Mycteria leucocephala</i> (Pennant, 1769)		Painted Stork	Schedule IV	NT
12	<i>Anastomus oscitans</i> (Boddaert, 1783)		Asian Openbill-Stork	Schedule IV	LC
13	<i>Ciconia nigra</i> (Linnaeus, 1758)		Black Stork	Schedule IV	LC
14	<i>Ciconia episcopus</i> (Boddaert, 1783)		White-necked Stork	Schedule IV	LC
15	<i>Ephippiorhynchus asiaticus</i> (Latham, 1790)		Black-necked Stork	Schedule IV	NT
	Family - Threskiornithidae	Ibises & Spoonbills			
16	<i>Plegadis falcinellus</i> (Linnaeus, 1766)		Glossy Ibis	Schedule IV	LC
17	<i>Threskiornis melanocephalus</i> (Latham, 1790)		Oriental White Ibis	Schedule IV	NT
18	<i>Pseudibis papillosa</i> (Temminck, 1824)		Black Ibis	Schedule IV	LC
19	<i>Platalea leucorodia</i> Linnaeus, 1758		Eurasian Spoonbill	Schedule IV	LC
	Order - Anseriformes				
	Family - Anatidae	Swans, Geese & Ducks			

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
20	<i>Dendrocygna javanica</i> (Horsfield, 1821)		Lesser Whistling-Duck	Schedule IV	LC
21	<i>Anser indicus</i> (Latham, 1790)		Bar-headed Goose	Schedule IV	LC
22	<i>Tadorna ferruginea</i> (Pallas, 1764)		Brahminy Shelduck	Schedule IV	-
23	<i>Sarkidiornis melanotos</i> (Pennant, 1769)		Comb Duck	Schedule IV	LC
24	<i>Nettapus coromandelianus</i> (Gmelin, 1789)		Cotton Teal	Schedule IV	LC
25	<i>Anas poecilorhyncha</i> J.R. Forester, 1781		Spot-billed Duck	Schedule IV	LC
26	<i>Anas clypeata</i> Linnaeus, 1758		Northern Shoveller	Schedule IV	LC
27	<i>Anas acuta</i> Linnaeus, 1758		Northern Pintail	Schedule IV	LC
28	<i>Anas querquedula</i> Linnaeus, 1758		Garganey	Schedule IV	LC
29	<i>Marmaronetta angustirostris</i> (Ménétrières, 1832)		Marbled Teal	Schedule IV	-
30	<i>Rhodonessa rufina</i> (Pallas, 1773)		Red-crested Pochard	Schedule IV	-
31	<i>Aythya ferina</i> (Linnaeus, 1758)		Common Pochard	Schedule IV	LC
32	<i>Aythya fuligula</i> (Linnaeus, 1758)		Tufted Pochard	Schedule IV	LC
	Order - Falconiformes				
	Family - Accipitridae				
		Hawks, Eagles, Buzzards, Old World Vultures, Kites, Harriers			
33	<i>Elanus caeruleus</i> (Desfontaines, 1789)		Black-shouldered Kite	Schedule IV	LC
34	<i>Milvus migrans</i> (Boddaert, 1783)		Black Kite	Schedule IV	LC
35	<i>Haliastur indus</i> (Boddaert, 1783)		Brahminy Kite	Schedule IV	LC
36	<i>Circus melanoleucos</i> (Pennant, 1769)		Pied Harrier	Schedule IV	LC
37	<i>Accipiter badius</i> (Gmelin, 1788)		Shikra	Schedule IV	LC
38	<i>Accipiter virgatus</i> (Temminck, 1822)		Besra Sparrowhawk	Schedule I, Part - III	LC
39	<i>Accipiter nisus</i> (Linnaeus, 1758)		Eurasian Sparrowhawk	Schedule I, Part - III	LC
40	<i>Buteo teesa</i> (Franklin, 1832)		White-eyed Buzzard	Schedule IV	LC
41	<i>Buteo rufinus</i> (Cretzschmar, 1827)		Long-legged Buzzard	Schedule IV	LC

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
42	<i>Ictinaetus malayensis</i> (Temminck, 1822)		Black Eagle	Schedule IV	LC
43	<i>Falco peregrinus</i> Tunstall, 1771		Peregrine Falcon	Schedule I, Part - III	LC
	Order - Galliformes				
	Family - Phasianidae	Pheasants, Partridges, Quails			
44	<i>Francolinus pictus</i> (Jardine & Selby, 1828)		Painted Francolin	Schedule IV	LC
45	<i>Coturnix coturnix</i> (Linnaeus, 1758)		Common Quail	Schedule IV	LC
46	<i>Pavo cristatus</i> Linnaeus, 1758		Indian Peafowl	Schedule I, Part - III	LC
	Order - Gruiformes				
	Family - Gruidae	Cranes			
47	<i>Grus virgo</i> (Linnaeus, 1758)		Demoiselle Crane	Schedule IV	LC
	Family - Rallidae	Rails, Crakes, Moorhens, Coots			
48	<i>Amaurornis phoenicurus</i> (Pennant, 1769)		White-breasted Waterhen	Schedule IV	-
49	<i>Porphyrion porphyrio</i> (Linnaeus, 1758)		Purple Moorhen	Schedule IV	LC
50	<i>Gallinula chloropus</i> (Linnaeus, 1758)		Common Moorhen	Schedule IV	LC
51	<i>Fulica atra</i> Linnaeus, 1758		Common Coot	Schedule IV	LC
	Order - Charadriiformes				
	Family - Jacanidae	Jacanas			
52	<i>Hydrophasianus chirurgus</i> (Scopoli, 1786)		Pheasant-tailed Jacana	Schedule IV	LC
	family - Charadriidae	Plovers, Dotterels, Lapwings			
53	<i>Charadrius dubius</i> Scopoli, 1786		Little Ringed Plover	Schedule IV	LC
54	<i>Vanellus malabaricus</i> (Boddaert, 1783)		Yellow-wattled Lapwing	Schedule IV	-
55	<i>Vanellus indicus</i> (Boddaert, 1783)		Red-wattled Lapwing	Schedule IV	-
	Family - Scolopacidae	Sandpipers, Stints, Snipes, Godwits & Curlews			
56	<i>Tringa stagnatilis</i> (Bechstein, 1803)		Marsh Sandpiper	Schedule IV	-

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
57	<i>Tringa glareola</i> Linnaeus, 1758		Wood Sandpiper	Schedule IV	LC
58	<i>Xenus cinereus</i> (Guldenstadt, 1774)		Terek Sandpiper	Schedule IV	-
59	<i>Actitis hypoleucos</i> Linnaeus, 1758		Common Sandpiper	Schedule IV	LC
60	<i>Calidris ferruginea</i> (Pontoppidan, 1813)		Curlew Sandpiper	Schedule IV	LC
	Family - Recurvirostridae	Ibisbill, Avocets & Stilts			
61	<i>Himantopus himantopus</i> (Linnaeus, 1758)		Black-winged Stilt	Schedule IV	LC
	Family - Laridae	Gulls, Terns & Noddies			
62	<i>Sterna aurantia</i> J.E. Gray, 1831		River Tern	Schedule IV	-
	Order - Columbiformes				
	Family - Pteroclididae	Sandgrouse			
63	<i>Pterocles exustus</i> Temminck, 1825		Chestnut-bellied Sandgrouse	Schedule IV	LC
	Family - Columbidae	Pigeons & Doves			
64	<i>Columba livia</i> Gmelin, 1789		Blue Rock Pigeon	Schedule IV	LC
65	<i>Streptopelia orientalis</i> (Latham, 1790)		Oriental Turtle-Dove	Schedule IV	LC
66	<i>Streptopelia senegalensis</i> (Linnaeus, 1766)		Little Brown Dove	Schedule IV	-
67	<i>Streptopelia chinensis</i> (Scopoli, 1786)		Spotted Dove	Schedule IV	-
68	<i>Streptopelia tranquebarica</i> (Hermann, 1804)		Red Collared-Dove	Schedule IV	-
69	<i>Streptopelia decaocto</i> (Frisvaldsky, 1838)		Eurasian Collared-Dove	Schedule IV	LC
70	<i>Treron phoenicoptera</i> (Latham, 1790)		Yellow-legged Green-Pigeon	Schedule IV	-
71	Order - Psittaciformes				
	Family - Psittacidae	Parakeets & Hanging-Parrots			
	<i>Psittacula krameri</i> (Scopoli, 1769)		Rose-ringed Parakeet	Schedule IV	LC
72	<i>Psittacula roseata</i> Biswas, 1951		Blossom-headed Parakeet	Schedule IV	LC
	Order - Cuculiformes				

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
	Family - Cuculidae	Cuckoos, Malkohas & Coucals			
73	<i>Clamator jacobinus</i> (Boddaert, 1783)		Pied Crested Cuckoo	Schedule IV	LC
74	<i>Hierococyx varius</i> (Vahl, 1797)		Brainfever Bird		-
75	<i>Cuculus canorus</i> Linnaeus, 1758		Common Cuckoo	Schedule IV	LC
76	<i>Eudynamis scolopacea</i> (Linnaeus, 1758)		Asian Koel	Schedule IV	
77	<i>Centropus sinensis</i> (Stephens, 1815)		Greater Coucal	Schedule IV	LC
	Order - Strigiformes				
	Family - Strigidae	Owls			
78	<i>Otus scops</i> (Linnaeus, 1758)		Eurasian Scops-Owl	Schedule IV	LC
	Order - Apodiformes				
	Family - Apodidae	Swifts			
79	<i>Cypsiurus balasensis</i> (J.E. Gray, 1829)		Asian Palm-Swift	Schedule IV	LC
80	<i>Apus affinis</i> (J.E. Gray, 1830)		House Swift	Schedule IV	LC
	Order - Coraciiformes				
	Family - Alcedinidae	Kingfishers			
81	<i>Alcedo althis</i> (Linnaeus, 1758)		Small Blue Kingfisher	Schedule IV	LC
82	<i>Alcedo meninting</i> Horsfield, 1821		Blue-eared Kingfisher	Schedule IV	LC
83	<i>Halcyon smyrnensis</i> (Linnaeus, 1758)		White-breasted Kingfisher	Schedule IV	-
84	<i>Ceryle rudis</i> (Linnaeus, 1758)		Lesser Pied Kingfisher	Schedule IV	-
	Family - Meropidae	Bee-eaters			
85	<i>Merops orientalis</i> Latham, 1801		Small Bee-eater	Schedule IV	LC
	Family - Coraciidae	Rollers			
86	<i>Coracias benghalensis</i> (Linnaeus, 1758)		Indian Roller	Schedule IV	LC
	Family - Upupidae	Hoopoes			

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
87	<i>Upupa epops</i> Linnaeus, 1758		Common Hoopoe	Schedule IV	LC
	Family - Bucerotidae	Hornbills			
88	<i>Ocyeceros birostris</i> (Scopoli, 1786)		Indian Grey Hornbill	Schedule IV	LC
	Order - Piciformes				
	family - Capitonidae	Barbets			
89	<i>Megalaima haemacephala</i> (P.L.S. Müller, 1776)		Coppersmith Barbet	Schedule IV	LC
	Family - Picidae	Woodpeckers			
90	<i>Chrysocolaptes festivus</i> (Boddaert, 1783)		Black-shouldered Woodpecker	Schedule IV	LC
	Order - Passeriformes				
	Family - Alaudidae	Larks			
91	<i>Mirafra assanica</i> Horsfield, 1840		Bengal Bush-Lark	Schedule IV	LC
92	<i>Eremopterix nigriceps</i> (Gould, 1839)		Black-crowned Sparrow-Lark	Schedule IV	LC
93	<i>Ammodramus phoenicurus</i> (Franklin, 1831)		Rufous-tailed Finch-Lark	Schedule IV	-
94	<i>Calandrella brachydactyla</i> (Leisler, 1814)		Greater Short-toed Lark	Schedule IV	LC
95	<i>Calandrella raytal</i> (Blyth, 1845)		Indian Short-toed Lark	Schedule IV	LC
96	<i>Galerida cristata</i> (Linnaeus, 1758)		Common Crested Lark	Schedule IV	LC
97	<i>Alauda arvensis</i> (Linnaeus, 1758)		Eurasian Skylark	Schedule IV	LC
	Family - Hirundinidae	Swallows & Martins			
98	<i>Hirundo concolor</i> Sykes, 1833		Dusky Crag-Martin	-	LC
99	<i>Hirundo rustica</i> Linnaeus, 1758		Common Swallow	-	LC
100	<i>Hirundo tahitica</i> Gmelin, 1789		House Swallow	-	LC
101	<i>Hirundo smithii</i> Leach, 1818		Wire-tailed Swallow	-	LC
102	<i>Hirundo daurica</i> Linnaeus, 1771		Red-rumped Swallow	-	LC
103	<i>Hirundo fluviicola</i> Blyth, 1855		Streak-throated Swallow	-	LC

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
104	Family - Motacillidae	Wagtails & Pipits			
	<i>Dendronanthus indicus</i> (Gmelin, 1789)		Forest Wagtail	-	LC
105	<i>Motacilla alba</i> Linnaeus, 1758		White Wagtail	-	LC
106	<i>Motacilla maderaspatensis</i> Gmelin, 1789		Large Pied Wagtail	-	-
107	<i>Motacilla flava</i> Linnaeus, 1758		Yellow Wagtail	-	LC
108	<i>Motacilla cinerea</i> Tunstall, 1771		Grey Wagtail	-	LC
109	<i>Anthus hodgsoni</i> Richmond, 1907		Oriental Tree Pipit	Schedule IV	LC
	Family - Campephagidae	Cuckoo-Shrikes, Flycatcher-Shrikes, Trillers, Minivets, Woodshrikes			
110	<i>Pericrocotus roseus</i> (Vieillot, 1818)		Rosy Minivet	Schedule IV	LC
111	<i>Pericrocotus flammeus</i> (Forster, 1781)		Scarlet Minivet	Schedule IV	LC
112	<i>Hemipus picatus</i> (Sykes, 1832)		Pied Flycatcher-Shrike	-	-
113	<i>Tephrodornis pondicerianus</i> (Gmelin, 1789)		Common Woodshrike	-	-
	Family - Pycnonotidae	Bulbuls & Finchbills			
114	<i>Pycnonotus cafer</i> (Linnaeus, 1766)		Red-vented Bulbul	Schedule IV	LC
115	<i>Hypsipetes leucocephalus</i> (P.L.S. Muller, 1776)		Black Bulbul	Schedule IV	LC
	Family - Irenidae	Ioras, Chloropsis/Lcafbird, Fairy-Bluebird			
116	<i>Aegithina tiphia</i> (Linnaeus, 1758)		Common Iora	Schedule IV	LC
117	<i>Chloropsis aurifrons</i> (Temminck, 1829)		Gold-fronted Chloropsis	Schedule IV	LC
	Family - Laniidae	Shrikes			
118	<i>Lanius vittatus</i> Valenciennes, 1826		Bay-backed Shrike	-	LC
119	<i>Lanius schach</i> Linnaeus, 1758		Rufous-backed Shrike	-	LC
120	<i>Lanius excubitor</i> Linnaeus, 1758		Great Grey Shrike	-	LC
	Family - Muscicapidae	Thrushes, Shortwings, Robins, Forktails, Wheaters			
	Subfamily - Turdinae				

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
121	<i>Saxicoloides fulvicata</i> (Linnaeus, 1776)		Indian Robin	Schedule IV	-
122	<i>Cercomela fusca</i> (Blyth, 1851)		Indian Chat	Schedule IV	LC
	Family - Muscicapidae Subfamily - Timaliinae	Babblers, Laughingthrushes, Babaxes, Barwings, Yuhinas			
123	<i>Macronous gularis</i> (Horsfield, 1822)		Yellow-breasted Babbler	Schedule IV	LC
124	<i>Chrysomma sinense</i> (Gmelin, 1789)		Yellow-eyed Babbler	Schedule IV	LC
125	<i>Turdoides malcolmi</i> (Sykes, 1832)		Large Grey Babbler	Schedule IV	LC
126	<i>Turdoides sirriatus</i> (Dumont, 1823)		Jungle Babbler	Schedule IV	-
	Family - Muscicapidae Subfamily - Sylviinae	Goldcrest, Prinias, Tesias, Warblers			
127	<i>Prinia buchanani</i> Blyth, 1844		Rufous-fronted Prinia	-	LC
128	<i>Prinia hodgsonii</i> Blyth, 1844		Franklin's Prinia	-	LC
129	<i>Prinia sylvatica</i> Jerdon, 1840		Jungle Prinia	-	LC
130	<i>Prinia socialis</i> Sykes, 1832		Ashy Prinia	-	LC
131	<i>Prinia inornata</i> Sykes, 1832		Plain Prinia	-	LC
132	<i>Orthotomus sutorius</i> (Pennant, 1769)		Common Tailorbird	-	LC
	Family - Muscicapidae Subfamily - Muscicapinae	Flycatchers			
133	<i>Muscicapa dauurica</i> Pallas, 1811		Asian Brown Flycatcher	Schedule IV	LC
134	<i>Ficedula westermanni</i> (Sharpe, 1888)		Little Pied Flycatcher	Schedule IV	LC
	Family - Muscicapidae Subfamily - Monarchinae	Monarch-Flycatchers & Paradise-Flycatchers			
135	<i>Terpsiphone paradisi</i> (Linnaeus, 1758)		Asian Paradise-Flycatcher	Schedule IV	LC
	Family - Paridae	Tits			

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
136	<i>Parus major</i> Linnaeus, 1758		Great Tit	Schedule IV	LC
137	<i>Parus nuchalis</i> Jerdon, 1844		Pied Tit	Schedule IV	VU
	Family - Nectariniidae	Sunbirds & Spiderhunters			
138	<i>Nectarinia zeylonica</i> (Linnaeus, 1766)		Purple-rumped Sunbird	Schedule IV	-
149	<i>Nectarinia minima</i> (Sykes, 1832)		Small Sunbird	Schedule IV	LC
140	<i>Nectarinia asiatica</i> (Latham, 1790)		Purple Sunbird	Schedule IV	LC
	Family - Zosteropidae	White-eyes			
141	<i>Zosterops palpebrosus</i> (Temminck, 1824)		Oriental White-eye	Schedule IV	LC
	Family - Estrildidae	Munias (Estrildid Finches)			
142	<i>Lonchura malabarica</i> (Linnaeus, 1758)		White-throated Munia	Schedule IV	LC
143	<i>Lonchura kelaarti</i> (Jerdon, 1863)		Black-throated Munia	Schedule IV	LC
144	<i>Lonchura punctulata</i> (Linnaeus, 1758)		Spotted Munia	Schedule IV	LC
	Family - Passeridae	Sparrows & Snowfinches			
	Subfamily - Passerinae				
145	<i>Passer domesticus</i> (Linnaeus, 1758)		House Sparrow	-	LC
	Family - Passeridae Subfamily - Ploceinae	Weavers			
146	<i>Ploceus philippinus</i> (Linnaeus, 1766)		Baya Weaver	Schedule IV	LC
	Family - Sturnidae	Starlings & Mynas			
147	<i>Sturnus pagodarum</i> (Gmelin, 1789)		Brahminy Starling	Schedule IV	LC
148	<i>Sturnus roseus</i> (Linnaeus, 1758)		Rosy Starling	Schedule IV	LC
149	<i>Sturnus contra</i> Linnaeus, 1758		Asian Pied Starling	Schedule IV	LC
150	<i>Acridotheres tristis</i> (Linnaeus, 1766)		Common Myna	Schedule IV	LC
	Family - Dicruridae	Drongos			
151	<i>Dicrurus macrocerus</i> Vieillot, 1817		Black Drongo	Schedule IV	LC

Sr. No.	Scientific Name	Group Name	Common Name	IWPA Status	IUCN Status
152	<i>Dicrurus caeruleus</i> (Linnaeus, 1758)		White-bellied Drongo	Schedule IV	LC
	Family - Corvidae	Crows, Jays, Treepies, Magpies			
153	<i>Dendrocitta vagabunda</i> (Latham, 1790)		Indian Treepie	Schedule IV	LC
154	<i>Corvus splendens</i> Vieillot, 1817		House Crow	Schedule V	LC
155	<i>Corvus macrorhynchos</i> Wagler, 1827		Jungle Crow	Schedule IV	LC

LC: Least Concern, NT: Near Threatened, VU: Vulnerable

C. Reptiles:

Species like Rat snake, Indian Cobra, Sand Boa, Beaked Blind snake and Checkered Keel-back snake were reported to be present in the study area. The Checkered Keel Back was observed in the river Tiru (tributary of river Lendi, during aquatic ecology sampling). Rat snakes and Cobra were reported nearby the human habitation, agricultural fields as well as wilderness areas.

Table 9.18 Checklist of Prominent Reptiles that have distribution in the Study Area (Systematic classification - R. Aengals, V.M. Sathish kumar and Muhamed Jafer Palot)

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	PHYLUM: CHORDATA			
	CLASS: REPTILIA			
II	ORDER : TESTUDINES			
	Suborder: Cryptodira			
	3. Family Bataguridae (Emydidae)			
1	<i>Melanochelys trijuga</i> (Schweigger, 1812)	Indian black turtle,		LR-nt
2	<i>Pangshura tentoria</i> Gray, 1834	Indian tent turtle	Schedule I, Part - II	Vulnerable
	5. Family Dermochelyidae			
	6. Family Testudinidae			
3	<i>Geochelone elegans</i> (Schoepff, 1795)	Indian star tortoise	-	Vulnerable
	7. Family Trionychidae		-	
4	<i>Nilssonia leithii</i> (Gray, 1872)	Deccan Soft Shelled Turtle	Schedule -IV	Vulnerable
5	<i>Chitra indica</i> (Gray, 1830)	Indian Narrow Headed Turtle		
6	<i>Lissemys punctata</i> (Bonnaterre, 1789)	Indian flapshell turtle	Schedule -I, Part - II	LRnt
III	ORDER : SQUAMATA			
	Suborder : Sauria			
	8. Family Agamidae			
7	<i>Calotes versicolor</i> (Daudin, 1812)	Indian garden lizard	-	LRnt
8	<i>Psammophilus blanfordianus</i> (Stoliczka, 1871)	Blanford's rock agama		LRnt
9	<i>Sitana ponticeriana</i> Cuvier, 1829	Fan throated lizard	-	LRlc

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	10. Family Chamaeleonidae			
10	<i>Chamaeleo zeylanicus</i> Laurenti, 1768	Indian Chamaeleon		Vulnerable
	12. Family Eublepharidae			
11	<i>Eublepharis macularius</i> (Blyth, 1854)	Common leopard gecko		LRlc
	13. Family Gekkonidae			
12	<i>Hemidactylus brookii</i> Gray, 1845	Brook's house gecko	-	LRlc
13	<i>Hemidactylus flaviviridis</i> Rüppell, 1835	Yellow green house gecko		LRlc
14	<i>Hemidactylus leschenaultii</i> Duméril & Bibron, 1836	Bark gecko		LRlc
15	<i>Hemidactylus maculatus</i> Duméril & Bibron, 1836	Spotted house gecko		LRlc
	14. Family Lacertidae			
16	<i>Ophisops jerdoni</i> Blyth, 1853	Snake-eyed lacerta		LRlc
	15. Family Scincidae			
17	<i>Eutropis carinata</i> (Schneider, 1801)	Common keeled skink		LRnt
18	<i>Eutropis trivittata</i> (Hardwicke & Gray, 1827)	Three-lined grass skink		LRlc
19	<i>Lygosoma punctata</i> (Gmelin, 1799)	Spotted supple skink	-	LRlc
	17. Family Varanidae			
20	<i>Varanus bengalensis</i> (Daudin, 1802)	Monitor Lizard	Schedule - I, Part - II	VU
	Suborder: Serpentes			
	18. Family Typhlopidae			
21	<i>Ramphotyphlops braminus</i> (Daudin, 1803)	Brahminy worm snake	Schedule IV	LRnt
22	<i>Typhlops porrectus</i> Stoliczka, 1871	Slender worm snake	Schedule IV	LRnt
23	<i>Grypotyphlops acutus</i> (Duméril & Bibron, 1844)	Beaked worm snake	Schedule IV	LRnt
	23. Family Boidae			
24	<i>Gongylophis conicus</i> (Schneider, 1801)	Common sand boa	Schedule IV	LRlc

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
25	<i>Eryx johnii</i> (Russell, 1801)	Red sand boa	Schedule IV	LRlc
	25. Family Colubridae			
26	<i>Coelognathus helena helena</i> (Daudin, 1803)	Common trinket snake		LRnt
27	<i>Pyas mucosa</i> (Linnaeus, 1758) x	Indian Rat Snake	Schedule II, Part II	LRnt
28	<i>Argyrogena fasciolata</i> (Shaw, 1802)	Banded racer	Schedule IV	LRnt
29	<i>Oligodon taeniolatus</i> (Jerdon, 1853)	Russell's kukri snake	Schedule IV	LRnt
30	<i>Oligodon arnensis</i> (Shaw, 1802)	Common kukri snake	Schedule IV	LRlc
31	<i>Lycodon striatus</i> (Shaw, 1802),	Barred wolf snake	Schedule IV	LRnt
32	<i>Lycodon aulicus</i> (Linnaeus, 1754),	Common wolf snake	Schedule IV	LRlc
33	<i>Amphiesma stolatum</i> (Linnaeus, 1758)	Striped keelback	Schedule IV	LRnt
34	<i>Xenochrophis piscator</i> (Schneider, 1799)	Checkered keelback	Schedule - II, Part - II	LRlc
35	<i>Macrophistodon plumbicolor</i> (Cantor, 1839)	Green keelback	Schedule IV	LRlc
36	<i>Boiga trigonata</i> (Bechstein, 1802)	Common cat snake	Schedule IV	LRlc
37	<i>Ahaetulla nasuta</i> (Lacepede, 1789)	Common vine snake	Schedule IV	LRnt
	26. Family Elapidae			
38	<i>Bungarus caeruleus</i> (Schneider, 1801)	Common Indian krait	Schedule IV	LRnt
39	<i>Calliophis melanurus</i> (Shaw, 1802)	Slender coral snake	Schedule IV	LRnt
40	<i>Naja naja</i> (Linnaeus, 1758)	Spectacled cobra	Schedule II, Part II	LRnt
	28. Family Viperidae			
41	<i>Daboia russelii</i> (Shaw & Nodder, 1797)	Russell's viper	Schedule - II, Part - II	LRnt
42	<i>Echis carinatus</i> (Schneider, 1801)	Saw-scaled viper	Schedule IV	LRnt

LR -nt: Low Risk, near threatened, LR -lc: Low Risk, least concern, CR: Critically Endangered, VU: Vulnerable

D. Aquatic fauna

Aquatic faunal species at river Lendi and downstream i.e. up to river Manjira is reported by Fishery, Fish Farming Development Agency, Nanded.

Table 9.19 The checklist of the prominent aquatic species is provided in the table below: (Systematic classification - K. Rema Devi & T.J.Indra)

Sr. No	Scientific Name	Common Name	Status	Remark	Distribution
I	Order - Cypriniformes				
	Family - Cyprinidae				
	Sub Family - Cyprininae				
1	<i>Cirrhinus mirigala</i> (Ham-Buch)	Mrigal, Kandai	Common	it is a major carp	Northern India
2	<i>Cirrhinus reba</i> (Ham-Buch)	Reba carp	Common	Clear water inhabitant	Throughout India
3	<i>Puntius sophore</i> (Ham-Buch)	Spot fin swamp barb	Common	It is found in plains	Throughout India
4	<i>Puntius ticto</i> (Ham-Buch)	Khavali	Common	Surface feeder	Throughout India except Kerala & South Tamilnadu
	Subfamily - Rasbora				
5	<i>Devario aequipinnatus</i> McClelland	Balooki	Common	It is a larvivorous fish	Throughout India
6	<i>Rasbora daniconius</i> (Ham-Buch)	Danda, Gaimasa	Common	It moves in shoal	Throughout India
7	<i>Rasbora rasbora</i> (Ham-buch)	Ganggetic scissor tailed rasbora	Uncommon	It is a aquarium fish	India: West Bengal, Assam, Maharashtra
	Subfamily - Garrinae				
8	<i>Garra mulya</i> (Sykes)	Mallya	Common	It is bottom Dweller fish	Throughout India except Assam and Himalayas
	Family - Balitoridae				
	Subfamily - Nemacheilinae				

Sr. No	Scientific Name	Common Name	Status	Remark	Distribution
9	<i>Acanthocobitis baia</i> (Ham-Buch)	Loach	Common	It is an indicator of clear water	Northern India
	Family - Cobitidae				
	Subfamily - Cobitinae				
10	<i>Lepidocephalichthys thermalis</i> (Val.)	Stone loach	Common	Hill Stream fish	India: Kerala, Karnataka, M.S.
11	Order - Siluriformes				
	Family - Bagridae				
	Subfamily - Bagrinae				
11	<i>Mystus bleekeri</i> (Day)	Singhala	Common		Northern India
12	<i>Sperata seenghala</i> (Sykes)	Giant river Cat Fish	Common		Ganga, Yamuna, Krishna, Godavari & Kaveri River System of India
	Subfamily - Ritiinae				
13	<i>Rita kuturnee</i> (Sykes)	Katamee	Common		Rivers of Maharashtra, Karnataka, A.P.
	Family - Siluridae				
14	<i>Ompok bimaculatus</i> (Bloch)	Butter Cat Fish	Common	It is tasty food fish	Throughout India
	Family - Clariidae				
	Subfamily - Heteropneustinae				
15	<i>Heteropneustes fossilis</i> (Bloch)	Singing Cat Fish, Bicchu ka kata	Common	It is of high economic importance	Throughout India
III	Order - Atheriniformes				
	Family - Belontiidae				
16	<i>Xenotodon cancula</i> (Ham-Buch)	Freshwater gar fish, Choch masa	Common	It is surface living fish	Throughout India
IV	Order - Perciformes				
	Family - Ambassidae				
17	<i>Parambassis ranga</i> (Ham-Buch.)	Glassy Fish	Common	Transparent Fish	Throughout India

Sr. No	Scientific Name	Common Name	Status	Remark	Distribution
18	<i>Chanda nama</i> (Ham-Buch)	Glassy perch	Common	Useful in guinea worm & Mosquito control	Throughout India
	Family - Cichlidae				
19	<i>Oreochromis mossambica</i> (Peters)	Tilapia	Exotic common	Harmful to Native stock	Throughout India
	Family - Chanidae				
20	<i>Channa striatus</i> (Bloch)	Striped Snakeheaded	Common	It is food Fish	Throughout India
21	<i>Channa marulius</i> (Ham-Buch)		Common	Aquarium fish in various regions	Throughout India
V	Order - Synbranchiformes				
	Family - Mastacembelidae				
	Subfamily- Mastacembelinae				
22	<i>Macragnathus pancatus</i> (Ham-Buch.)	Striped spiny eel, Muri Vam	Common	Inhabits plains	Throughout India
23	<i>Mastacembelus armatus</i> (Lacepede)	Tire-track spiny eel	Common		Throughout India

The river Lendi is seasonal and get almost dry in summer, which restricts the movement & migration of the fishes. No migratory fish species is recorded from the area.

Creation of the reservoir will help in fisheries development, both culture as well as breeding.

E. Insects: The checklists of insects, which are present in the study area, are enumerated in the table below.

Table 9.20 Insects recorded in the study area during the study (Systematic classification - Avtar Kaur Sidhu, Kailash Chandra and P. C. Pathania Updated till January, 2010)

No.	Common Name	Scientific Name
	Order - Lepidoptera	
	Family - Hesperidae	
1	Golden angle	<i>Coprona ransonnati</i> (Felder, 1868)
	Family - Lycaenidae	
2	Common cerulean	<i>Jamides celeno</i> (Cramer, 1775)
3	Zebra blue	<i>Tarucus plinius</i> (Fabricius, 1793)
	Family - Nymphalidae	
4	Glossy tiger	<i>Parantica aglea</i> (Stoll, 1782)
5	Plain tiger	<i>Danais chrysippus</i> (Linnaeus, 1758)
6	Leopard butterfly	<i>Phalanta phalantha</i> (Drury, 1773)
7	Tawny coster	<i>Acraea terpsicore</i> (Linnaeus, 1758)
8	Blue tiger	<i>Tirumala septentrionalis</i> (Buller, 1874)
9	Common crow	<i>Euploea core</i> (Cramer, 1780)
10	Glossy blue tiger	<i>leopis vulgaris</i> (Buller, 1874)
11	Stripped tiger	<i>Danais genutia</i> Cramer, 1779
12	Baronet	<i>Euthalia nais</i> (Forster, 1771)
13	Blue pansy	<i>Junonia orithya</i> (Linnaeus, 1758)
14	Chocolate pansy	<i>Junonia iphita</i> (Cramer, 1779)
15	Common leopard	<i>Phalanta phalantha</i> (Drury, 1773)
16	Indian fritillary	<i>Argynnis hyperbius</i> (Linnaeus, 1763)
17	Peacock pansy	<i>Junonia almana</i> (Linnaeus, 1758)
18	Yellow pansy	<i>Junonia hierta</i>
19	Common evening brown	<i>Melanitis leda</i> (Linnaeus, 1758)
	Family - Papilionidae	
20	Blue mormone	<i>Papilio polymnestor</i> Cramer, 1775
21	Common rose	<i>Atrophaneura (Pachliopta) aristolochiae</i> (Fabricius, 1775)
22	Common mormon	<i>Papilio polytes</i> Linnaeus, 1758
23	Common rose	<i>Atrophaneura (Pachliopta) aristolochiae</i> (Fabricius, 1775)
24	Lime butterfly	<i>Papilio demoleus</i> Linnaeus, 1758
	Family - Pieridae	
25	Grass yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)
26	Common Jezebel	<i>Delias eucharis</i> (Drury, 1773)
27	Common emigrant	<i>Catopsilia pomona</i> Fabricius, 1775
28	Common grass yellow	<i>Eurema hecabe</i> (Linnaeus, 1758)
29	Lemon emigrant	<i>Catopsilia pomona</i> Fabricius, 1775
	Family - Pseudocercaria	
30	Pale grass blue	<i>Pseudocercaria uahia</i> (Kollar 1848)

F. Conclusion

Following 23 species belonging to schedule I & II of the wild life protection act 1972 (As amended up to 2006) have been reported from the project area. Out of these, twelve species belong to class Mammalia; four species belong to class Aves while remaining seven species belong to class Reptilia.

Table No.9.21 Conservation status of the Faunal Species

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
	Class- Mammalia			
1	<i>Macaca radiata</i> (E. Geoffroy, 1812)	Bonnet Macaque	Schedule II Part - I	Least Concern
2	<i>Semnopithecus entellus</i> (Dufresne, 1797)	Northern Plains Gray Langur	Schedule II Part - I	Near Threatened
3	<i>Manis crassicaudata</i> E. Geoffroy, 1803	Indian Pangolin	Schedule I Part- I	Vulnerable
4	<i>Felis silvestris</i> Schreber, 1777	Wild cat	Schedule I, Part- I	LR-nt
5	<i>Panthera pardus</i> (Linnaeus, 1758)	Leopard	Schedule I Part- I	Vulnerable
6	<i>Paradoxurus hermaphroditus</i> (Pallas, 1777)	Asian Palm Civet	Schedule II Part - II	Least Concern
7	<i>Viverricula indica</i> (E. Geoffroy Saint-Hilaire, 1803)	Small Indian Civet	Schedule II Part - II	LR-nt
8	<i>Canis aureus</i> Linnaeus, 1758	Golden Jackal	Schedule II Part - II	LR-lc
9	<i>Canis lupus</i> Linnaeus, 1758	Grey Wolf	Schedule I Part- I	LR-nt
10	<i>Vulpes bengalensis</i> (Shaw, 1800)	Bengal Fox	Schedule II Part - II	LR-lc
11	<i>Antelope cervicapra</i> (Linnaeus, 1758)	Blackbuck	Schedule I Part- I	LR-lc
12	<i>Gazella bennettii</i> (Sykes, 1831)	Indian Gazelle	Schedule I Part- I	LR-lc
	Class - Aves			
1	<i>Accipiter virgatus</i> (Temminck, 1822)	Besra Sparrowhawk	Schedule I Part - III	LC

Sr. No	Scientific Name	Common Name	IWPA Status	IUCN Status
2	<i>Accipiter nisus</i> (Linnaeus, 1758)	Eurasian Sparrowhawk	Schedule I Part - III	LC
3	<i>Falco peregrinus</i> Tunstall, 1771	Peregrine Falcon	Schedule I Part - III	LC
4	<i>Pavo cristatus</i> Linnaeus, 1758	Indian Peafowl	Schedule I, Part - III	LC
	Class: Reptilia			
1	<i>Pangshura tentoria</i> Gray, 1834	Indian tent turtle	Schedule I, Part - II	Vulnerable
2	<i>Lissemys punctata</i> (Bonnaterre, 1789)	Indian flapshell turtle	Schedule - I, Part - II	LRnt
3	<i>Varanus bengalensis</i> (Daudin, 1802)	Monitor Lizard	Schedule - I, Part - II	VU
4	<i>Ptyas mucosa</i> (Linnaeus, 1758) x	Indian Rat Snake	Schedule II, Part II	LRnt
5	<i>Xenochrophis piscator</i> (Schneider, 1799)	Checkered keelback	Scheduled- II Part II	LRlc
6	<i>Naja naja</i> (Linnaeus, 1758)	Spectacled cobra	Schedule II, Part II	LRnt
7	<i>Daboia russelii</i> (Shaw & Nodder, 1797)	Russell's viper	Schedule - II, Part - II	LRnt

G. Nearest Protected Area

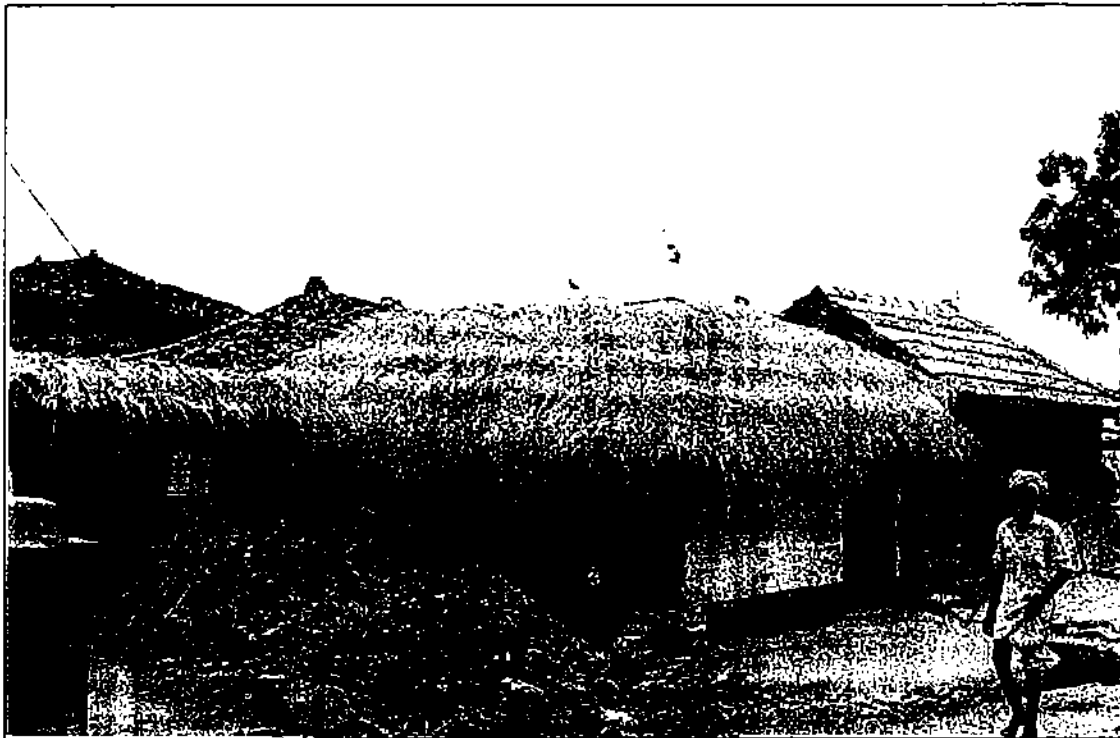
There are no protected areas within the 25 km radius from the command and Catchment area of the Lendi Major Interstate Project.

CHAPTER – 10

SOCIO ECONOMIC

STUDIES

CHAPTER 10.0 SOCIO-ECONOMIC STUDY



10.1 General Introduction and Scope:

As a part of Environmental Impact Assessment, socio-economic study mainly involves obtaining information on demographic structure, existing infrastructure facilities (education, water supply sanitation, roads, electricity, school, post office, bank, village panchayat, police station approach road etc.) and occupational structure. The study is an attempt to assess and quantify the impacts of the project interventions so that ameliorative measures can be planned to substantially enhance the overall social benefits accruing from the project. To understand the socio-economic impacts of the dam, we shall study human settlements/project affected families/beneficiaries from the catchment and command areas. We would also make effort to understand the impacts during the construction and during post-construction phase.

The impacts in the catchment area are related to socio-economic changes in families and villages whose lands and houses are submerged due to the project. It is necessary to review and study the potential socio-economic impacts of the project on the project affected people and the other villages in the catchment area as well as their views on

the project. The impacts in the command area can be related to positive impacts due to increased irrigated area as well as impacts of canal construction.

Construction of project is generally expected to provide increased job opportunities during construction as skilled and unskilled labourers by contractors and hence improvement of socio-economic condition of the region. It is expected that there will be improvement in the transport facility, education, medical and marketing facilities. It will help build infrastructure facilities, water supply, sanitation and communication facilities. The influx of migrant workers may have some adverse impact on life style and cultural values of the local communities. The social life style of the people may change which may be beneficial or harmful to the community. Hence, critically analyzing the baseline status of the socio-economic profile and visualizing the scenario with the proposed project is essential.

There might be certain negative impacts of proposed intervention on socio-economic environment due to the following:

- ❖ Change in land use pattern
- ❖ Loss and change of occupation
- ❖ Immigration of population from nearby areas for employment
- ❖ Strain on the existing infrastructure

Similarly, there will be certain positive impacts of the proposed project on the socio-economic environment due to the following:

- ❖ General development of the area, infrastructure and communication facilities
- ❖ Increased agricultural yield
- ❖ Enhanced employment opportunities
- ❖ Better education facilities
- ❖ Development of other ancillary industries based on agricultural products, fishery etc.

The chapter covering the above aspects has been divided into two parts.

Part I (10.3): Socio-economic information and demographic details obtained from the literature study forms part I of the study. It includes the latest available data Census

2011 (census 2001 data is extrapolate considering the district wise growth rate in census 2011)

Part II (Chapter 14): Primary data obtained on project affected families using questionnaire. The data provided by the project authorities on project affected villages as well as data obtained from 2001 Census was utilized for the preparation of sampling plan.

The outcome of the study is expected to help us anticipate and evaluate impacts of the proposed and existing interventions of Lendi major interstate project on the local community. The intended exercise is expected to enhance our understanding of:

- Distribution and characteristics of the human population including aspects like life pattern, communities, employment, public facilities, education, agriculture, animal husbandry, health facilities and housing among others
- Cultural, social and economic setting of the general area with recognition of the resource use and the natural environment
- The expected livelihood changes resulting from the acquisition of land for project purposes and the compensation offered
- Evaluation of possible impacts with reference to tribal communities of the area.

10.2 Methodology

Part I (10.3): Socio-economic information and demographic details obtained from the literature study forms part I of the study. It includes the latest available data Census 2011 (census 2001 data is extrapolate considering the district wise growth rate in census 2011)

Part II (Chapter 14): Primary data obtained on project affected families using questionnaire. The data provided by the project authorities on project affected villages as well as data obtained from 2001 Census was utilized for the preparing a sampling plan.

In the present context, secondary information has been obtained and analyzed so as to address various objectives mentioned above. The detailed primary information collection exercise was carried out using questionnaire survey for the Project Affected Families (PAFs) of the project. For this, a comprehensive questionnaire was designed and survey conducted for obtaining pertinent information on the socio-economic aspects of Project-Affected Families (PAFs). Though free exchange of ideas is desirable in such studies, in order to maintain uniformity, a questionnaire was found necessary to guide the interview process. The household survey was thought to be the most appropriate method of data collection, for the following reasons:

- ✓ The acquisition of land will affect the family; degree of its impact on the individual heads will vary.
- ✓ For undertaking various measures of development, family can be considered as more viable social unit.
- ✓ Household was thus found to be a more meaningful unit of inquiry for collection of information. Hence, instead of interviewing individual persons, they would be interviewed in the context of their families. This will also make it possible to correlate the impacts with varying family characteristics.
- ✓ The response given by the respondent should be considered as an appropriate response than what it is in reality. However, the information provided in such an interview would be recorded and evaluated without any prejudice or bias.
- ✓ The village-wise list of project-affected families was obtained and was used to identify them. Hundred percent sampling was undertaken for PAFs.
- ✓ Information generated through informal group discussions was also used. Group discussion will be the second method of data collection that was adopted in the study. These were planned for verifying the trends and seeking their qualitative explanations. The groups were formed to represent the entire village profile. As and when and wherever possible, the panchayat members, representatives of local organizations, school teachers etc. were included in these groups; and a formal discussion was held with entire PAF and insights obtained during this meeting were also included.



Meeting with PAFs and Project Authorities

- ✓ Additionally, the village level questionnaire was filled in during group discussions at village level.
- ✓ The questionnaire designed for this purpose and executed in the field is provided as an annexure.

The detailed outcome of the questionnaire survey forms Part II of this Chapter. On the other hand the Part I – Socioeconomic study is based on the secondary information and insights obtained during actual field surveys. The section on the health survey however is based on the primary data collected using questionnaire.

10.3 Part I: Socioeconomic Studies: It includes the latest available data Census 2011 (census 2001 data is extrapolate considering the district wise growth rate in census 2011)

The recent Census 2011 data (census 2001 data is extrapolate considering the district wise growth rate in census 2011) available was utilized to obtain socioeconomic status of the local community. This includes 2 Talukas of Maharashtra territory and 2 talukas / mandals of Andhra Pradesh territory in command area and Mukhed takula of Nanded district in submergence area. The results are summarized at Taluka level.

10.3.1 Command area: (Maharashtra & Andhra Pradesh)

Table 10.1 Demographic and Socio-economic Information of Villages in command area of Maharashtra & Andhra Pradesh

(Source: Census 2001 & census 2001 data is extrapolated considering the district wise growth rate in census 2011)

Teluka	NAME	No_HH	TOT_P	TOT_M	TOT_F	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	P_UT	P_IL	TOT_WORK_P	NON_WORK_P	MAIN_WORK_P	MARG_WORK_P
Mukhed	Lonai	113	637	327	310	211	107	104	0	0		489	147	324	313	303	21
Mukhed	Aurai	108	692	341	351	206	103	103	73	34	39	532	160	347	346	177	169
Mukhed	Rajura Bk.	631	3816	1958	1858	541	268	273	349	177	172	2932	884	1569	2247	1105	464
Mukhed	Ambulga Bk.	568	3402	1763	1639	916	469	448	1011	523	488	2614	788	1347	2055	952	394
Mukhed	Ambulga Kh.	10	50	29	21	0	0	0	0	0	0	38	12	28	22	12	16
Mukhed	Igyal P.D.	166	1037	545	492	304	165	139	0	0	0	797	240	469	568	379	89
Mukhed	Sangvi Bhadev	181	969	457	512	255	115	140	0	0	0	744	224	402	566	181	222
Mukhed	Thana	70	379	190	189	197	93	104	28	10	17	291	88	148	231	61	87
Mukhed	Rajura Kh.	118	698	351	347	280	140	139	261	129	132	537	162	376	322	188	188
Mukhed	Lingapur	102	559	281	278	41	19	22	38	20	19	430	129	196	363	121	75
Deglur	Wannai	389	2583	1321	1262	384	194	190	0	0	0	1985	598	1152	1431	1119	32
Deglur	Khanapur	777	4649	2388	2261	1484	762	721	161	93	68	3572	1077	2297	2352	1978	319
Deglur	Antapur	179	1165	580	585	324	171	153	0	0	0	895	270	405	760	229	176
Deglur	Chalapur	325	1943	979	964	502	254	248	223	113	110	1493	450	945	998	686	260
Deglur	Munjalga	209	1357	698	659	679	349	329	14	6	8	1043	314	669	688	652	17
Deglur	Takli Bagam	170	1245	644	601	334	171	164	9	5	5	956	288	541	704	121	420
Deglur	Tadkhel	608	3975	2031	1944	1593	804	789	205	94	111	3054	921	1606	2369	1029	578
Deglur	Degaon Bk.	384	2454	1233	1221	246	137	109	20	9	10	1886	568	1227	1227	856	341
Deglur	Malkapur	45	280	145	135	111	61	50	0	0	0	215	65	88	191	50	38

Taluka	NAME	No_HH	TOT_P	TOT_M	TOT_F	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	P_LIT	P_HL	TOT_WORK_P	NON_WORK_P	MAIN_WORK_P	MARG_WORK_P
Deglur	Achegaon	201	1200	630	571	674	367	307	107	53	53	922	278	537	663	204	333
Deglur	Bhayeagaon	181	1178	571	608	371	184	187	0	0	0	906	273	452	726	394	58
Deglur	Kavalgadda	218	1220	640	580	393	213	180	108	53	55	938	283	643	578	304	339
Deglur	Tupshelgaon	134	702	346	356	515	257	257	22	9	13	539	163	293	408	268	26
Deglur	Limba	93	445	229	217	99	50	49	0	0	0	342	103	215	231	21	194
Deglur	Rampur P.shahapur	18	109	53	56	26	9	16	0	0	0	84	25	64	45	61	2
Deglur	Kotekallur	199	1141	573	568	502	245	257	29	14	15	877	264	579	563	399	180
Deglur	Alur	531	3096	1577	1518	1198	610	588	314	164	151	2379	717	1604	1492	701	904
Deglur	Nandur	198	1065	542	523	332	168	164	31	17	14	818	247	603	462	257	346
Deglur	Shevala	447	2611	1323	1287	1114	568	545	531	259	273	2006	605	1294	1316	805	489
Deglur	Shekhapur	43	194	100	94	30	16	14	34	19	15	149	45	92	102	80	12
Deglur	Shelgaon	809	3962	2016	1946	1362	705	657	341	183	158	3045	918	2422	1540	1009	1413
Deglur	Kare Malkapur	105	621	322	298	369	191	177	50	29	21	477	144	240	380	126	114
Deglur	Shahapur	1153	6666	3364	3302	1209	622	587	299	161	138	5122	1544	3095	3571	1495	1600
Deglur	Sujayapur	115	491	241	249	409	204	205	0	0	0	377	114	230	261	42	188
Deglur	Narangal Bk.	602	3608	1827	1782	1205	599	607	624	314	310	2773	836	1793	1815	880	913
Deglur	Tamlur	826	4897	2541	2356	1593	810	783	753	386	367	3763	1134	2474	2423	2156	318
Deglur	Mendankallur	358	1987	1036	951	383	209	174	138	70	68	1527	460	907	1080	126	781
Deglur	Sangvi Umar	430	2178	1103	1075	906	460	445	77	45	31	1674	504	1216	963	658	558
Deglur	Thadi Sawargaon	173	938	481	457	122	67	55	75	32	43	721	217	481	457	273	209
Deglur	Mandgi	283	1487	770	717	949	494	455	51	27	24	1143	344	601	886	600	1
Deglur	Kurudgi Bk	137	834	415	419	339	173	166	0	0	0	641	193	426	408	313	113
Deglur	Takli Walag	65	394	211	183	168	90	78	6	3	2	303	91	217	177	41	176
Deglur	Hanuman	183	1081	553	528	329	162	167	212	106	107	831	250	472	609	465	7

Taluka	NAME	No_HH	TOT_P	TOT_M	TOT_F	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	P_LIT	P_ILL	TOT_WORK_P	NON_WORK_P	MAIN_WORK_P	MARG_WORK_P
	Hipparga																
Deglur	Sundgi Bk.	198	1298	661	637	300	162	138	0	0	0	997	301	499	799	493	6
Deglur	Hawarga	199	1203	592	611	383	189	194	43	22	21	924	279	579	624	419	160
Deglur	Malegaon (M)	431	2739	1374	1364	702	349	353	473	239	234	2104	634	1255	1484	724	531
Madnoor	Salabathpur	65	386	189	197	118	55	62	0	0	0	240	146	174	212	136	38
Madnoor	Chinna Shekkarga	162	857	438	419	199	103	96	0	0	0	534	324	401	456	339	62
Madnoor	Pedda Shekkarga	393	2230	1124	1106	274	138	136	0	0	0	1388	842	1029	1201	448	581
Madnoor	Sonala	78	412	195	218	165	74	91	0	0	0	257	156	221	191	44	177
Madnoor	Thadi Hipparga	283	1590	824	766	595	292	304	0	0	0	990	600	725	865	478	247
Madnoor	Limboor	358	1956	991	965	582	293	289	0	0	0	1218	738	912	1044	523	388
Madnoor	Hassa Takli	106	530	267	263	164	86	78	0	0	0	330	200	263	267	106	158
Madnoor	Pedda Takli	183	1236	633	603	387	193	195	1	0	0	769	467	447	789	138	309
Madnoor	Sirpur	244	1290	681	609	435	222	213	0	0	0	803	487	625	666	171	454
Madnoor	Mahad Hipparga	313	1684	840	844	406	187	219	0	0	0	1048	636	949	735	596	353
Madnoor	Elegaon	121	610	298	312	102	44	59	0	0	0	380	230	318	293	317	1
Madnoor	Kurla	239	1261	631	630	218	106	112	0	0	0	785	476	687	574	545	141
Madnoor	Enbhura	247	1408	739	669	244	122	122	0	0	0	876	531	772	635	749	24
Madnoor	Dongli	502	2650	1334	1316	591	285	306	55	29	26	1650	1001	1333	1318	976	357
Madnoor	Mogha	383	2166	1070	1097	442	215	226	0	0	0	1348	818	1148	1018	892	256
Madnoor	Madnur	1550	8665	4349	4316	1252	607	645	100	46	54	5394	3271	3725	4940	2273	1452
Madnoor	Lachmapur	22	144	65	78	144	65	78	0	0	0	89	54	71	73	36	35
Madnoor	Marepalle	171	1086	534	552	388	196	193	0	0	0	676	410	539	547	485	53
Madnoor	Dhoti	123	733	364	369	199	95	104	0	0	0	456	277	499	234	499	0
Madnoor	Mallapur	157	763	406	357	169	79	89	0	0	0	475	288	430	333	430	0

Taluka	NAME	No_HH	TOT_P	TOT_M	TOT_F	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	P_LIT	P_ILL	TOT_WORK_P	NON_WORK_P	MAIN_WORK_P	MARG_WORK_P
Madnoor	Sultanpet	261	1506	768	738	293	154	138	5	2	3	937	568	719	787	387	332
Madnoor	Lachan	278	1875	938	937	565	284	281	0	0	0	1167	708	848	1027	526	322
Bichkunda	Rajola	248	1370	696	673	358	181	177	0	0	0	853	517	446	924	407	39
Bichkunda	Mishankallali	252	1438	732	706	187	95	92	0	0	0	895	543	734	704	228	506
Bichkunda	Gundekalloor	198	1139	579	560	339	169	171	0	0	0	709	430	646	493	596	50
Bichkunda	Khatgaon	228	1337	715	622	321	183	138	44	23	21	832	505	675	663	458	217
Bichkunda	Shetloor	176	1049	519	530	332	157	175	0	0	0	653	396	610	438	262	348
Bichkunda	Meka	83	448	235	213	36	16	20	0	0	0	279	169	152	296	49	103
Bichkunda	Hasgul	456	2811	1384	1427	269	135	134	0	0	0	1750	1061	1222	1590	378	844
Bichkunda	Bichkunda	2314	12788	6540	6248	1293	638	655	503	263	239	7961	4828	4850	7938	3413	1437
	Total	23677	136655	69432	67223	35652	18023	17629	7419	3782	3638	96628	40027	63587	73068	40427	23160

Demography of the Project Villages: Four tehsils are coming under the command area of proposed project. The total number of villages in command area of these tehsils is 76, of which Degloor has highest number of villages i.e. 36. Total 136653 population will be benefited.

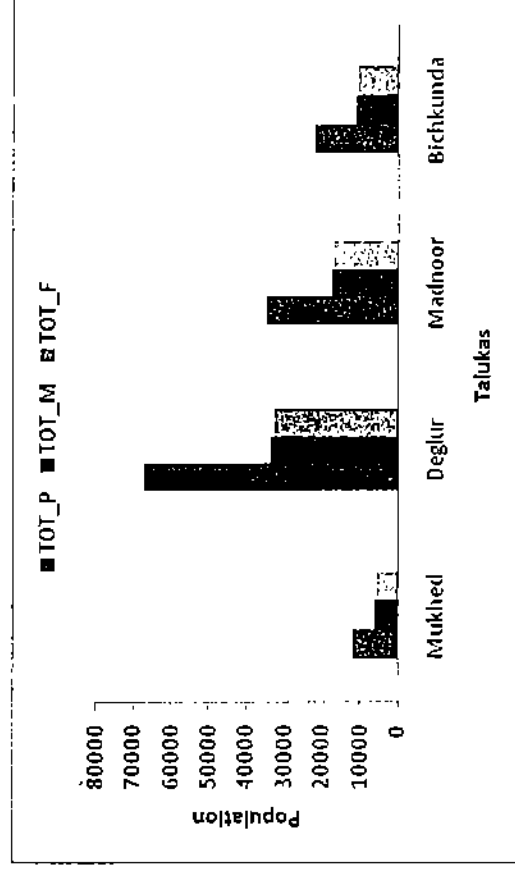
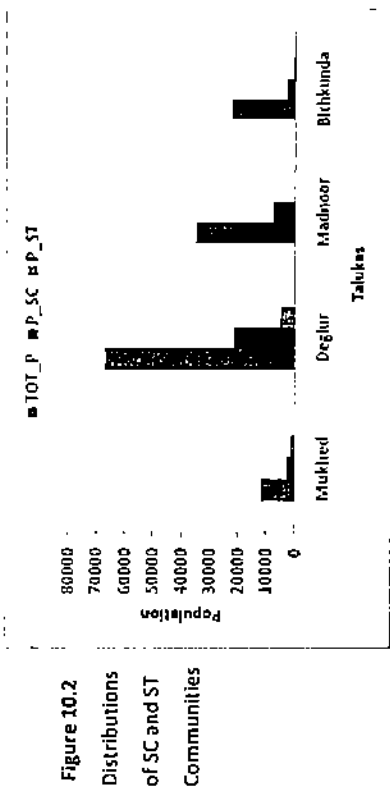
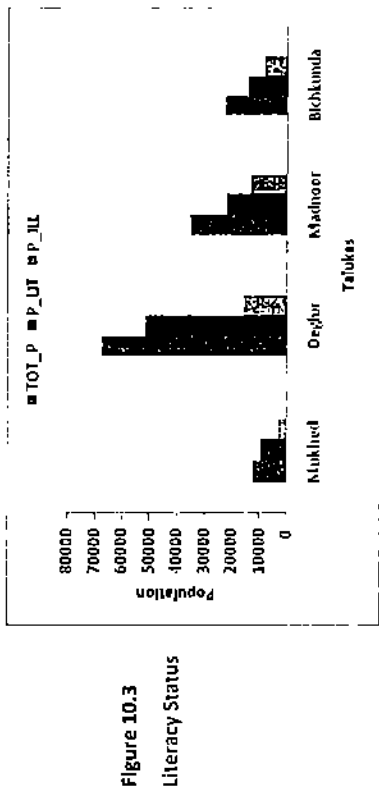


Figure 10.1 Demography of Project Village

SC and ST Population: Madnoor tehsil has lowest population of the ST community while the Degloor tehsil has the highest ST population. For details, refer to Figure 10.2.



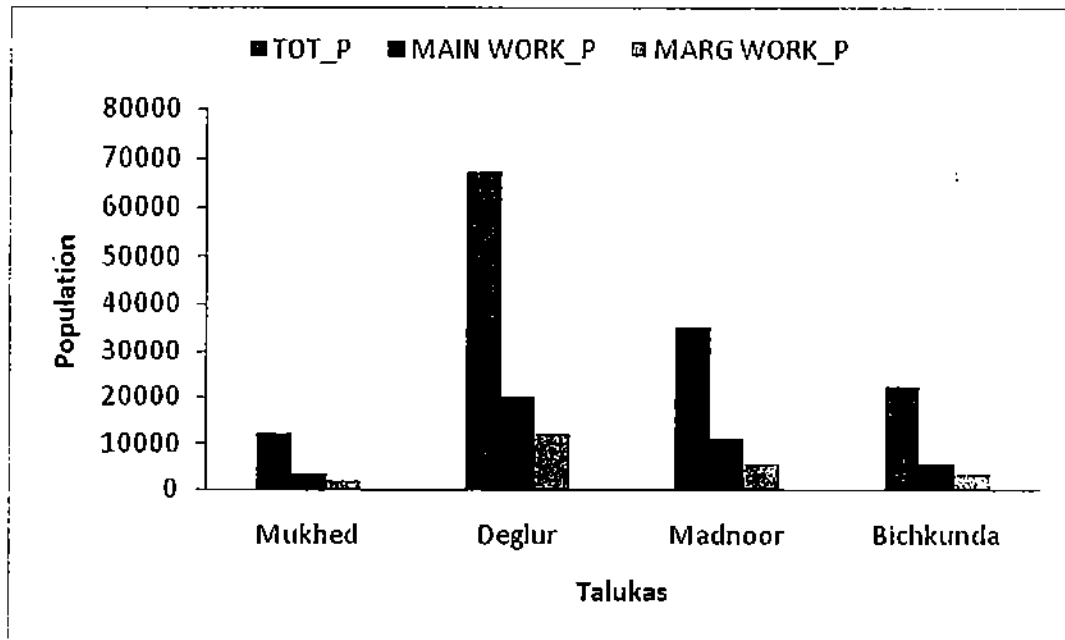
Literacy Status: Overall literacy rate is 71% in the study area and 29 % of the population is illiterate. Tehsils in Maharashtra showed a high literacy rate, as compared to the tehsils of Andhra Pradesh. Among the literate, males have higher percentage in comparison to the females.



Working and Dependent Class of Population: Distribution of working class and nonworking class is very distinct. About 46% population is working while 54% of the population is in nonworking class. There are many more persons in non-working

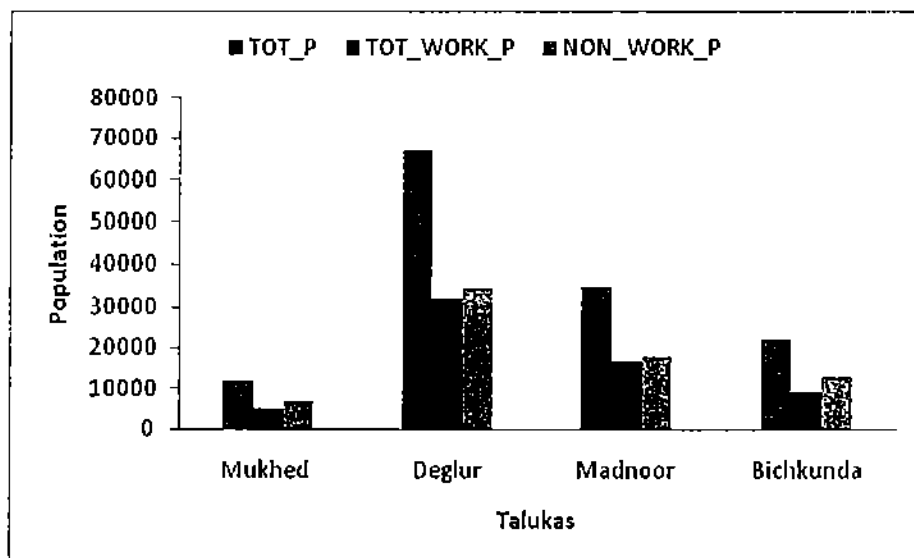
population for the Nizamabad district in comparison with the Nanded district. The situation needs urgent attention.

Figure 10.4 Working and Dependent Class of Population



Main and Marginal Workers: Majority of the population is engaged in main occupation while relatively less population is engaged in marginal work such as agriculture wages, auto rickshaw drivers, industry, small business etc. The main occupation of the population is identified as agriculture.

Figure 10.5 Main and Marginal Workers



10.3.2 Submergence Area:

Table No.10.2 Demographic and Socio-economic Information of Villages In Submergence area (Source: Census 2001 & census 2001 data is extrapolated considering the district wise growth rate in census 2011)

Taluka	NAME	No_HH	TOT_P	TOT_M	TOT_F	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	P_LIT	P_ILL	TOT_WORK_P	NON_WORK_P	MAIN_WORK_P	MARG_WORK_P
Mukhed	Kolnur	177	930	479	451	340	176	164	168	92	77	715	215	467	463	387	80
Mukhed	Hasnal	218	1094	565	529	438	230	209	17	8	9	840	253	514	580	311	203
Mukhed	Bhingoli	114	654	333	321	166	86	80	0	0	0	503	152	255	399	131	124
Mukhed	Bhendegaon Bk.	151	777	387	390	302	152	150	10	5	6	597	180	459	318	293	166
Mukhed	Bhendegaon Kh.	250	1387	726	661	241	122	119	41	24	16	1066	321	714	673	472	242
Mukhed	Walanki	277	1557	811	746	380	196	184	36	20	16	1196	361	869	688	798	71
Mukhed	Mukramabad	1249	8123	4184	3939	1141	618	523	90	49	42	6242	1881	3140	4983	2353	786
Mukhed	Bhaswadi	326	1775	930	844	79	41	38	0	0	0	1364	411	941	834	608	333
Mukhed	Bhatapur P.Mu.	55	299	146	153	111	48	64	0	0	0	230	69	145	154	128	17
Mukhed	Ravangaon	284	1775	955	820	339	197	142	140	65	75	1364	411	695	1080	444	251
Mukhed	Marajwadi	280	1395	701	695	353	175	177	3	2	1	1072	323	653	742	307	346
Mukhed	Itgyal P.Mu.	431	2174	1125	1049	483	251	232	74	43	31	1670	503	1008	1166	998	10
		3812	21940	11342	10598	4373	2292	2082	579	308	273	16859	5080	9860	12080	7230	2629

12 villages of Mukhed taluka will be submerged due to proposed project. The total affected population is 21940 as per Census 2011. Bhaswadi has lowest population of the SC community while the Kolnur has the highest ST population.

10.3.3 Preliminary insights on Socio-economic Aspects

The Lendi Project is a joint project between the Governments of Maharashtra and Andhra Pradesh. Irrigation facilities from this project will be available to areas largely in Nanded District in Maharashtra and Nizamabad District in Andhra Pradesh. The population is mainly agrarian with sizable illiterates. Therefore, intensive efforts are required towards educating the masses. Also, majority of the populations seems to be without proper employment and hence creation of employment needs to be undertaken on war-footing. Since agriculture is the main source of livelihood, agro-based industries needs to be promoted in the region. The proposed project involves construction of dam for irrigation purposes and, therefore, an overall boost in agriculture is expected. Also, small agro-based industries and other enterprises are expected as a spin-off of overall development of the region. The proposed project therefore attaches much importance to the poor community and will trigger developmental process of the region. Otherwise, even if the river is flowing within a few kilometres from the region, due to lack of sufficient funds, people have not opted for irrigation on cooperative basis, as normally is the case with the western Maharashtra.

The survey conducted by the Irrigation Department has been presented here as a sample survey to investigate 'Socio-economic status'. The major findings are as follows:

- ❖ The land of 19 villages is being affected due to Lendi Project. (12 Villages are fully Submerged & land of 7 villages are being affected)
- ❖ The average family size is around 5 and population is skewed towards male.
- ❖ Sizable population is illiterate while only 10% of the population was graduate
- ❖ Around 60% of the population comes under un-employed category

- ❖ Major occupation is agriculture, followed by agricultural labour and are the major contributors to the livelihood

Expenditure in consumer category is mostly towards food like cereals, pulses and oil, cooking fuel, and clothing. The quantity and frequency of consumption vary with the economic level of the household. Expenditure towards education is less than that of social function and health. In addition to the above study, we have undertaken detailed study of Project Affected Families and results are presented in the Rehabilitation and Resettlement Section - II.

10.4 Health Status

The total submergence area (about 2338.06 ha.) of Lendi Major Irrigation Project lies in Mukhed taluka of Nanded District and major part of command in Maharashtra State falls in Degloor Taluka. After the construction of the Dam and commencement of irrigation, the overall water use in and around the submergence area and command area will rise. This situation may result in positive or negative impacts on the health of local residents which was decided to be explored as a part of Health Delivery System of Lendi Major Irrigation Project, Nanded Irrigation Circle, Nanded. In this situation it is essential to prepare an action plan to monitor and to deal with if any emergency arises. Keeping this in mind detailed Health Management plan, based upon both the primary as well as secondary data is prepared.

The Lendi Major interstate project involves water supply to two States, i.e. Maharashtra and Andhra Pradesh. A dam that will be constructed across the river Lendi will play the role of a reservoir. The command area of the project is split up in already irrigated and prosperous area and the areas, which are poor or not irrigated. Determining the exact health status is therefore will be a challenge. This would involve collection of information from both healthcare providers and beneficiaries. Though the community members are in a position to comment on the prevailing health status, they are quite unable to predict the possible impact on overall health, whether the situation improves or worsens. Thus, the data was collected from various healthcare providers – both public and private from the command area as well as from the

nearby already irrigated areas and non-irrigated areas, to get a comparative picture of the health situation. The data collected is based on the actual records and experience of health personnel working in both types of areas and used for predicting the health status in the command area when the project becomes functional. Assessment is mainly done on increase, decrease or no change in the status of various diseases. The pattern of the diseases in the areas and the differential ways of tackling the problems by the resident people can also be used for analysing the health impacts.

Location and Project brief: The project envisages a construction of earthen dam and masonry weir across the Lendi River upstream of village Gonegaon, Taluka Mukhed in Nanded district for irrigating the land of both the states i.e. Mukhed and Degloor talukas of Nanded district of Maharashtra and Madnoor and Bichkunda mantel / Tehsils of Nizamabad district of Andhra Pradesh.

The common main canal takes off from the L/S flank of Lendi dam. The length of common carrier canal is 19.00 km. From common canal originates 28.46 km long left bank canal, which irrigates 15710 ha of land in Nanded, Maharashtra. The length of right bank canal which starts from 18.98 km which irrigates 11214 ha. of land mainly in drought prone areas of Nizamabad district, Andhra Pradesh. The main and branch canals are completely lined. At full development, the annual irrigation envisaged from the project is 26924 ha. The intensity of irrigation will be 124% for Maharashtra and 100% for Andhra Pradesh.

Methodology: The present assessment therefore involved interviews of the health functionaries and the local people in the area. The data is collected in the form of an interview guide precisely designed to obtain the necessary information required for assessment and prediction of health status of the people residing in the Project area, such as command, catchment and submergence. The data is then compiled and analysed in order to come up with the necessary inferences. Information from the selected places is collected from different health functionaries like Medical Officers, Auxiliary Nurse Midwife (ANM) and/or private practitioners. In certain places information is also collected from community leaders like school teachers.

The list of Primary Health Centres (PHC), Sub centres and civil hospitals that come under the project area is given below:

Primary Health Centres: Shahapur, Rajura, Barhali, Sawargaon, Sawarmal, Jamb (bk), Candola, Markhel, Hanegaon.

Civil Hospital : Mukramabad, Degloor, Madnoor.

Sub centres: Hasnal, Ravangaon, Bhayegaon, Khanapur, Narangal, Chaiinpur, Shelgaon, Ambulga, Rajura, Eklara, Tamrur, Dabka Gundopant, Sugaon, Kalambar, Wadgaon, Manjari, Junna, Kamjalaga, Sawargaon, Mukramabad, Dabka Raja, Jamb (bk), Sawarmal, Gojegaon, Ravi, Degaon, Undari, Billali, Jahur, Yeoti, Eklara, Mala, Angarga, Betmogara, Motarga, Maoli, Ralgara, Chandola, Alur, Banhali, Shahpur, Hanegaon, Loni, Malegaon, Shilvani, Bembra, Yedur, Wazar, Kumarpalli, Karadkhed, Zari, Kawalgaon, Degloor, Belur, Yergi.

The study was conducted throughout the catchment, submergence and the command area of the project.

It was observed during the study that seasonal diseases associated with change in the climate are very common. People of vulnerable group are more commonly affected due to diarrhoea, cough, common cold, dysentery, worm infestation, etc. This is due to poor sanitary practices and improper storage of water. Supply of water is scanty and irregular in some of the areas, thus people practice storage of water to some extent. Where water availability is more frequent, wastage of water is observed. Proper drainage facilities are not available. Thus water remains stagnant at places causing diseases. Stagnant water has lead to mosquito borne diseases that arise due to mosquito bite. Recent occurrence of *Chicken guinea* is one such example. Almost 60% of the population from all the villages were affected due to Chicken guinea. People are still found suffering from this disease.

Due to various reasons, people get attracted towards tobacco chewing, gutkha and alcoholism at a very young age. Thus Tuberculosis (TB), Nervous breakdown, 2nd or 3rd stage blood/lung/oral cancer, Sub mucous fibrosis of the mouth, Gastritis, Duodenal

ulcer, cirrhosis and alcohol are other diseases reported from here. Cases of HIV/AIDS are common in the people those are migratory, such as drivers, people who frequently migrate in big cities for jobs or labours.

Self-medication is rare and, where it occurs is associated with common diseases. Other cases of dog bite, snakebites or injuries due to any accident are scanty and are treated immediately in hospitals and PHC. It is observed that people prefer PHC to private hospitals, as quoted by some of the private doctors. Diseases such as hepatitis, arthritis, skin infections, and malnutrition are observed in vulnerable groups. On the other hand antenatal and post-natal care is observed and people are seen to attach prime importance towards this care. Immunization, food and feeding habits, sanitation are given a priority in larger towns. Private Doctors maintain a follow up procedure with these patients for ensuring a cure, especially at Mukramabad, Degloor, and Khanapur.

All the PHC and sub centres are reported to have health care equipments and the facility functions at satisfactory level for the medicines to cope up with initial care. Any serious case is immediately referred to *Nagri Hospital* at Mukramabad or the *Gramin Rugnalaya* at Degloor. But some of these hospitals are less equipped in terms of availability of medical kits. This sometimes results in suffering of patients and leads to rushing of patients to the main hospital at Nanded if the case is serious. The Gramin rugnalaya at Degloor has a good campus and is equipped with some of the latest equipment. Their laboratory and other departments are supported by qualified staff. However, fund scarcity for medicines sometimes deters patients to approach this place. For example, not a single blood bank is operating in this region and can be seen as major drawback in planning.

The village where resettlement is proposed, viz. Khanapur, at present does not have good health delivery system. At present, it has only a single room *Nagari hospital* and no medical stores are present here. However, once people start residing, such facilities can be made available here. People from the adjoining areas of proposed reservoir, often visit hospitals at Degloor even for minor health problems.



Proposed resettlement site-Khanapur

The premises of PHC and hospital surveyed have cleanliness at satisfactory level but no facility for biomedical waste management. At many places, after the delivery, the placenta is handed over to the family members of the patient for disposal. Also, the other sanitary waste is mostly dumped in an open pit. This attracts dogs, and pigs and unhealthy situation prevails. In places, where incineration facilities are available for hospital waste, lack of manpower is reported to be a factor preventing the utilization of such facility.

10.5 Health Management Plan

At present the employment in non-agriculture sector is grim. Even the agriculture has not flourished well in the region because of shortage of water. In many places people are forced to migrate in search of livelihood. The migratory and floating population is thus a cause for bringing in various infections like malaria, dengue, tuberculosis and HIV, which are communicable. The present health status of people revealed incidences of water borne diseases. The water borne diseases are attributed to scarcity of water and poor or no purification of drinking water. Anaemia, malnutrition, skin infections and leprosy are also reported from this area. Health awareness is especially poor in rural areas.

However health surveys during the present study have revealed no epidemic of any of the diseases in the recent period, except that of chicken guinea. For the digestive disorders that are linked with water, purified water supply would be able to reduce such incidences. Following measures are suggested to avoid any risk of water borne diseases and to maintain good hygiene conditions in the project area.

- ❖ Provision of adequate and safe drinking water along with irrigation facilities to the villages in order to check waterborne diseases. Health awareness/education programmes along with provision of 'Sulabh Shouchalaya' type community toilets will go a long way in preventing such diseases.
- ❖ Provision of improved sanitation, purified and piped water supply and vaccination to check water borne communicable diseases like viral hepatitis, eye infection, diarrhoea, enteric fever, skin infection (scabies), cholera, jaundice, viral gastro enteritis, typhoid, hepatitis A & E, Leptospirosis. Most of these diseases already exist and others also show a high chance of occurrence given the present availability of water and the prevailing sanitary conditions.
- ❖ Providing improved health facilities and making people aware of the general health issues, existing health status, causes of diseases, their control measures, practising personal hygiene, treatment seeking etc.
- ❖ Along with irrigation water, which will bring prosperity and economic development to the area, provisions need to be made for setting up educational institutions.
- ❖ Improved transport facilities to ensure smooth in flow and outflow of people, buying and selling of agricultural products, better communication, accessibility to educational institutions, health centres, markets etc.
- ❖ Setting up of community health centres and appointing health workers or NGOs, to make people aware and educate them about various health issues, their communicability, control measures to be taken, better ways of living to be adopted, personal hygiene and sanitation, encouraging them to seek health

treatment facilities etc. Awareness is required to be created so that no new infections would add. More awareness about safe sexual practices may control the spread of HIV infection.

- ❖ Since agricultural scene is definitely going to improve with availability of irrigation water, there will be a need to purchase or improved cattle varieties. In this case there should be a parallel provision to market various products from livestock like milk and milk products, poultry etc. Better transport facilities will enhance the export of these dairy and other products in outside markets, which will in turn give them more means of livelihood.
- ❖ Creating more livelihoods means to make the resident people self-sufficient and decrease the migration of the working group to urban centres in search of work and improve their living standards. Such decrease in migration would in turn check the spread of deadly diseases like HIV, which is common in most of the villages and other diseases like malaria, typhoid, tuberculosis etc. The improved living standards of the people will decrease life style related diseases like anaemia and malnutrition.
- ❖ Provision of pest control facilities like fumigation, spraying, rodent control etc. in the villages, which will reduce incidences of malaria.
- ❖ Improvisation of infrastructure and facilities including medicine supply and trained manpower for hospitals and PHCs would improve the health scenario of the region.
- ❖ Also, people need to be trained in the area of selecting from products which would have ready markets in larger cities. They should also be trained to use IT infrastructure so as to keep larger margins than is possible when the middleman gobble up the major share of wealth, leaving producers in poverty. In short, people should be encouraged to become market-savvy through education and use of IT.

CHAPTER – 11

SOCIAL IMPACT

ASSESSMENT

CHAPTER 11.0 SOCIAL IMPACT ASSESSMENTS

11.1 Introduction

As a part of Environmental Impact Assessment, socio-economic study mainly involves obtaining information on demographic structure, existing infrastructure facilities (education, water supply sanitation, roads, electricity, school, post office, bank, village panchayat, police station approach road etc.) and occupational structure. The study is an attempt to assess and quantify the impacts of the project interventions so that ameliorative measures can be planned to substantially enhance the overall social benefits accruing from the project. To understand the socio-economic impacts of the dam, we did survey human settlements/project affected families/beneficiaries from the submergence areas.

11.2. Description of the Project

The Lendi Major Irrigation project is a joint venture of Maharashtra and Andhra Pradesh States. The project was administratively approved by the Government of Maharashtra in the year 1986. Irrigation facilities from this project would benefit to the areas largely in Nanded District in Maharashtra and Nizamabad District of Andhra Pradesh.

The project envisages construction of an earthen dam and masonry weir across the Lendi River, upstream of village Gonegaon, Taluka Mukhed in Nanded District for irrigating the land of both the States i.e. Mukhed and Degloor talukas of Nanded district of Maharashtra and Madnoor and Bichkunda mandal / Tehsils of Nizamabad district of Andhra Pradesh.

In the context of Lendi Project, construction of Lendi Dam will result in impounding of water. This will result in submergence of land, house, other structures etc., in 19 villages of Mukhed (Nanded District), Maharashtra. Out of these, 12 villages are required to be fully resettled. For the remaining 7 villages only agricultural land is going to be submerged and habitations will remain intact. Overall, nearly 30680

Project Affected Persons (PAPs) across 5731 families will loose their houses and are to be relocated in different resettlement gaothans.

11.3. Methodology

The Social Impact Assessment Report has been prepared on the basis of Primary data and available secondary data.

The primary data is obtained on by interview of project affected families using questionnaire as well as group discussion. The questionnaire was designed to obtain the information on socio-economic aspects as well as status of the families before the resettlement was obtained.

The supplementary secondary data obtained from Census was utilized for the SIA. The information thus obtained is analysed.

11.4. Social Impact Assessment

The main objective of this section is to assess the economic and social status of the PAPs. It is imperative to know, whether the living standard of the project affected families will be improved as a consequence of this project. Therefore, the specific inquiries were made during the survey with following objectives:

- ❖ To determine the total number of PAPs to be affected by Lendi Project,
- ❖ To determine their social and economical status, household asset structure, losses in course of acquisition/displacement and compensation,
- ❖ To ascertain the sources and levels of household income so as to identify economically vulnerable sections among the PAPs,
- ❖ To assess the loss of public and common lands and their impact on future living standard,
- ❖ Ascertain the loss of any public infrastructure and social services (as available to PAPs) as a result of land acquisition, and

- ❖ To formulate suggestions for improving the status of the PAPs and linking it with Government schemes. Also to suggestion if any, on upgrading and maintenance of the civic amenities being provided in the Resettlement Gaothan.

In the present context, secondary information has been obtained and analyzed so as to address various objectives mentioned above. The detailed primary information collection exercise was carried out using questionnaire survey for the Project Affected Families (PAFs) of the project. For this, a comprehensive questionnaire was designed and survey conducted for obtaining pertinent information on the socio-economic aspects of Project-Affected Families (PAFs). Though free exchange of ideas is desirable in such studies, in order to maintain uniformity, a questionnaire was found necessary to guide the interview process. The household survey was thought to be the most appropriate method of data collection, for the following reasons:

- ✓ The acquisition of land will affect the family; degree of its impact on the individual heads will vary.
- ✓ For undertaking various measures of development, family can be considered as more viable social unit.
- ✓ Household was thus found to be a more meaningful unit of inquiry for collection of information. Hence, instead of interviewing individual persons, they would be interviewed in the context of their families. This will also make it possible to correlate the impacts with varying family characteristics.
- ✓ The response given by the respondent should be considered as an appropriate response than what it is in reality. However, the information provided in such an interview would be recorded and evaluated without any prejudice or bias.
- ✓ The village-wise list of project-affected families was obtained and was used to identify them. Hundred percent sampling was undertaken for PAFs.
- ✓ Information generated through informal group discussions was also used. Group discussion will be the second method of data collection that was adopted in the study. These were planned for verifying the trends and seeking their qualitative explanations. The groups were formed to represent the entire village profile. As

and when and wherever possible, the panchayat members, representatives of local organizations, school teachers etc. were included in these groups; and a formal discussion was held with entire PAF and insights obtained during this meeting were also included.



Meeting with PAFs

- ✓ Additionally, the village level questionnaire was filled in during group discussions at village level.
- ✓ The questionnaire designed for this purpose and executed in the field is provided as an annexure.

The detailed outcome of the questionnaire survey forms and insights obtained during actual field surveys are as follows.

Preliminary insights on Socio-economic Aspects

The population is mainly agrarian with sizable illiterates. Therefore, intensive efforts are required towards educating the masses. Also, majority of the populations seems to be without proper employment and hence creation of employment needs to be undertaken on war-footing. Since *agriculture is the main source of livelihood*, agro-based industries needs to be promoted in the region. The proposed project involves construction of dam for irrigation purposes and, therefore, an overall boost in

agriculture is expected. Also, small agro-based industries and other enterprises are expected as a spin-off of overall development of the region. The proposed project therefore attaches much importance to the poor community and will trigger developmental process of the region. Otherwise, even if the river is flowing within a few kilometres from the region, due to lack of sufficient funds, people have not opted for irrigation on cooperative basis, as normally is the case with the western Maharashtra.

11.5. Baseline Condition of Project Affected Families

The detailed survey of PAFs was carried out and results are described in the following paragraphs.

i) **Distribution of Sex:** Table 11.1 shows, distribution of sex among the project affected families. Sex ratio (the number of females per 1000 males) for India is 933 females per 1000 males. Out of the total 27284 project affected persons, 13984 are males while 13300 are females (1000:951); this is above national average and state average (1000:922).

Table 11.1 Population Distribution of Project Affected Villages

Sr. No.	Village	No. of Males	No. of Females	Total
1	Bamni	89	98	187
2	Bhaswadi	1529	1289	2818
3	Bhatapur	212	199	411
4	Bhendegaon (Bk)	359	367	726
5	Bhendegaon (Kh)	700	715	1415
6	Bhingoli	640	660	1300
7	Dornali	82	69	151
8	Hasnal	633	581	1214
9	Itgyal	1498	1492	2990
10	Kabnoor	50	49	99
11	Kalambar	8	9	17
12	Kolnur	572	501	1073
13	Lakhmapur	218	183	401
14	Marajwadi	1060	1029	2089
15	Mukramabad	3607	3601	7208
16	Paratpur	37	38	75

17	Ravangaon	1713	1532	3245
18	Ravi	47	38	85
19	Walanki	1019	948	1967
	Total	13984	13300	27284

ii) **Age distribution:** The age distribution among the project affected persons is 9409 in age class between 0-17, 9505 in age class between 18-34 and 8552 in above 35. The last two classes together contribute to the working class. We find, more population in the working class than that of young class pursuing education. The village wise age-class distribution is provided below:

Table 11.2 Age distribution among the project affected persons

Sr. No.	Village Name	Age Distribution		
		0-17	18-34	35 and Above
1	Bamni	65	70	52
2	Bhaswadi	1091	966	761
3	Bhatapur	143	115	153
4	Bhendegaon (Bk)	290	224	212
5	Bhendegaon (Kh)	445	470	500
6	Bhingoli	418	464	418
7	Dornali	47	51	53
8	Hasnal	433	341	440
9	Itgyal	985	1078	927
10	Kabnoor	38	26	35
11	Kalambar	4	4	2
12	Kolnur	342	371	360
13	Lakhmapur	146	132	123
14	Marajwadi	782	780	527
15	Mukramabad	2416	2506	2286
16	Paratpur	25	19	31
17	Ravangaon	1013	1147	1085
18	Ravi	23	35	27
19	Walanki	720	722	525
	Total	9409	9505	8552

iii) **Caste Distribution:** Except for the 15 households where caste details are not revealed, for the rest of the population, SC contributed up to 18% of families, while ST contributed up to 2.6% of the families. The population in the other backward class is 10.2% and may further increase depending upon other caste falling under this category. This is because; the castes such as Jangam, Shimpi, and Muslim are many

times

categorized

under OBC

class. The

national

average of

OBC class is

around 53 %.

The nomadic

tribes



contribute 12.3% and number is very significant. Overall Maratha is the most dominant group.

Table 11.3 Caste Distribution

No.	Caste	Frequency	Percent	No.	Caste	Frequency	Percent
1	SC	754	18	11	Bhoi	52	1.2
2	ST	109	2.6	12	Shimpi	8	0.2
3	BC	45	1.1	13	Muslim	466	11.1
4	OBC*	425	10.2	14	Jangam	34	0.8
5	NT	514	12.3	15	Sonar	5	0.1
6	Maratha	1350	32.3	16	SBC	1	0
7	Pinjari	1	0	17	Hatkar	4	0.1
8	Gosavi	2	0	18	Komti	24	0.6
9	Brahmin	70	1.7	19	Nhavi	4	0.1
10	Lingayat	299	7.1	20	NA	15	0.4
					Total	4182	100

NA: Data not available about caste; * the tally of OBC class may expand in case, any of the mentioned class falls under this category. Not all of the families are aware whether they fall in OBC categories.

iv) Dwelling Pattern: When we examined the dwelling pattern of the local community, it was observed that, 78% of the families have tiled roof, followed by Galvanized tins and mud or wooden roof. The thatched roof category had only 36 houses indicating overall good standards of living. The details are provided in table below:

Table 11.4 House-Roof characteristics of project affected families

Sr. No.	Village Name	Kaularu	Steel	Cement	Plastic	Thatched roof	Wooden/ Mud	RCC
1	Bamni	13	9	0	0	0	0	0
2	Bhaswadi	207	170	10	26	3	23	0
3	Bhatapur	63	4	0	0	0	0	0
4	Bhingoli	182	19	3	2	2	0	0
5	Dornali	22	0	0	0	0	0	0
6	Hasnal	210	18	1	0	0	1	0
7	Itgyal	400	18	0	2	1	1	0
8	Kabnoor	20	2	0	0	0	0	0
9	Kalambar	2	0	0	0	0	0	0
10	Kolnur	212	7	0	3	1	1	0
11	Lakhmapur	40	6	0	0	0	0	0
12	Marajwadi	221	52	4	0	4	13	0
13	Mukramabad	556	110	47	1	18	164	5
14	Paratpur	5	0	0	0	0	0	0
15	Ravangaon	396	59	0	3	2	3	0
16	Ravi	7	0	0	0	1	0	0
17	Walanki	236	40	0	0	1	9	0
18	Bhendegaon(Bk)	164	18	1	2	2	0	0
19	Bhendegaon(Kh)	288	39	1	0	1	5	0
	Total	3244	571	67	39	36	220	5

Most of the populations have pucca houses made up of either stone or bricks. Less than 20% of the families have thatched walls. This represents less than 20% of the population representing low standard of living. For details see the table below:

Table 11.5 House-all characteristics of project affected families

Sr. No.	Village Name	Kudachi	Steel	Kachha Bricks	Pucca Bricks	Stone
1	Bamni	0	2	0	0	20
2	Bhaswadi	117	66	6	138	112
3	Bhatapur	17	14	7	19	10
4	Bhingoli	3		52	18	135
5	Dornali	0	3	7	0	12
6	Hasnal	39	0	61	67	63
7	Itgyal	14	93	24	65	226
8	Kabnoor	2	0	0	2	18
9	Kalambar	0	0	0	0	2
10	Kolnur	4	20	3	5	192
11	Lakhmapur	0	0	0	0	46

Sr. No.	Village Name	Kudachi	Steel	Kachha Bricks	Pucca Bricks	Stone
12	Marajwadi	60	33	25	39	137
13	Mukramabad	238	51	102	202	308
14	Paratpur	0	0	0	0	5
15	Ravangaon	91	9	20	255	88
16	Ravi	0	1	0	1	6
17	Walanki	1	29	19	25	212
18	Bhendegaon(Bk)	18	125	7	7	30
19	Bhendegaon(Kh)	211	69	2	37	15
	Total	815	433	335	880	1637

v) **Assets possessed by the PAF's:** Survey of assets revealed that 25.62 % of the population owns TV/radio as an appliance for entertainment and education while 14.06% of the population owns a two-wheeler. Looking at the assets surveyed, it can be concluded that the population of have-not is far more than the population that possess these assets.

Table 11.6 Assets possessed by the PAF's

Sr. No.	Village Name	Two wheeler		Three wheeler		Four wheeler		TV/Radio		Furniture	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
1	Bamni	11	11	21	1	22	0	9	13	21	1
2	Bhaswadi	315	124	439	0	432	7	251	188	272	167
3	Bhatapur	67	0	67	0	67	0	56	11	64	3
4	Bhingoli	163	45	206	2	204	4	137	71	171	37
5	Dornali	20	2	22	0	22	0	21	1	21	1
6	Hasnal	224	6	230	0	230	0	197	33	209	21
7	Itgyal	264	158	419	3	415	7	167	255	275	147
8	Kabnoor	22	0	22	0	22	0	22	0	22	0
9	Kalambar	2	0	2	0	2	0	2	0	2	0
10	Kolnur	209	15	222	2	219	5	194	30	213	11
11	Lakhmapur	34	12	46	0	46	0	27	19	43	3
12	Marajwadi	248	46	294	0	294	0	241	53	293	1
13	Mukramabad	827	74	899	2	889	12	714	187	892	9
14	Paratpur	3	2	5	0	5	0	2	3	4	1
15	Ravangaon	440	23	462	1	457	6	411	52	456	7
16	Ravi	6	2	8	0	8	0	7	1	7	1
17	Walanki	252	34	286	0	283	3	238	48	245	41
18	Bhendegaon (Kk)	180	7	187	0	187	0	165	22	167	20
19	Bhendegaon (Bk)	309	25	334	0	332	2	248	86	301	33
	Total	3596	586	4171	11	4136	46	3109	1073	3678	504

vi) **Population categorized based on Primary occupation:** Employment would mean any activity leading to meaningful economic gain. In India, most of the male population is engaged in agriculture related activities while females are in household activities. Here, agriculture is main source of livelihood supporting 34% of the PAFs directly and 52.4% indirectly as agricultural labour. Among the other categories job (salaried class) finds preference over the other categories. Surprisingly dairy has not yet picked up as source of livelihood as in the case of many progressive districts of Maharashtra. The income from remittance or pensions also figured during the survey. Surprisingly, pottery or artisans or small-scale village industries had very few takers. In many cases farmers are not rich enough to afford bullocks for farming operations.

Table 11.7 Major sources of livelihood

Sr. No.	Village Name	Primary Occupation							
		Agriculture	Agriculture Labour	Job	Dairy	Other	Pensioner	Fishery	Business
1	Bamni	20	0	2	0	0	0	0	0
2	Bhaswadi	198	210	26	1	0	0	1	3
3	Bhatapur	33	26	8	0	0	0	0	0
4	Bhingoli	62	128	14	0	3	1	0	0
5	Dornali	13	7	0	2	0	0	0	0
6	Hasnal	111	112	7	0	0	0	0	0
7	Itgyal	248	163	10	1	0	0	0	0
8	Kabnoor	21	1	0	0	0	0	0	0
9	Kalambar	2		0	0	0	0	0	0
10	Kolnur	124	81	18	0	0	1	0	0
11	Lakhmapu	22	24	0	0	0	0	0	0
12	Marajwad	153	133	3	0	0	0	0	5
13	Mukramab	141	540	114	4	66	4	5	27
14	Paratpur	5	0	0	0	0	0	0	0
15	Ravangao	146	282	30	1	2	0	0	2
16	Ravi	7		1	0	0	0	0	0
17	Walanki	172	112	1	0	1	0	0	0
18	Bhendegaon(Bk)	35	138	8	2	0	0	4	0
19	Bhendegaon(Kh)	78	234	12	1	1	0	0	8
	Total	1591	2191	254	12	73	6	10	45

Nearly 44% of the families did not have a secondary occupation. Agriculture appeared directly or indirectly appears to be major secondary source of income for remaining families. Very little population was engaged in business, employment or dairy as a secondary source of income. Bhaswadi and



Mukramabad appear to have some population of entrepreneurs engaged in business. Mukramabad is known business center of the region.

Table 11. 8 Sources of secondary livelihood

Sr. No.	Village Name	None	Agriculture	Agriculture Labour	Job	Dairy	Other	Pensioner	Fishery	Business
1	Bamni	0	20	0	2	0	0	0	0	0
2	Bhaswadi	210	50	151	10	4	0	0	0	14
3	Bhatapur	0	26	33	8	0	0	0	0	0
4	Bhingoli	2	44	146	14	0	1	1	0	0
5	Dornali	0	12	7	1	2	0	0	0	0
6	Hasnal	0	92	131	6	1	0	0	0	0
7	Itgyal	0	198	192	21	10	1	0	0	0
8	Kabnoor	0	20	2	0	0	0	0	0	0
9	Kalambar	0	2	0	0	0	0	0	0	0
10	Kolnur	1	105	90	27	0	0	1	0	0
11	Lakhmapur	1	8	37	0	0	0	0	0	0
12	Marajwadi	224	11	49	2	2	0	0	0	6
13	Mukramabad	753	30	58	14		13	1	9	23
14	Paratpur	0	5	0	0	0	0	0	0	0
15	Ravangaon	326	14	119	4	0	0	0	0	0
16	Ravi	0	7	0	1	0	0	0	0	0
17	Walanki	94	59	131	1	0	1	0	0	0
18	Bhendegaon (Bk)	0	36	135	8	6	0	0	2	0
19	Bhendegaon (Kh)	202	38	78	4	2	0	0	0	10
	Total	1813	777	1359	123	27	16	3	11	53

vii) **Village wise Agriculture Land:** It is observed from the data collected by actual survey of project-affected families that, a total of 6053.08 ha land is acquired across 19 projects affected villages. These values are very close to the actual land acquired (6473 acres) as obtained from the Revenue department, indicating high reliability in the socioeconomic studies undertaken. The high reliability in the data was a result of series of meetings conducted with the local communities, community chiefs, village chiefs and common folks. Also, the survey was conducted with the help of educated youths from the project affected villages after imparting them rigorous training. The process of data collection was very transparent and the questionnaire was in local language and copies were made accessible to all. The size of land acquired ranges from 0.44 acres to 902.19 acres. The details are provided in the table below:

Table 11.9 Village wise agricultural land

Name of the village	Area of Agricultural land (Acre)					
	Cultivable			Non-cultivable		
	Before acquisition	Total Land Acquired	After acquisition	Before acquisition	Total land Acquired	After acquisition
Itgyal	1890.874	673.468	1202.406	74.8626	10.05	64.8126
Lakhmapur	48.83	21.96	26.87	0	0	0
Bamni	69.75	3	66.75	4	0	0
Kalambar	10.78	0.44	10.34	0	0	0
Ravi	36.95	1.05	35.9	0	0	0
Paratpur	14.63	7.4	7.23	0	0	0
Mukramabad	1755.3	702.58	1013.07	29.2	12	21.2
Bhingoli	1127.136	357.006	769.27	37.66	14.29	23.37
Hasnal	571.25	551.06	20.19	0	0	0
Bhatapur	240.62	230.74	9.88	0	0	0
Kabnoor	75.18	35.76	39.42	0	0	0
Dornali	124.22	44.714	79.506	5.26	0	5.26
Bhendegaon (Bk)	311.765	157.715	148.05	14.41	3.47	10.94
Bhaswadi	948.1448	902.1948	28.2	9.60025	6.54025	2.33
Ravangaon	945.58	893.68	26.4	5.04	0	3.75
Marajwadi	998.1	588.3	393.2	11.2	2	3
Kolnur	813.81	466.97	344.37	2.36	0	2.36
Bhendegaon (Kh)	790.58	179.59	608.99	53.16	3	55.16
Walanki	1087.34	235.46	827.48	4	0	3
Total	11860.8398	6053.0878	5657.522	250.75285	51.35025	195.1826

The major purposes for which the land was acquired include submergence, dam seat, construction of tail channel, colony construction and construction of roads and for quarries.

viii) **Village wise total income:** The majority of the PAFs were engaged in agriculture as a main income source. It was observed that the majority of the population (51.7 %) falls under Below Poverty Line (BPL) category indicating very grim economic situation. It can be referred from the data below that most of the families are poverty stricken. This is supported by earlier data on the socioeconomic aspects viz. low literacy, high dependence on agriculture, large no. of population engaged in agriculture labour, less family with secondary income source, and predominantly rain fed agriculture practices. As indicated in the table below, 44.45% of the families fall in the category of 21000-100000 income categories. Hardly a few families had income above Rs. 100,000/-. The existing labour rate is Rs. 70/day for men and considering 8 months employment, the average income of labour families mounts up to Rs. 17,000/-. This means most of labourers fall Below Poverty Line (BPL) category. There is also high income disparity arisen mainly between the have and have-nots. The dry land agriculture is no more lucrative and even secondary income sources are little.

Table 11.10 Income classes and population representing the class

No.	Village Name	Income Categories			Total
		0-20000 BPL*	21000-100000	100000 and Above	
1	Bamni	1	21		22
2	Bhaswadi	196	216	27	439
3	Bhatapur	27	35	5	67
4	Bhendegaon (Bk)	104	80	3	187
5	Bhendegaon (Kh)	187	139	9	335
6	Bhingoli	103	101	4	208
7	Dornali	8	13	1	22
8	Hasnal	164	62	4	230
9	Itgyal	115	302	5	422
10	Kabnoor	16	6		22
11	Kalambar		2		2
12	Kolnur	175	27	22	224
13	Lakhmapur	3	39	4	46
14	Marajwadi	129	163	2	294
15	Mukramabad	499	363	39	901
16	Paratpur		5		5
17	Ravangaon	322	112	29	463
18	Ravi		8		8
19	Walanki	113	165	7	285
Total		2162	1859	161	4182

* BPL-Below poverty line

ix) **Village wise Annual Expenditure on Household items:** The survey revealed that the expenditure on household items falls under low bracket category for 65.40% project affected families, indicating correlation of income and expenditure. Overall, the study indicates that a low standard of living is prevalent among the Project Affected Families. High standard of living observed only in exceptional cases.

Table 11.11 Expenditure on Household items and families representing the class

Sr. No.	Village Name	No Expenditure	1-20000	21000-40000	41000-60000	61000-80000	81000-100000	100000 And Above
1	Bamni	0	22	0	0	0	0	0
2	Bhaswadi	12	104	231	71	18	2	1
3	Bhatapur	0	62	4	1	0	0	0
4	Bhingoli	2	196	9	1	0	0	0
5	Dornali	0	20	2	0	0	0	0
6	Hasnal	1	226	3	0	0	0	0
7	Itgyal	1	364	45	11	1	0	0
8	Kabnoor	0	22	0	0	0	0	0
9	Kalambar	0	2	0	0	0	0	0
10	Kolnur	2	210	11	1	0	0	0
11	Lakhmapur	0	9	25	7	4	0	1
12	Marajwadi	3	275	15	1	0	0	0
13	Mukramabad	55	721	93	21	9	0	2
14	Paratpur	0	5	0	0	0	0	0
15	Ravangaon	14	304	141	4	0	0	0
16	Ravi	0	8	0	0	0	0	0
17	Walanki	3	266	16	1	0	0	0
18	Bhendegaon (Bk)	3	158	25	1	0	0	0
19	Bhendegaon (Kh)	7	200	113	14	0	0	0
Total		103	3174	733	134	32	2	4

The major expenditure categories are education, health and agriculture. The detailed distribution of families across various classes of major expenditure classes is described in the following tables. Consumables items like cereals, pulses, oil, fuel, and clothing contribute most of the expenditure. The quantity and frequency of consumption vary with the economic level of the household. The expenditure of average household on other heads like health, education, social functions etc. is 37.72%.

Table 11.12 Expenditure on Education

Sr. No.	Village Name	Zero Expenditure	1-20000	21000-40000	41000-60000	61000-80000	81000-100000	100000 And Above
1	Bamni	3	19	0	0	0	0	0
2	Bhaswadi	90	276	60	9	2	1	1
3	Bhatapur	14	53	0	0	0	0	0
4	Bhingoli	11	192	5	0	0	0	0
5	Dornali	6	16	0	0	0	0	0
6	Hasnal	55	172	3	0	0	0	0
7	Itgyal	32	385	4	0	0	1	0
8	Kabnoor	0	22	0	0	0	0	0
9	Kalambar	1	1	0	0	0	0	0
10	Kolnur	83	137	3	1	0	0	0
11	Lakhmapur	7	38	1	0	0	0	0
12	Marajwadi	44	249	1	0	0	0	0
13	Mukramabad	127	760	12	1	1	0	0
14	Paratpur	1	4	0	0	0	0	0
15	Ravangaon	58	400	5	0	0	0	0
16	Ravi	2	6	0	0	0	0	0
17	Walanki	21	263	2	0	0	0	0
18	Bhendegaon (Bk)	91	96	0	0	0	0	0
19	Bhendegaon (Kh)	169	160	3	1	1	0	0
Total		815	3249	99	12	4	2	1

Substantial families have expressed that they spend very little (up to a maximum of Rs. 20000/-/ year) or no money on education.

Table 11.13 Annual Expenditure on Health

Sr. No.	Village Name	No Expenditure	0-20000	21000-40000	41000-60000	61000-80000	100000 And Above
1	Bamni	1	21	0	0	0	0
2	Bhaswadi	14	375	44	4	1	1
3	Bhatapur	0	66	1	0	0	0
4	Bhingoli	3	203	2	0	0	0
5	Dornali	0	22	0	0	0	0
6	Hasnal	2	226	2	0	0	0
7	Itgyal	3	415	2	2	0	0

8	Kabnoor	0	22	0	0	0	0
9	Kalambar	0	2	0	0	0	0
10	Kolnur	3	210	10	0	0	1
11	Lakhmapur	0	45	1	0	0	0
12	Marajwadi	3	289	1	0	1	0
13	Mukramabad	60	833	7	1	0	0
14	Paratpur	0	5	0	0	0	0
15	Ravangaon	14	446	3	0	0	0
16	Ravi	0	8	0	0	0	0
17	Walanki	2	282	2	0	0	0
18	Bhendegaon (Bk)	12	173	2	0	0	0
19	Bhendegaon (Kh)	15	316	1		2	0
Total		132	3959	78	7	4	2

Substantial families have expressed that they spend very little (up to a maximum of Rs. 20000/-/ year) or no money on health.

Table 11.14 Annual Expenditure on Agriculture

Sr. No.	Village Name	No Expenditure	0-20000	21000- 40000	41000- 60000	61000- 80000	81000- 100000	100000 and Above
1	Bamni	1	21	0	0	0	0	0
2	Bhaswadi	208	155	46	20	1	4	5
3	Bhatapur	30	32	4	1	0	0	0
4	Bhingoli	65	135	7	1	0	0	0
5	Dornali	6	15	1	0	0	0	0
6	Hasnal	125	98	6	1	0	0	0
7	Itgyal	48	346	16	7	1	0	4
8	Kabnoor	0	20	2	0	0	0	0
9	Kalambar	0	2	0	0	0	0	0
10	Kolnur	86	117	10	11	0	0	0
11	Lakhmapur	0	35	6	3	0	1	1
12	Marajwadi	133	147	10	3	1	0	0
13	Mukramabad	761	110	24	5	1	0	0
14	Paratpur	0	5	0	0	0	0	0
15	Ravangaon	304	121	34	4	0	0	0
16	Ravi	1	7	0	0	0	0	0
17	Walanki	101	168	16	1	0	0	0
18	Bhendegaon (Bk)	112	71	4	0	0	0	0
19	Bhendegaon (Kh)	162	160	11	1	0	0	0
Total		2143	1765	197	58	4	5	10

The major sources of expenditure are food, health and education. There were also expenses towards clothing, transport and fuel requirements. The occasional expenses towards social functions are also incurred by the PAFs. The expenditure as well as income from agriculture was low. This indicates typical low input, low output pattern exists while operating on low risk



strategy. The joint families have ranked 'above' in income as well as expenditure category while, nuclear families are in the high income category, though sparingly reported. Agrarian families prefer joint family wherein both the income and expenditure are shared. Overall, there exists poor standard of living.

x) Live Stock : Project area mainly represents agrarian population and therefore, cattle rearing go hand in hand with agriculture here. Unfortunately the cattle rearing are not sufficiently lucrative mainly because of absence of high yielding and superior breeds of cattle. An awareness program on this aspect is required to be carried out. Rearing of poultry, goats and sheep, buffaloes, cows, as well as camel is reported from the project area.

Table 11.15 Live Stock

Sr. No.	Village Name	Bulls	Cows	Buffalo	Goat/ Sheep	Hens	Camels
1	Bamni	19	6	21	0	0	0
2	Bhaswadi	204	128	264	395	177	0
3	Bhatapur	42	27	36	11	8	0
4	Bhendegaon (Bk)	57	84	63	54	49	1
5	Bhendegaon (Kh)	121	98	116	145	125	17
6	Bhingoli	237	179	197	381	81	2
7	Dornali	16	25	11	18	2	0
8	Hasnal	90	85	121	62	44	0

9	Itgyal	427	240	418	333	341	2
10	Kabnoor	10	3	3	4	10	0
11	Kalambar	4	10	4	0	0	0
12	Kolnur	132	98	77	54	99	0
13	Lakhmapur	28	21	38	19	38	0
14	Marajwadi	123	70	160	63	171	20
15	Mukramabad	172	131	233	834	105	0
16	Paratpur	10	9	8	25	10	0
17	Ravangaon	91	36	64	2	21	0
18	Ravi	12	13	16	15	17	0
19	Walanki	148	123	117	57	19	2
	Total	1943	1386	1967	2472	1317	44

xi) **Migration:** The shortage of employment opportunities in the project area has resulted in migration of trained and unskilled labour to the nearest towns and elsewhere in search of livelihood opportunities. Unlike the usual pattern wherein migration of skilled personnel is high, the situation in the project area is quite different. Majority of the migrants are in the labour (unskilled) class, while the other classes of migrants are students and skilled workers.

Table 11.16 Migration

Sr. No.	Village Name	Migration			
		Education	Job	Labour	Business
1	Itgyal	3	16	26	2
2	Lakhmapur	0	3	2	0
3	Bamni	0	0	0	1
4	Kalambar	0	0	0	0
5	Ravi	0	0	0	0
6	Paratpur	0	0	0	0
7	Mukramabad	54	70	103	19
8	Bhingoli	60	17	33	14
9	Hasnal	6	5	14	1
10	Bhatapur	0	0	0	0
11	Kabnoor	0	0	0	0
12	Dornali	1	0	0	0
13	Bhendegaon (Bk)	4	2	7	3
14	Bhaswadi	16	15	45	2
15	Ravangaon	4	23	50	8
16	Marajwadi	10	2	3	0
17	Kolnur	12	12	29	7

18	Bhendegaon (Kh)	5	12	72	3
19	Walanki	2	0	17	0
	Total	177	177	401	60

xii) **Irrigation Facilities:** Except for 4 villages with canal or pipelines facilities, the rest of the villages heavily depend on groundwater for irrigation. Most of the families practice rain-fed agriculture.

Table 11.17 Irrigation Facilities

Sr. No.	Village Name	NA	Well	Bore well	Canal	River/ Stream	Rain	Pipeline
1	Bamni	0	1	1	0	15	5	0
2	Bhaswadi	339	16	10	0	13	61	0
3	Bhatapur	31	4	7	0	4	18	3
4	Bhingoli	71	4	17	5	17	78	16
5	Dornali	6	0	1	0	13	2	0
6	Hasnal	116	15	14	5	63	17	0
7	Itgyal	69	27	53	3	52	218	0
8	Kabnoor	0	8	0	0	14	0	0
9	Kalambar	0	0	0	0	2	0	0
10	Kolnur	81	70	24	0	41	7	1
11	Lakhmapur	2	10	3	1	24	6	0
12	Marajwadi	213	7	4	0	5	65	0
13	Mukramabad	798	7	5	0	20	71	0
14	Paratpur	0	0	0	0	4	1	0
15	Ravangaon	423	6	3	0	10	21	0
16	Ravi	0	1	1	0	4	2	0
17	Walanki	203	0	4	0	9	69	1
18	Bhendegaon (Bk)	121	4	15	0	25	20	2
19	Bhendegaon (Kh)	298	3	8	0	3	22	0
Total		2771	183	170	14	338	683	23

NA: Land Not Available thus source of water is not considered

Table 11.18 Trees in the Project Affected Villages

Sr. No.	Village Name	Trees (No.)																				
		Neon	Acacia	Mango	Dallimb	Shami	Biba	Umbar	Bartendi	Hirda	Tamarind	Teak	Sitaphal	Bor	Coconut	Moh	Chiku	Cattapa	Karanj	Butea	Shindi	Jambhul
1	Itgyal	1584	789	514	162	0	0	0	0	0	0	383	112	29	290	0	0	0	69	0	0	0
2	Lakhmapur	131	435	165	38	60	49	67	62	26	271	79	63	26	40	9	0	0	30	20	48	71
3	Bamnli	85	219	30	4	5	43	1	0	0	0	28	8	11	26	13	0	0	1	0	1	25
4	Kalambar	2	1	11	2	13	12	4	5	6	15	1	0	3	0	0	0	0	0	0	0	2
5	Ravi	52	33	18	16	17	7	6	6	6	8	1	1	0	3	3	0	0	0	4	0	0
6	Paratnur	97	65	5	0	0	0	20	0	0	175	0	4	100	0	0	0	0	0	0	0	0
7	Mukramabad	900	689	160	14	0	7	1	0	0	0	42	333	0	2553	83	17	59	0	0	0	0
8	Bhimgoli	332	589	1984	44	93	20	14	86	15	64	75	71	100	488	159	0	0	2	14	14	82
9	Hasnai	155	480	180	23	36	11	11	12	24	10	70	39	219	267	26	0	0	6	28	12	39
10	Bhatapur	37	63	27	4	8	7	4	5	6	7	7	9	11	30	5	0	0	0	1	6	16
11	Kabnoor	108	23	31	7	5	7	2	0	2	0	31	12	2	5	1	0	0	0	0	3	1
12	Dornali	7	2	1	0	0	0	0	0	0	0	2	0	0	4	1	0	0	0	2	0	5
13	Bhendegaon (Bk)	155	88	80	29	8	6	6	7	19	8	15	24	11	5	11	0	0	8	7	10	33
14	Bhaswadi	3216	670	226	4	5	23	5	78	1	27	105	18	305	97	4	0	0	0	1	0	37
15	Ravangaon	147	162	107	1	6	6	17	9	15	44	1	6	186	0	0	0	24	0	0	0	0
16	Marajwadi	657	712	175	0	0	32	0	0	0	48	343	131	117	46	2	0	0	0	0	0	0
17	Kolnur	870	260	540	37	35	28	18	23	30	14	219	359	496	315	26	0	0	3	17	15	281
18	Bhendegaon (Kh)	429	231	204	0	0	11	1	1	1	63	118	62	62	10	4	0	0	0	3	1	5
19	Walanki	543	549	176	6	15	19	13	6	7	3	100	39	1	124	5	0	0	5	15	1	1
		9507	6060	4634	391	306	288	190	300	158	757	1620	1291	1679	4303	352	17	83	124	112	111	598

Trees: The Neem (*Azadirachta indica*), Acacia (*Acacia nilotica*), Mango (*Mangifera indica*), teak (*Tectona grandis*) and coconut (*Cocos nucifera*) are the common trees cultivated mostly along the borders of the agricultural land. On not so fertile land, Sitaphal (*Annona squamosa*) and Ber (*Zizyphus jujube*) plants are cultivated.

xiii) **Loan:** Majority of the population has no debts. Among the borrowers, most of them have borrowed up to Rs. 20,000/- indicating low credit of local communities. As explained during the surveys, lack of assured income makes them difficult to secure the loan from banking institutions.

Table 11.19 Loan

Sr. No.	Village Name	Loan amount						
		No Loan taken	0-20000	21000-40000	41000-60000	61000-80000	81000-100000	100000 & above
1	Bamni	13	6	1	0	1	1	0
2	Bhaswadi	355	49	17	5	1	5	7
3	Bhatapur	65	1	1	0	0	0	0
4	Bhingoli	184	23	1	0	0	0	0
5	Dornali	9	13	0	0	0	0	0
6	Hasnal	223	6	1	0	0	0	0
7	Itgyal	373	34	13	1	0	0	1
8	Kabnoor	1	18	2	1	0	0	0
9	Kalambar	2	0	0	0	0	0	0
10	Kolnur	93	113	13	4	0	0	1
11	Lakhmapur	5	29	8	2	1	0	1
12	Marajwadi	287	6	0	1	0	0	0
13	Mukramabad	815	50	17	7	4	2	6
14	Paratpur	5	0	0	0	0	0	0
15	Ravangaon	439	23	1	0	0	0	0
16	Ravi	8	0	0	0	0	0	0
17	Walanki	262	16	6	2	0	0	0
18	Bhendegaon (Bk)	180	5	2	0	0	0	0
19	Bhendegaon (Kh)	276	57	0	0	0	0	1
Total		3595	449	83	23	7	8	17

xiv) **Market Facilities:** Nanded district, although rich in agricultural resources, manpower and bovine population was industrially much backward due to lack of facilities for quick and easy transport. Besides the oldest textile mill at Nanded, there were 15 large scale industries in the district till 1961, the other processing industries being cotton ginning and pressing, oil mills and dal processing mills. Small scale establishments were occupied mainly by flour mills, ginning and pressing units, dal mills, oil mills, timber saw mills, printing presses etc. Gur (jagary) manufacturing is also an important industry in the district, but it is purely seasonal. Other small scale and cottage industries in the district are steel processing, weaving, tanning, carpentry,

brick-making etc. Over the years, Mukramabad has established as one of important market for agricultural produce. Due to, its vicinity to the project affected area, all the project-affected villages and villagers even from a distance of 12 km prefer to visit Mukramabad for availing market facility.

Table 11.20 Market Facilities

Sr. No.	Village	Nearest Market Place	Distance of market place
1	Itgyal	Mukramambad	3
2	Lakhmapur	Mukramambad	2
3	Bamni	Mukramambad	3
4	Kalambar	Mukramambad	10
5	Ravi	Mukramambad	4
6	Paratpur	Mukramambad	2
7	Mukramabad	Mukramambad	0
8	Bhingoli	Mukramambad	12
9	Hasnal	Mukramambad	10
10	Bhatapur	Mukramambad	8
11	Kabnoor	Mukramambad	12
12	Dornali	Mukramambad	5
13	Bhendegaon (Bk)	Mukramambad	12
14	Bhaswadi	Mukramambad	7
15	Ravangaon	Mukramambad	7
16	Marajwadi	Mukramambad	5
17	Kolnur	Mukramambad	10
18	Bhendegaon (Kh)	Mukramambad	8
19	Walanki	Mukramambad	2

xv) Presence of Social Organizations and NGOs: There are a few organisations working towards social and economic upliftment of local communities. These organisations are mostly in the form of Women Self-Help Groups, Cooperative Societies and Youth Federations. Women Self-Help Groups are almost omnipresent while Youth Federations are the least represented in the project villages. Details are represented in the table below:

Table 11.21 Presence of Social organizations and NGOs

Sr. No.	Village	Mahila Mandal	Sahakari Sanstha	Yuva Mandal
1	Itgyal	1	0	0
2	Lakhmapur	1	0	0
3	Bamni	1	1	0
4	Kalambar	0	0	0
5	Ravi	1	0	1
6	Paratpur	1	0	0
7	Mukramabad	1	1	1
8	Bhingoli	1	0	0
9	Hasnal	1	1	0
10	Bhatapur	1	0	0
11	Kabnoor	1	0	0
12	Dornali	1	1	0
13	Bhendegaon (Bk)	1	1	0
14	Bhaswadi	1	1	0
15	Ravangaon	1	1	0
16	Marajwadi	1	0	0
17	Kolnur	1	0	0
18	Bhendegaon (Kh)	1	1	0
19	Walanki	1	0	0

xvi) **Education Facilities in Villages:** Most of the villages have primary schools while except for Ravi, Mukramabad and Ravangaon no other villages have Secondary School. The higher education facilities are not available in any of the project-affected villages. For higher education, Nanded is highly preferred location.

Table 11.22 Education Facilities in Villages

Sr. No.	Village	Anganwadi	Primary School	Secondary School	College
1	Itgyal	1	1	0	0
2	Lakhmapur	1	1	0	0
3	Bamni	1	1	0	0
4	Kalambar	1	1	0	0
5	Ravi	1	1	1	0
6	Paratpur	1	2	0	0
7	Mukramabad	1	1	1	
8	Bhingoli	1	0	0	0
9	Hasnal	1	1	0	0

10	Bhatapur	1	1	0	0
11	Kabnoor	1	1	0	0
12	Dornali	1	1	0	
13	Bhendegaon (Bk)	1	1	0	0
14	Bhaswadi	1	1	0	0
15	Ravangaon	1	1	1	0
16	Marajwadi	1	1	0	0
17	Kolnur	1	1	0	0
18	Bhendegaon (Kh)	1	1	0	0
19	Walanki	1	1	0	0

Note: 1: Yes, 2: No

xvii) **Health Facilities:** There are only three Primary Health Centers (PHC) located in the project area of which Mukarabad is the only one located in the project affected village. Of the remaining two, Barhali and Sawarmal are located outside the project affected area. Except for the Ravi village that consults to Sawarmal, the remaining project affected villages either consult Mukramabad or Barhali PHCs.

Table 11.23 Health Facilities

Sr. No.	Village	PHC	Distance of PHC from Village (Km)
1	Itgyal	Mukramambad	3
2	Lakhmapur	Mukramambad	7
3	Bamni	Barhali	20
4	Kalambar	Barhali	10
5	Ravi	Sawarmal	14
6	Paratpur	Mukramambad	2
7	Mukramabad	Mukramambad	0
8	Bhingoli	Barhali	12
9	Hasnal	Barhali	12
10	Bhatapur	Barhali	15
11	Kabnoor	Barhali	10
12	Dornali	Mukramambad	5
13	Bhendegaon (Bk)	Barhali	12
14	Bhaswadi	Mukramambad	7
15	Ravangaon	Mukramambad	12
16	Marajwadi	Mukramambad	5
17	Kolnur	Barhali	10
18	Bhendegaon (Kh)	Barhali	9
19	Walanki	Mukramambad	2

xviii) **Availability of Electricity:** For the entire project affected villages 12 hours load shedding is a regular phenomenon. Availability of electricity has greater influence in suggesting livelihood options to the local community. The industrial activities and processing unit setting up may not take root properly for the want of sufficient energy source. On the contrary alternative energy sources may be viable option for investment as well as development of the region.

Table 11.24 Availability of Electricity

Sr. No.	Village	Electricity availability (Hrs)	Sr. No.	Village	Electricity availability (Hrs)
1	Itgyal	12	11	Kabnoor	12
2	Lakhmapur	12	12	Dornali	12
3	Bamni	12	13	Bhendegaon (Bk)	12
4	Kalambar	12	14	Bhaswadi	12
5	Ravi	12	15	Ravangaon	12
6	Paratpur	12	16	Marajwadi	12
7	Mukramabad	12	17	Kolnur	12
8	Bhingoli	12	18	Bhendegaon (Kh)	12
9	Hasnal	12	19	Walanki	12
10	Bhatapur	12			

11.6 Anticipated Impacts

11.6.1 Economic Benefits: The majority of the PAFs were engaged in agriculture as a main income source. It was observed that the majority of the population (51.7 %) falls under Below Poverty Line (BPL) category indicating very grim economic situation. It can be referred from the data below that most of the families are poverty stricken. This is supported by earlier data on the socioeconomic aspects viz. low literacy, high dependence on agriculture, large no. of population engaged in agriculture labour, less family with secondary income source, and predominantly rain fed agriculture practices.

Survey indicated that, 44.45% of the families fall in the category of 21000-100000 income categories. Hardly a few families had income above Rs. 100,000/-. The existing labour rate is Rs. 70/day for men and considering 8 months employment, the average

income of labour families mounts up to Rs. 17,000/-. This means most of labourers fall Below Poverty Line (BPL) category. There is also high income disparity arisen mainly between the have and have-nots.

The project area is coming under the drought prone area. The command area of the project is 26924 ha. The command is covering the area of Mukhed - Degloor talukas in Nanded district of Maharashtra and the area of Madnoor and Bichkunda talukas / mandals in Nizamabad district of Andhra Pradesh. The proposed project is providing water to irrigation and drinking purpose, will increase the assured agriculture yield and it help to increase the agriculture based small business. The proposed project therefore attaches much importance to the poor community and will trigger developmental process of the region.

11.6.2 Job opportunities: Apart of negative impacts resulting from the construction of Lendi project, there are also positive impacts such as employment opportunities for local people.

It has been planned to employ local workers in the construction activities of Project. The required staff will first be chosen among local people. In addition to positive impacts on livelihoods and standards of living of people, this increase in the employment rates will contribute indirectly to development of the local economy. Thus, improvement in the local economy and development will be valid in a wider geographic area.

11.6.3 Fish production: Lendi is a seasonal river and flow is up to November only. Due to the construction of Lendi dam across the River Lendi, reservoir will create. Fish production business would be the income source for the local people.

11.6.3 Irrigation: The main aim of this project is to provide water for irrigation and increase the agriculture yield. This project will provide assured water to irrigation. Irrigation facilities would be appropriate for the upliftment of the region. The proposed project involves construction of dam for irrigation purposes and, therefore, an overall boost in agriculture is expected. Also, small agro-based industries and other enterprises are expected as a spin-off of overall development of the region

11.6.4 Drinking Water Supply: In the Project area, water scarcity is major problem. This project will provide assured water for drinking. In the planning, 1.5 mcum drinking water has been allocated for Udgir Taluka of Latur District of Maharashtra while, for Andhra Pradesh around 6.80 mcum water is reserved for the drinking water. Additionally once the project is operational, many small water supply schemes will be undertaken for the villages in the periphery of the reservoir.

11.6.5 Improvement of Infrastructure: Lendi Irrigation project will also contribute to the local economy and development due to irrigation facility and improvement of existing infrastructure. Furthermore new infrastructure will be constructed such as transmission lines and roads in new Gaothon areas. Therefore project will be a greater contribution to local economy and development.

11.6.6 Loss of land: The total submergence area of proposed project will be 2338.06 ha. The area of physical land take by the Lendi Project authority includes the submergence area and the project components such as dam site, camp facilities, access roads etc.

Table 11.25 Details of land acquisition

Sr. No.	Category of land acquisition	Total land in ha.
1	Submergence	2338.06
2	Dam Seat	111.03
3	Tail channel	37.23
4	Colony	36.56
5	Roads	0.62
6	For Quarries	45.92
	Total area	2569.42

Out of the total land acquired, 75 ha is irrigated land and dry land is 2569.42 ha. The entire work relating to the rehabilitation and resettlement of the oustees is expected to be completed one year before filling the gorge of the Lendi Project.

Table 11.26 land use classification of submergence area

Sr. No.	Classes	Area (ha)	Area (%)
1	Water body	556.09	15.13
2	Harvested field	1461.77	39.77
3	Standing crop	1383.92	37.66
4	Barren land	24.70	0.67

5	Wasteland	132.42	3.60
6	Settlement	49.24	1.34
7	Scrubland	67.11	1.83
	TOTAL	3675.235	100
	Correct	2338.06	

11.6.7 Loss of houses: The total 4182 house will be affected. Out of total houses, only 643 houses are RCC, cement and steel made and remaining are Kaularu, wooden and mud made.

Sr. No.	Village Name	Total	Sr. No.	Village Name	Total
1	Bamni	22	11	Lakhmapur	46
2	Bhaswadi	439	12	Marajwadi	294
3	Bhatapur	67	13	Mukramabad	901
4	Bhingoli	208	14	Paratpur	5
5	Dornali	22	15	Ravangaon	463
6	Hasnal	230	16	Ravi	8
7	Itgyal	422	17	Walanki	286
8	Kabnoor	22	18	Bhendegaon(Bk)	187
9	Kalambar	2	19	Bhendegaon(Kh)	334
10	Kolnur	224		Total	4182

11.6.8 Displacement of People: People will be displaced due to reservoir of project. The total 19 villages will be affected. Out of these, 12 villages are required to be fully resettled, remaining 7 village's only agricultural land is going to be submerged and habitations will remain intact. Overall, nearly 18,915 Project Affected Persons (PAPs) across 4745 families will loosen their houses and are to be relocated in different resettlement gaothans.

Table 11.27 Affected villages, area submerged and number of families affected

Sr. No.	Villages	Area Submerged (Ha)	No. of Families affected (2012)	No. of Families affected At the Time OF survey	Families surveyed	Remark
1	Ravangaon	277.14	613	414	467	46 repeated
2	Bhatapur	125.67	86	80	68	18 repeated
3	Hasanal	243.24	305	221	230	75 repeated
4	Bhaswadi	349.01	486	392	415	71 repeated
5	Marajwadi	209.98	694	591	425	34 migrated

Sr. No.	Villages	Area Submerged (Ha)	No. of Families affected (2012)	No. of Families affected At the Time OF survey	Families surveyed	Remark
6	Kolnoor	139.19	215	215	225	10 extra
7	Bhingoli	120.31	177	177	208	31 extra
8	Bhendegaon (BK)	55.69	151	151	189	32 repeats, on 8 names no information
9	Bhendegaon (KH)	85.07	309	309	189	20 repeat and 9 temples, 26 no info, 14 deceased
10	Walanki	53.89	331	331	290	11 migrated and 30 repeated
11	Itgyal (P.M.)	160.36	452	292	294	2 repeated
12	Mukramabad*	408.95	1912	1310	1009	140 migrated
13	Kabnoor*	11.19	25	25	22	3 repeats
14	Dornali*	43.48	36	25	25	Land acquisition only
15	Kalambar*	0.45	4	2	2	Land acquisition only
16	Bamni*	5.34	25	22	22	Land acquisition only
17	Ravi*	1.05	8	8	8	Land acquisition only
18	Lakhamapur*	27.17	46	46	46	Land acquisition only
19	Paratpur*	20.88	5	5	5	Land acquisition only
	Total	2338.06	5880	4616	4139	

(* indicates only land affected villages; source: Lendi Project Document on R and R)

Land of 19 villages is affected due to the construction of dam resulting in impoundment of water. Among the project affected villages, Mukramabad has highest number of project affected families while, Kalambar has the least number of affected families. The Stage I rehabilitation include 5 gaothans that are situated up to the RL 388.0 m elevation. These are being rehabilitated at Khanapur, Marajwadi, Hsanal & Biharipur etc. Payment of these 5 villages for gaothans and land is complete. The Stage II rehabilitation includes the 7 gaothans that are located within the elevation of 388 m to 398.5 m. The two major immovable assets that are generally lost due to impounding of water are the houses and agricultural land. For all the 5731 AFs from the fully submerged villages, loss of land and houses are inevitable while, for 149 families, only the loss of land is envisaged.

Fully submerged villages have a population of 30680. This entire population is distributed across 12 villages and 4121 houses. All of them belong to Mukhed Taluka of Nanded District.

11.7 Mitigation Measures

11.7.1 Loss of land and Property:

For the project affected families, compensation for the land and property acquisition will be made as per the Maharashtra Project Affected Peoples Rehabilitation and Resettlement Act 1999. The allocation for the plot is made for the construction of house in the rehabilitated villages. Though there was a provision for land for the land compensation, none of the PAPs have opted for land for land compensation. In land to land compensation, in place of 65% of the total financial compensation, land in the command area of any irrigation project can be allocated to the PAPs if they opt for land for land compensation. The amount for land and houses compensation has been calculated.

Table 11.28 Valuation of Properties held by PAPs (Rs. in lakhs)

Sr. No.	Resettlement Gaothan	Valuation of Houses	Valuation of Lands	Total
1	Ravangaon	318.45	402.88	721.33
2	Bhatapur	54.04	225.99	278.03
3	Hasnal	178.48	289.02	467.50
4	Bhaswadi	212.86	455.45	668.31
5	Marajwadi	312.88	301.87	614.75
6	Kolnoor	325.00	258.00	583.00
7	Bhingoli	230.00	251.11	481.11
8	Bhendegaon (Kh)	450.00	117.05	567.05
9	Bhendegaon (Bk)	86.58	56.19	142.77
10	Walanki	350.00	84.14	434.14
11	Itgyal (P.M.)	340.00	359.16	699.16
12	Mukramabad	950.00	997.32	1947.32
13	Kabnoor	-	12.37	12.37
14	Dornali	-	44.61	44.61
15	Kalambar	-	0.34	0.34
16	Bamni	-	8.31	8.31
17	Ravi	-	1.05	1.05
18	Lakhamapur	-	31.45	31.45
19	Paratpur	-	22.37	22.37
Total: Valuation of land and houses		3806.29	3918.68	7724.97

11.7.2 Compensation details:

For the project affected families, compensation for the land and property acquisition is made as per the Maharashtra Project Affected Peoples Rehabilitation and Resettlement Act 1999. The allocation for the plot is made for the construction of house in the rehabilitated villages. Though there was a provision for land for the land compensation, none of the PAPs have opted for land for land compensation. In land to land compensation, in place of 65% of the total financial compensation, land in the command area of any irrigation project can be allocated to the PAPs if they opt for land for land compensation.

The rehabilitation of project affected persons and civic amenities provided are as per Government of Maharashtra circular No. RPA/1087/CR.24/1987-R1 Dt 2.2.1987.

Table 11.29 Statement Showing The Details of Award of Land Payments

Sr. No.	Name of village	Area in ha	Award Amount in Lakhs
1	Bhatapur	125.67	225.99
2	Hasnal	243.24	289.02
3	Bhaswadi	349.01	455.44
4	Marajwadi	8.40	14.09
5	Marajwadi	199.94	286.70
6	Marajwadi	1.64	1.07
7	Rawangaon	0.92	3.83
8	Rawangaon	1.88	3.52
9	Rawangaon	7.80	8.30
10	Rawangaon	11.17	12.48
11	Rawangaon	24.31	16.38
12	Rawangaon	231.06	358.35
13	Bhendegaon(Kh)	85.07	117.05
14	Bhendegaon(Bk)	55.69	56.19
15	Walnki	53.89	84.14
16	Bhingoli	120.31	251.11
17	Itgyal (Patte Degloor) for colony	2.59	1.14
18	Itgyal (Patte Mukramabad)	160.36	359.16
19	Mukramabad	408.95	997.32
20	Kolnoor	139.19	140.74
21	Dornali	43.48	44.61
22	Kalambar	0.45	0.34
23	Bamni	5.34	8.31

24	Ravi	1.05	1.05
25	Lakhmapur	27.17	31.45
26	Paratpur	20.88	22.37
27	Kabnoor	11.19	12.31
28	Gonegaon	16.13	8.53
29	Gonegaon for road	0.62	0.40
30	Degloor for camp	13.61	4.70
	Total	2371.01	3816.09
	Average Rate/ha		1.609
	Say		Rs. 160900/ha

Source: Village wise awards – Lendi Project Division, degloor

Table 11.30 Compensation For Houses

Sr. No.	Name of Village	Area In Sq. Mtr	Compensation Paid (Rs. In Lakhs)
1	Ravangaon	40218	318.45
2	Bhatapur	7007	52.04
3	Marajwadi	26983	312.88
4	Bhaswadi	25673	212.85
5	Hasnal	21383	178.48
6	Bendegaon (Bk)	14337	86.58
7	Bendegaon (kh)	22536	450.00
8	Walanki	28062	350.00
9	Bhingoli	10747	230.00
10	Kolnoor	16910	325.00
11	Mukramabad	107231	950.00
12	Itgyal	34642	340.00
		355729	3806.28
	Average rate / Sqm		0.0106999
	Say		Rs. 1070/Sqm

Source: Village wise awards – Lendi Project Division, degloor

11.7.3 Phases of village level rehabilitation:

The rehabilitation activities in respect of five villages are included in the stage I programme while the remaining villages are included in the stage II programme. The Stage I villages include Ravangaon, Bhaktapur, Hasnal, Marajwadi and Bhaswadi while, the stage II villages include Bhendegaon (Bk), Bhendegaon (Kh), Walanki, Kolnoor, Bhingoli, Mukramabad and one partially affected village Itgyal.

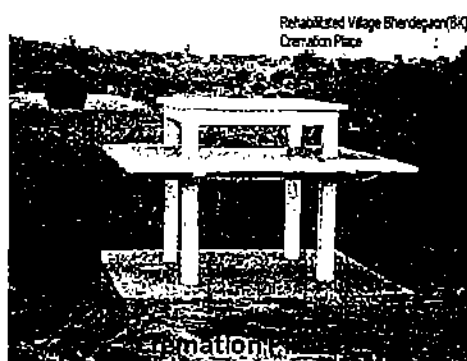
Table 11.31 Update on the rehabilitation activities

Sr. No.	Name of Village	No. of families and proposed rehabilitation areas	Progress status
1	Rawangaon	613 (all Khanapur)	For rehabilitation, 78.73 ha. Land has been acquired. Distribution of 577 plots to PAFs is done and according to fresh survey another 203 plots required to be distributed. Also provision is being made for the distribution of additional 376 plots (for that plots that have been fallen in nalla/ravine areas -52, 57 for Khatedars who loose land as well as house and 90 towards the plots that have erroneously allotted outside the acquired areas).
2	Bhatapur	86 (all Khanapur)	121 plots have been distributed covering all the PAFs. Fresh survey has indicated requirement of 6 additional plots.
3	Bhaswadi	486 (359- Khanapur, 127- Biharipur)	425 plots have been distributed covering all the PAFs. Fresh survey has indicated requirement of 89 additional plots at Khanapur. At Biharipur, acquisition of 6.01 ha of land for plot allotments is in progress for settling 127 PAFs.
4	Hasnal	305 (266-Khanapur, 39-Hasnal)	278 plots have been distributed covering all the 182 PAFs. Fresh survey has indicated requirement of 129 additional plots. For Hasnal, 3.2 ha of land acquisition for plot allotment is in progress for settlement of 39 families.
5	Marajwadi	694 (365 – Khanapur, 329-Marajwadi)	344 plots have been distributed covering all the 262 PAFs. For the remaining 329 families 20.64 ha land is being acquired at Marajwadi. Fresh survey has indicated requirement of additional 103 plots.
6	Bhendegaon (Bk)	151 (all Bhendegaon - Bk)	10.75 ha land has been acquired at Bhendegaon (Bk) for settling all the 151 PAFs.
7	Bhendegaon (Kh)	309 (all Bhendegaon - Kh)	20.60 ha land has been acquired at Bhendegaon (Kh) for settling all the 309 PAFs. Distribution of plots is expecting to take place soon (pending court matter).
8	Kolnoor	215 (all Bhendegaon Bk)	14.36 ha land has been acquired at Bhendegaon (Bk) for settling all the 215 PAFs. Distribution of plots is expecting to take place soon (pending court matter).
9	Walanki	331 (all Walanki)	23.39 ha land has been acquired at Walanki for settling all the 331 PAFs. Distribution of plots is expecting to take place soon (pending court matter).
10	Bhingoli	177 (all Bhingoli)	11.80 ha land has been acquired at Bhingoli for settling all the 177 PAFs. Distribution of plots is in progress.

Sr. No.	Name of Village	No. of families and proposed rehabilitation areas	Progress status
11	Itgyal (PM)	452 (all Itgyal)	26.93 ha land acquisition is on progress for settling all the 452 PAFs.
12	Mukramabad	1912 (all Mukramabad)	92.35 ha land is being acquired at Mukramabad for settling all the 1912 PAFs.

The rehabilitation for the Stage I villages is in progress at Khanapur and Marajwadi village. The house compensation for 11 villages has been paid. The work of providing Civic amenities is progressing with full swing. The payment for land acquisition of all submerged area is completed as per the award The payment of compensation of houses are paid to PAPs for 11 villages (excluding Mukaramabad).

Bhendegaon (Bk) Rehabilitation

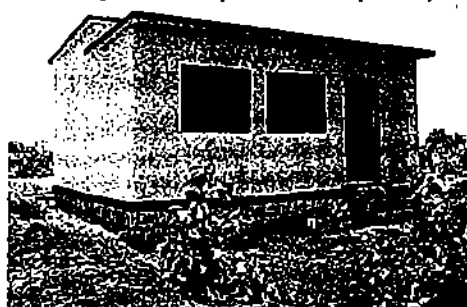


Rehabilitated Village Bhendegaon (Bk)
Crematorium Place



School Building

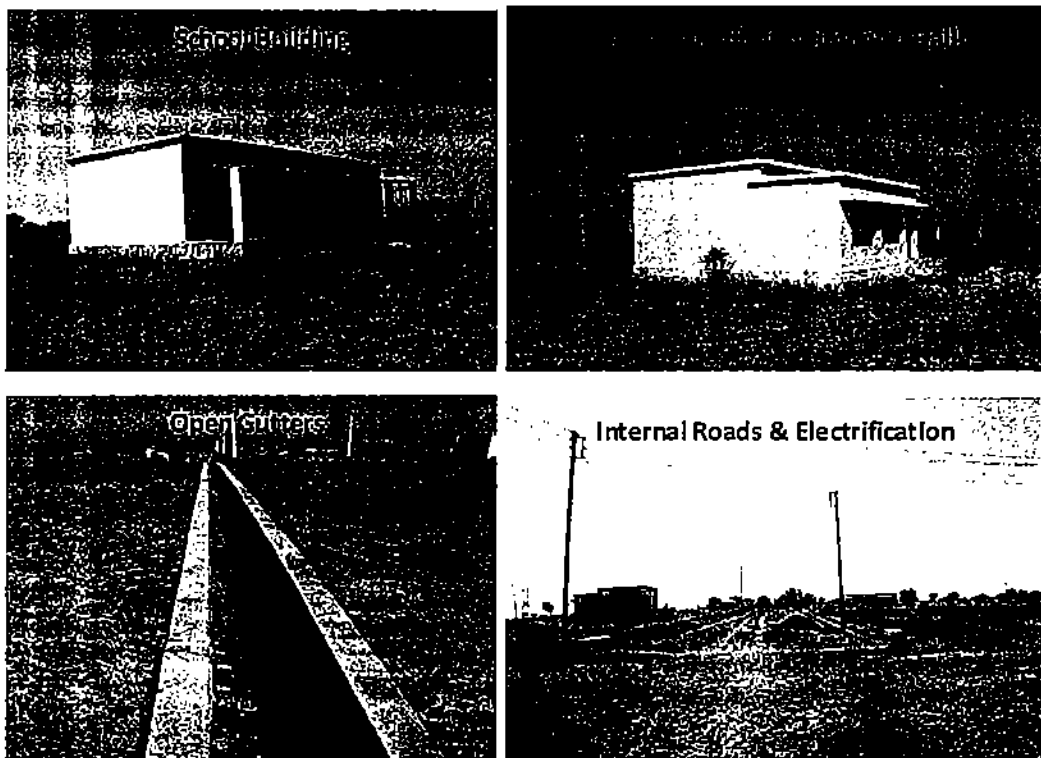
Samaj Mandir (Community Hall)



Well Construction Work

At present, most of the compensation payment is complete. The compensation has been paid towards land acquisition, house under submergence, wells, crops, electrical lines, fruit bearing orchards, plots for rehabilitation etc. Over and above the compensation amount, solatium charges have been paid @ 30% on acquisition of land under submergence, dam seat, colonies etc.

Marajwadi Rehabilitation



About 1689 families are to be rehabilitated in survey no. 5, gut no 8 of village Khanapur, taluka Degloor of Nanded District. The detailed layout plan for the proposed new gaothan at Khanapur inclusive of area under plots, open space, under shops, for civic amenities works has been approved by the District Town Planning and Valuation department. Similarly, about 329 families from the village Marajwadi are proposed to be rehabilitated in survey no 33 and 34 of village Marajwadi. The layout of the same is ready.

All the plot allotments are made strictly as under Maharashtra Resettlement of Project affected persons act 1976. Every agricultural ousted family shall be entitled to and allotted house site, i.e. a plot of land measuring 370 sq metres for the family of 5 members and an additional area of 185 sq. metres for every 3 members subject to the ceiling of 740 sq. meters in the aggregate. A non-agricultural ousted family shall be entitled to plot of half of this scale.

In the context of design of the house, no standard design is enforced on the project affected persons. They are at liberty to construct their own house as per their

requirement and resources. The oustees rehabilitated in the newly established gaathan shall be provided with the following civic amenities and other services.

The amenities are proposed as per directives given in the Govt. of Maharashtra circular issued in this context. The civic amenities and other services include dug well or bore well or piped water supply scheme for drinking water, school with playground, Chavdi or samaj mandir, internal and approach roads, electric supply, cremation or burial ground, open built-up gutters for each side of the internal roads, public latrines, lands for cattle, lands for pick-up shade for state transport bus services, land for threshing floor wherever required, pasture land for cattle, land for market and future expansion of Gaathan. The work of providing civic amenities for the stage I villages is in progress, and agencies involved in providing are as follows:

- ✓ Irrigation Department of the State: to carry out civil works viz. internal roads, buildings, etc
- ✓ Maharashtra Jeevan Vikas Pradhikaran: to carry water supply works
- ✓ Maharashtra State Electricity Board: to carry electrification works.

Overall a total provision of Rs.20521 lakhs (RSR 2009-2010) is made under subhead B lands of the project. It includes provision for acquisition of lands or structures of various categories, solatium charges, rehabilitation and resettlement of displaced persons, crop compensation, compensation for fruit bearing trees, establishment charges for agriculture, legal charges etc.

Cost for Rehabilitation and Resettlement is Rs 8718.0 lakh.

Figure 11.1 Graphical representation of progress of Rehabilitation and Resettlement

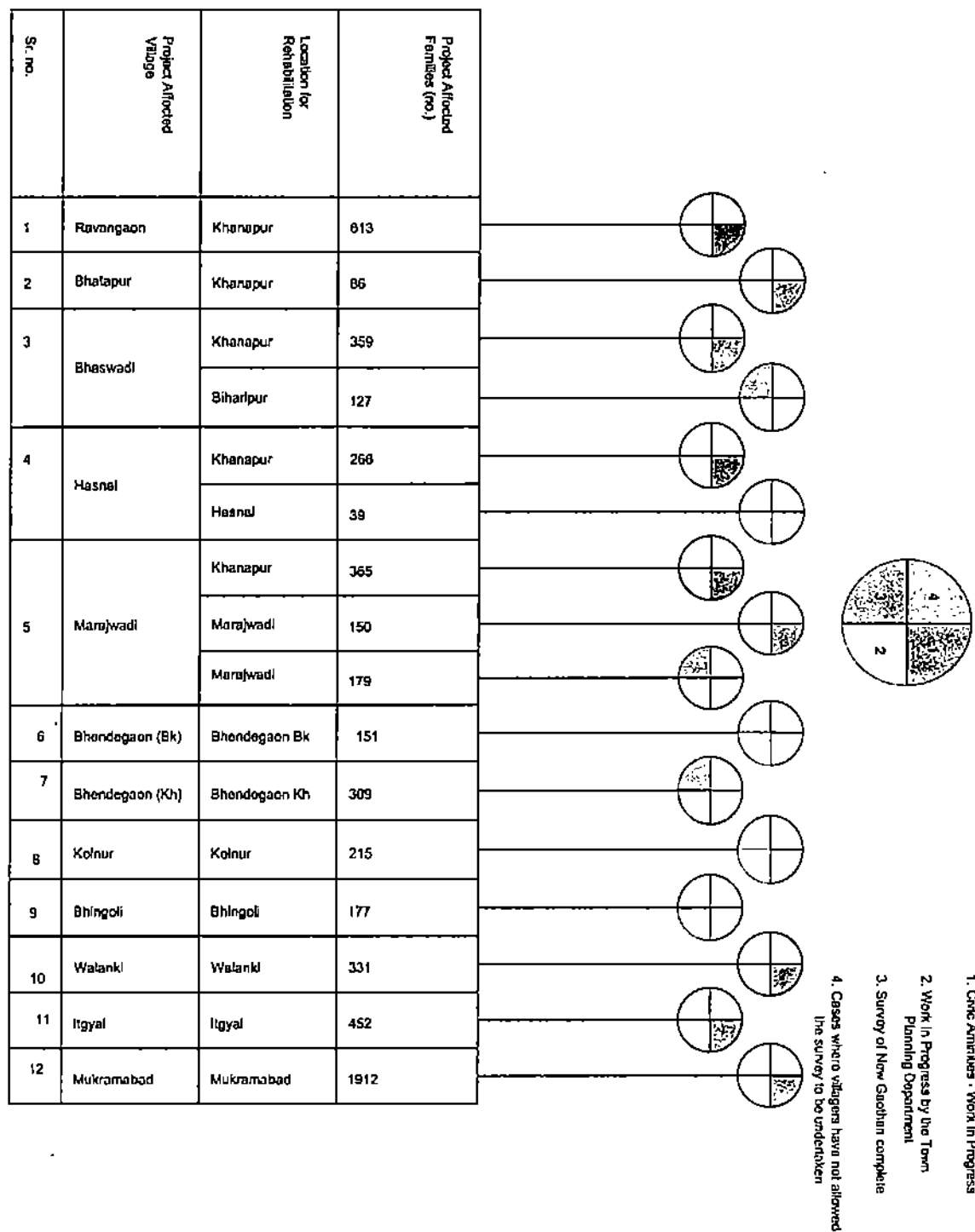


Table 11.32 Statement showing the present position of work of civic amenities in the new locations/ gaothans.

Sr. No	Status of Amenities planned	Proposed Rehabilitation sites										
		Khanapur	Marajwadi	Hasnal	Biharipur	Bhingoli	Bhendegao n (Bk)	Bhendegao n (kh)	Itgyal P.Mu.	Mukramabad	Wafanki	Kolnoor
1	Well	Completed	-	Land is in possession. Works will be started shortly	Land is in possession. Works will be started shortly	Completed	Completed	Land is in possession. Works will be started shortly	Land is in possession. Works will be started shortly	Land Acquisition is In Progress	Land Acquisition is In Progress	Land Acquisition is In Progress
2	Bore well	Completed	Completed			Completed	Completed					
3	Overhead Tank	Completed	-			Completed	Completed					
4	Piped water supply	Completed	Completed			Completed	Completed					
5	School	Completed	Completed			Completed	Completed					
6	Chavdi - Samaj Mandir	Completed	Completed			Completed	Completed					
7	Electric supply	-	Completed			-	-					
8	Drainage	Completed	Completed			Completed	Completed					
9	Public toilets	-	-			-	-					
10	Cattle sheds	-	-			-	-					
11	Bus stop	-	-			-	-					
12	Threshing ground	Completed	Completed			Completed	Completed					
13	Grazing land	Completed	Completed			Completed	Completed					
14	Village Market	Completed	Completed			Completed	Completed					
15	Crematory /Burial ground	-	Completed			-	-					
16	Grampanchayat office	-	-			-	-					
17	Internal Roads	Completed	Completed			Completed	Completed					
18	Approach Roads	Completed	Completed			Completed	Completed					

CHAPTER – 12

ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER 12.0 ENVIRONMENTAL IMPACT ASSESSMENTS

12.1 Introduction

This chapter presents identification and appraisal of various impacts from the proposed project. The description of the existing environmental setting/baseline conditions for three seasons and project details furnished in the previous chapters were instrumental in forming a basis for the impact assessment.

"Environmental Impact" can be defined as any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration. Generally the environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly to the project. Secondary impacts are those, which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action.

Different types of projects will have different impacts and it should not be assumed that the modern methods of construction and operation would have fewer impacts. Impacts will also vary according to the stage of implementation. For example, during the construction period there may be specific health and other social risks due to an influx of migrant workers living in temporary and unhygienic shelters. Later, once the project becomes operational for several years, cumulative impacts may begin to present environmental constraints to the project sustainability.

12.2 Impacts during Construction and Operational Phase

Various impacts during the construction and operational phases on the environmental parameters have been studied to assess the impact on environment around the project. These project activities include levelling of site and cutting of trees in submergence area, construction of earthen dam on Lendi River, construction of colony for the workers and also of other related structures.

The activities related to the construction and operational phases will have varying impacts on the environment and they have been considered for impact assessment viz. Physical resources, environmental resources, Ecological resources, Human use values and quality of life.

Physical Resources

- ❖ Impact on Topography
- ❖ Impact on Climate

Environment Resources

- ❖ Impact on Air Quality
- ❖ Impact on Noise Levels
- ❖ Impact on Surface Water Hydrology
- ❖ Impact on Water Quality/Water use
- ❖ Impact on Geology

Ecological Resources

- ❖ Terrestrial ecology
- ❖ Aquatic ecology

Human Use Values

- ❖ Soil
- ❖ Land use

Quality of life

- ❖ Impact on social and community structure
- ❖ Impact due to agriculture loss and trees
- ❖ Impact on civic amenities
- ❖ Impact on public health and nutrition
- ❖ Impact on aesthetic value

The details on impact of the project activity on each of the above environmental attributes are discussed below:

12.3 Impact on Physical Resources

12.3.1 Impact on Topography: During construction of dam and related activities such as excavation for casing and hearting material and quarrying for rubble, the impact is likely to be on physical environment. As per the satellite imagery data and the field observations, the topography of catchment area are undulating while, less undulating for the submergence zone. The total length of the dam alignment surveyed is 1651.40 m (excluding spillway) out of which, most of it is an earthen dam (on either flank) except for the masonry spillway in the centre (ogee with 14 gates of size 12 x 8 m) and two river sluices. The terrain adjacent to the river is less undulating at both the flanks and is almost flat; good soil cover exists.

There will be clearing of vegetation in the submergence area although vegetation is extremely scanty in the submergence zone. Except for a few standing trees of *Mangifera indica*, *Ailanthus excelsa* and *Acacia nilotica*, the rest of the terrain is flat, and land is under cultivation, except near the riverbed. The other topographical changes are likely due to excavation of borrow areas; dumping of construction material, stone quarry etc. As the construction activities progresses, due care required to be taken to select the borrow areas in the submergence zones. This would minimize the alteration of topography. Construction road for material handling will also alter the topography of the area, but this will be minimal as the existing road till the village Gonegaon will be used. The additional activities that are expected to change in topography are construction of structures like dam wall, building, camp office etc. The major topographical changes would be due to construction of main dam, colony, creation of reservoir and related infrastructure. Minor topographical changes will be due to cutting of the present vegetation, which is scanty, in the submergence zone. No rare species is reported from the submergence (ref: Ecology chapter).

Due care has been taken to decide the FRL 396 m and the area considered under submergence is 2338.06 ha. The total catchment area is 1594 sq. km. of the total catchment area, *Water body constitutes to 5%, Harvested field to 31%, Standing Crop to 21%, Barren land to 2%, Wasteland to 25%, Settlement to 1%, and Scrubland to 15%.* This land use of the catchment zone may give an idea about the changes that

would occur in the topography. The impact on topography will be irreversible considering the construction of dam and water spread in submergence zone. On the other hand, there will be *Pucca* roads and plantation around dam site and colony. This will improve aesthetics of the area.

12.3.2 Impact on Climate: The dam is located in a slightly undulating terrain in the rain-shadow zone of the Deccan plateau of Maharashtra. The dam may contribute to changes in micrometeorological conditions (weather pattern) on local scale at the project site. The main affected parameters will be wind, evaporation rate, ambient temperature, relative humidity and to some extent visibility.

The water bodies of this scale, either man made or natural may contribute to formation of Lake Breeze during daytime and land breeze during night time. The created water reservoir due to dam construction at the project site will enhance the natural up-slope winds during day time due to Lake Breeze phenomenon and also enhance the down-slope winds during night time due to land breeze phenomenon and because of existing hill slopes on the banks of reservoir on both the sides.

The dam construction will result in slight reduction in transpiration process due to cutting and submergence of vegetation coverage in the reservoir area. Once the dam construction is completed, there will be enhancement in evaporation rate, especially during summer seasons. However, there will be insignificant changes in evaporation during monsoon season. The increased evaporation of water vapour from the reservoir will increase the moisture content of the atmospheric layer existing above the water surface. The moisture will be carried by prevailing winds and turbulence to the surrounding areas.

The evaporation process at such a water body will naturally decrease the ambient air temperature near the dam site and up to certain distance in the downwind direction. Under calm conditions humid weather will prevail on the banks of the reservoir due to higher relative humidity. There will be marginal increase in frequency of occurrences of fog around the dam area due to evaporation process, which may reduce the visibility locally.

12.4 Impact on Environmental Resources

12.4.1 Impact on Air Quality

Construction Phase: The main impact on the air quality of proposed project is during the construction phase due to excavation, site levelling, transportation of materials etc., wherein there will be increase in the suspended particulate matter (SPM) level at the construction site. However, the level of SPM will be mainly dependant on the intensity of excavation operations and transport of material from the borrow areas to the project site. Similarly, drills, shovels, trucks of different capacity will be engaged mainly for extracting and transporting the material from the borrow areas. There are also chances of gaseous pollution (NOX, CO & HC) due to automobile exhausts and diesel operating construction machinery. However, the impact on the present ambient air quality will be localized and temporary in nature. Villages in the vicinity of the project area may face impact of construction activities. It is observed that the ambient air quality is within the prescribed limits at all the sites studies. The maximum values recorded for SO_2 , Nox, and SPM are $10.2 \mu\text{g}/\text{m}^3$, $10.6 \mu\text{g}/\text{m}^3$, and $82.4 \mu\text{g}/\text{m}^3$ respectively.

Also, the project site is without any pollution sources in the surrounding area. There are no industries in the project area and the present sources of pollution include the occasional movement of vehicle and domestic fuel burning.

Thus, the impact on ambient air quality though negative, is temporary and reversible. Mitigation measures as suggested in Environmental Management Plan (EMP) will also help in reduction of these levels during construction phase. The sprinkling of water before the vehicular movement is practiced and was confirmed during the field visits. Also the local residents confirmed it during the Health Impact Assessment survey carried out.

Operational Phase: As all the construction activities will cease during this phase, there will be no impact on ambient air quality during operational phase of the project. There will not be any emissions from the project activities. Existing metalled roads in the project areas would ensure that there will not be increase in dust and particulate matter due to the movement of vehicles at the dam site during operational phase.

12.4.2 Impact on Noise Levels

Construction Phase: Construction activities produce noise levels in the range of 44-76 dB (A). The noise produced during the construction will have significant impact on the existing ambient noise levels surrounding the construction site. The major work generating the noise will be carried out during the daytime. Though there are some settlements near the dam site they are about at 1000 m distance from the dam site. Thus the construction activities will not affect the livelihood of the people. The workers are using existing old colony present near the site.

The construction equipment may have high noise levels, which can affect the personnel, operating the machines. The noise levels in the working environment are compared with the standards prescribed by Occupational Safety and Health Administration (OSHA-USA), which in turn are being enforced by Govt. of India through Model rules framed under the Factories Act. These standards were established with the emphasis on reducing the hearing loss. The noise level exposure during the shift is 90 dB (A). Drilling and blasting which generates the noise above this level are being done only for short duration i.e. for 2 to 3 hours to avoid the exposure to the safety limit for longer duration.

The maximum daytime noise level at the dam site is observed during the construction to be 76 dB (A). The noise likely to be generated during excavation, loading and transportation of material is in the range of 90 to 100 dB (A) and this will occur only when all the equipments operate together and simultaneously which is a remote possibility. The workers in general are likely to be exposed to an equivalent noise level of 50-60 dB (A) in an 8-hour shift. Use of proper personal protective equipment like earplugs, mufflers will help to attenuate the noise generated by construction equipments.

Operational Phase: As all the construction activities will cease during this phase, the impact on ambient noise levels during this phase will be marginal and limited to vehicle movement in the project area, which is predicted to be well below the permissible limits.

12.4.3 Impact on Surface Water Hydrology

Water Resources: The River Lendi with its two main tributaries Tiru and Kundrala originates at an altitude of 650m, near Udgir in the Latur district of Maharashtra State. It flows 85 km in the eastern direction and joins Manjara River at an altitude of 362 m. The river flows through hilly area with an average bed fall of 11 m per km initially for the 15 km from its origin. Thereafter it flows with an average bed fall of 4 m per km for about 21 km up to the confluence with Tiru river tributary. Finally it joins the Manjra river with a bed fall of 1 m per km for the remaining length of 49km. thus the overall slope bed of the Lendi River is 3.11 m per km; from the upstream to the dam site the river length counts to be 78.89km. The available water from the Lendi river basin is not fully utilized except for some of the minor schemes and two medium irrigation projects. Hence it is proposed to have a storage reservoir by constructing dam across this river with a gross storage of 145.15 M Cum.

Upstream Effects: The creation of the reservoir will alter the normally free flowing condition of the river. River currents will be reduced in the reservoir area and the water will cover the previously exposed areas along the bank of the river.

The operation of the project will cause a fluctuation of the reservoir water levels. The drawdown will normally be about 4 -7 m. The drawdown process may create environmental problems in the reservoir such as edge effect and bank erosion.

Downstream Effects: Regulation of the reservoir will significantly modify the flow pattern of the river in the downstream of the Dam site. The fluctuations will be with much narrower ranges along the downstream reaches. However, these changes will not be significant owing to seasonal nature of the river. Improved flood prevention and control are also envisaged to minimize the impacts in the downstream of the reservoir.

Reductions in low flows and flood flows may significantly alter the river morphology, reducing the capacity to transport sediment and thereby causing a build up of sediments in slower moving reaches and possibly shrinking of the main channel. Increased flows will have reverse effect. Where the sediment balance changes over a short distance, perhaps due to a reservoir or the flushing of a sediment control

structure, major changes to the local river morphology are likely to occur. But because of the continuous flow for irrigation, nature of impacts will be less significant. The release of clear water from reservoirs may result in scour and a general lowering of the bed level immediately downstream of the dam, the reverse of the effect that might be expected with a general reduction in flows. Changes to the river morphology may affect downstream uses, in particular use for drinking and irrigation. But on the contrary the life of river will extend and flow will be regulated and would support not only drinking and irrigation needs but also need of flora and wildlife in the downstream. Thus the river ecology may have positive impacts on the aquatic life, although the river is not known to harbour biota of rare category.

12.4.4 Impact on Ground Water Quality: The present water quality has been assessed by collecting and analyzing the ground water samples in the project area (Refer Chapter 8). The ground water is found to be potable for drinking and other domestic uses but it is recommended to provide prior disinfection and filtration, the conventional methods will work owing to the chemical properties of water.

Construction Phase: Ground water pollution can take place only due to a dump containing chemical substances which will get leached by precipitation of water and percolate to the ground water table. This is not the case with the present project, as the activity doesn't contain any use of large-scale harmful ingredients, which could leach down to water table. Hence, impact in the ground water quality is not anticipated from the project during the construction phase.

Operation Phase: Agricultural intensification surrounding the submergence area (2338.06ha) and command area is envisaged due to availability of water through increased ground water table in the wells. Agricultural intensification may increase the usage of pesticides, insecticides and fertilizers and other agriculture chemicals. These chemicals may seep into soil along with the runoff and may ultimately join the ground water. Hence there is possibility of deterioration in ground water quality over the period of time due to indiscriminate use of pesticides, insecticides and fertilizers surrounding the project area.

12.4.5 Impact on Ground water Table: The ground water levels will rise to optimum levels in the command area of proposed project. The construction activities especially excavation in the river bed is likely to develop secondary porosity by way of cracks and joints and thereby increase the retentive power and infiltration index enhancing the percolation of water to the ground, enhancement of recharge, results in the simultaneous decrease of surface run-off which is not a matter of concern because ultimately the percolated water will emerge again to the surface. The quantum of water not entering the surface discharge will supplement the ground water resource, which can be considered beneficial to the ground water regime of the area.

For most time of the year, groundwater in the project area is 3m below the ground level. The present groundwater level of the command is also deep. In addition, most of the villages of the study area have shown fall in the ground water levels, over the years.

The pH of all the examined groundwater samples is normal. Water is found to be potable and suitable for other uses but it is recommended to provide prior disinfection and filtration. The levels of Sodium and Fe are observed higher, which indicate anthropogenic activities.

During the operational phase, rise in water table in the nearby wells is envisaged in the project area due to the creation of reservoir and irrigation activities. However, at present, the groundwater levels are deep, and there is a natural drainage in the form of network of streams, excess water if any, can be easily drained out. The soils are moderately drained and would assist in draining the excess water from the farm lands.

Construction Phase: The construction activities especially excavation in the river bed is likely to develop secondary porosity by way of cracks and joints. This might increase the retentive power and infiltration index, enhance the percolation of water to the ground and enhance the groundwater recharge. Reduced surface run-off may not be a major concern. The percolated water would supplement the existing ground water resources, and can be considered as beneficial to the ground water regime of the area.

Operation phase: Ground water level in the study area is 3m below the ground or deeper, for the most part of the year. Additionally, majority of the villages have shown fall in the ground water levels, over the years. The P^H of all ground water samples is normal. Water is found to be potable and suitable for most of the uses, though, it is recommended to provide prior disinfection and filtration, before its use for drinking. The levels of Sodium and Fe are observed higher, which indicate anthropogenic activities.

During the operational phase, reservoir creation would likely to result in rise of the water table in nearby wells of the command area. However, at present, most of command area has exhibited water table deeper than 3m bgl, and there is no cause for an alarm. Since the terrain has a natural slope, and network of nallahs flowing, the excess irrigation water is likely to be drained out. In addition to the natural drainage of the command, supplementary measures have been proposed under command area development plan to minimise waterlogging situations.

12.4.6 Impact on Surface Water: The present water quality has been assessed by collecting and analyzing the surface water samples in the project area (Refer Chapter 8). All examined parameters are found within the permissible limits as per IS: 2296-1982. There is no intense agricultural activity in the catchment as most of the area has a hilly terrain. The water is slightly hard, though the pH and EC is within the normal limits. In general water is good for irrigation for use up to 20 years though for more parameters it is suited for continuous use. The accumulation of salt and mineral levels for some sites may have occurred because of extremely dry conditions prevailing in the region. Once the more water will be available for the use, the dilution may improve the quality of water.

Construction Phase : Construction activities of the project involve site clearing, excavation of river bed for construction of dam foundation, excavation of aggregate materials from the stream bed, borrowing of the impervious core material from the borrow areas and dumping of the filling material in the river. Such activities result in and would likely further increase turbidity and sediments in the water and subsequent siltation of sediments on the riverbed. Short-term effects on downstream water will

exist during the construction phase. To avoid this, construction activities will be restricted mostly to non-monsoon months, when the river bed is dry.

The construction activities will be taken up in the non-monsoon months only. Deterioration of water quality in the river may take place due to discharge of sanitary effluents into the river from the construction camps and use of river water for other domestic purposes during the construction phase. Another critical parameter would be bio-degradation of woody vegetation in the water-spread area, which may result into eutrophication of water body. Clearing of vegetation from the river should be carried out during the construction phase to avoid eutrophication of water bodies. Reduction of downstream flow will impact dilution of pollutants. An adequate foresight and creation of physical facilities would minimize the above problem. This should form integral components of construction activity.

Operational phase: Reservoir could cause several changes in the water quality including sediment entrapment, increase in carbonaceous compounds and nutrients needed for aquatic life, depletion of dissolved oxygen and increase in gaseous H_2S and CO_2 at the lower part of the reservoir due to anaerobic decomposition of flooded vegetation and organic matters in bottom sediments and inundated soils. The consequences would include high productivity of the upper water layer and damages to aerobic organisms in the bottom parts of the reservoir. Thermal stratification would exist in the reservoir in most of the periods of the year, with turnover being expected in November - January. Thermal stratification refers to the layering that occurs, particularly in the warm months, during which a warmer, less dense layer (the epilimnion) overlies a colder denser layer (the hypolimnion). Thermal stratification is a common occurrence in deep temperate lakes. Between these two layers is a third layer (the metalimnion) where strong vertical differences (gradients) in temperature exists, and therefore, difference in density prevails. The upper layers would be aerated while the lower part would be septic near the bottom, resulting in release of organic materials and nutrients from the sediments and soils.

The dam will be 1651.40 m long, with the top of dam RL 401.00 m with a gross storage capacity of 145.15 M Cum. Excess water after the required storage will pass through

Ogee type spillway with 14 gates of size 12 x 8 M. Due to the storage, depletion of DO and lowering of pH levels may occur at the bottom of the reservoir. However, if there is depletion in the dissolved oxygen/pH levels, the water after passing the dam will re-aerate due to the turbulence and would reach the initial levels after travelling through a particular stretch.

Further care should be taken in clearing the vegetation in the submergence area. This activity will be completed during the construction phase. The list of trees and its number is provided in the ecology chapter. Impact due to eutrophication of water body is not anticipated during the operation phase, since there is no industrial or sewage discharge into water bodies in the upstream of the dam. However, the vegetation in the submergence zone is very scanty, with no presence of rare elements and can be removed.

There could be a deterioration of water quality, especially in the reservoir due to upstream discharges containing agricultural runoffs, which in turn accumulate pesticides, fertilizers and other chemicals. However, this impact will be negligible since there will be limited agricultural activity in the catchment due to typical hilly nature of terrain and the nature of crops that would be grown. The present surface water quality meets the regulatory standards. The results indicate that the river water quality is free from pesticides, fertilizers and heavy metal contamination. Hence, accumulation of these ingredients is not envisaged, as the river will be flushed during the monsoon season. Reduced river water availability downstream of the dam will reduce the dilution and dispersal of pollutants to a limited extent for a seasonal river like Lendi. However, reservoir operation will take care of such problems.

Sediment Yield: The phenomenon of sedimentation in reservoir is complex one and is governed by number of parameters. Sediments brought by the stream into reservoir depend upon the catchment characteristics, intensity and duration of rainfall, flood flow and sediment transport capacity of the stream.

The calculations indicated that the rate of sediment yield from the basin ranges from 880 to 1620. The details are provided in the summary table below. In general the

sediment yield is expected to be higher during first showers of the monsoon season when the soil sediment is loose. However, as the grass and vegetation grows, the sediment movement is restricted and rate of sediment yield drops to a minimum level.

Silt Yield Index- Summary table for the Lendi Major Interstate Project

SYI values (arranged in ascending order)	AREA KM2	Yield category (up to 1000:very low, 1000- 1099:low, 1100- 1199:Medium, 1200- 1299:High, >1300:very high)	Total area under major yield category (low up to 1199, medium 1200- 1299, high 1300 and above) sq. km	% area under major yield categories
880	37.18	Low		
880	23.63	Low		
880	9.69	Low		
935	23.19	Low		
935	11.49	Low		
1040	16.86	Low		
1040	8.08	Low		
1040	9.51	Low		
1040	11.09	Low		
1105	24.89	Low	Low: 176.51	21.12
1200	22.05	Medium		
1200	6.08	Medium		
1200	11.22	Medium		
1200	10.5	Medium		
1200	17.18	Medium		
1200	13.23	Medium		
1200	18	Medium		
1200	32.52	Medium		
1200	24.83	Medium		
1260	21.67	Medium		
1275	31.45	Medium		
1275	33.45	Medium		
1275	45.37	Medium		
1275	20.1	Medium		
1275	44.31	Medium		
1275	19.64	Medium	Medium: 371.6	44.46
1350	25.87	High		
1350	20.75	High		
1350	23.88	High		
1530	40.82	High		

1530	20.16	High		
1530	13.43	High		
1530	19.66	High		
1620	27.37	High		
1620	48.09	High		
1620	48.66	High	High: 288.69	34.53
44515	835.9			100.0

Information on the existing watershed activities in the catchment is obtained and indicates that part of the catchment has some treatment done. A detailed investigation into Catchment Area Treatment (CAT) Plan has indicated that the proposed treatments will minimize the rate of sediment inflow into the reservoir to a great extent. Also the estimated value of sedimentation rate would be lesser once the proposed CAT plan is implemented. For example a tank or check-dam within the catchment area influences the siltation yield by acting as a silt trap / stilling basin. This drastically reduces the sediment yield. The details are presented in the comprehensive CAT plan prepared (EMP-Chapter 17, Catchment Area Treatment Plan).

12.4.7 Impact on Geology : The Deccan Volcanic Province is characterized by basalts that display unique hydro-geological characteristics. The basalts are devoid of significant amount of intergranular porosity i.e. < 3 %. A weathered portion of the basaltic flows, particularly the vesicular upper portion is a potential site for infiltration of rainwater as well as for the occurrence and storage of groundwater. Beginning from the north, the first of these ranges known as the Satmala enters the district after the gap cut by the Penganga just west of Mahur hills. It rises in three distinct terraces, the first being some 100 meters above the valley flats of the Penganga at an altitude of 350 meters above sea level. On this terrace are some small tanks and a few villages set in the midst of cultivated fields. Mahur is the largest or them and is considered as a sacred place. The next higher terrace is at a level of 570 meters above sea level, rising sharply from all sides except the south where it is cut apart by stream erosion. There is a fort on this terrace which enjoyed the protection afforded by the Penganga surrounding the hill on all the sides except the east in addition to that afforded, by the densely clad jungle slopes inhabited by wild animals. There is a still higher terrace at a level of 600 meters covered with dense jungle.

As the Mahur hill extends south-eastwards, it is bordered on the north by a ridge whose summits rises over 600 meters and is separated there from by a very narrow

trough which is occupied by sections of various minor streams. It may be noted that the road and the railway line from Ambadi to Adilabad use this narrow depression.

The geology of the study area: it is broadly constituted of basaltic flows belonging to the Deccan Volcanic Province. Alluvial and colluvial deposits respectively occur along the river channels and hill slopes. A thin veneer of residual soil is developed on the valley floor and top of the plateau. At the dam site and in surrounding areas, no field evidence of any lineament could be found.

Absence of loose material on the peripheral slopes around the water impoundment ensures good safety against land-sliding problems. Hence problem of reservoir-associated landslides can be considered as minimal.

12.4.8 Reservoir Induced Seismicity (RIS): Some evidence exists to link the construction of larger dams with the occurrence of seismic events. In seismically active areas, a reservoir may advance the occurrence of earth tremors (possibly resulting in more frequent but smaller magnitude events). However, the relationship between water impoundment and seismic events and the mechanisms by which a reservoir could cause earthquakes are not wholly understood and there is considerable debate on the subject.

It has been suggested that large reservoirs may induce increased seismic activity through:

- Change in the normal effective stresses in the underlying rock due to increased pore pressures; and
- Transmitting hydrostatic pressure through discontinuities in the underlying rock.

Induced seismic activity may be classified into three categories:

- No change in seismic activity.
- Micro-earthquakes, the frequency of which increase with initial inundation and thereafter vary according to water level variation. These tremors eventually subside.
- Macro-earthquakes, the frequency of which increase with the initial inundation and thereafter vary according to water level variation above a threshold value.

Subsequent to this medium size earthquakes may occur, followed by micro earthquakes and eventual stabilization.

General characteristics of induced earthquakes are:

- Occurrence within the vicinity of the reservoir;
- Small focal depths;
- The frequency of small earthquakes is higher than that of large earthquakes; and
- High chance of occurrence in an area of normal or lateral faults.

Medium sized earthquakes tend to occur in situations where:

- The generating head is large (typically over 100 m),
- The impounded water volume is considerable (typically over 1 km³); and
- There are many fissures and faults in the crust.

The increase in local seismic activity may lead to consequences ranging from numerous small stress relieving earthquakes to catastrophic earthquakes and slides similar to the events.

Various seismic events, subterranean sounds and ground shaking are all related to basement tectonic structures below the Deccan volcanic. The faults associated with these structures are sometimes activated is evident by neotectonic activity. On satellite images these basement faults are identified by closely spaced lineaments. These closely spaced lineaments are thus believed to be the bifurcated fault planes of major basement faults. Continued tectonic activity along them is largely responsible for their propagation and various geo-morphological processes which have accentuated them.

Much of the Maharashtra state now lies in Zone III. Reservoir induced seismicity has also been noted at a few dams in the Maharashtra State, namely Bhatsa and Koyna. Seismicity in the State of Maharashtra is very well studied and maps showing different locations of epicentres and their magnitude have been prepared. The entire Deccan Trap region is considered to be vulnerable to moderate earthquakes. The highest recorded earthquake magnitude in Maharashtra is estimated to be 6.8.

However, the Dam design in India is regulated by a national standard developed by the Bureau of Indian Standards (BIS), namely - Criteria for Earthquake Resistant Design of Structures (Third Revision). The BIS classifies the Indian Subcontinent into 5 zones based on the frequency and magnitude of seismic activity with most stringent conditions being imposed on engineering structures occurring within zones 1 & 2. Engineering structures must be designed to withstand the maximum predicted earthquake within a given category. The study area is considered with moderate seismic activity.

Geological examination and interpretation has revealed that underlying rock is basalt - a basic volcanic rock. Dykes and veins of quartz are also common. Conversion of basalt into laterite is also noticed in few places. Absence of loose material on the peripheral slopes around the water impoundment ensures good safety against landslide problems. Hence the problem of reservoir-associated landslides can be considered negligible. In the present context, the dam is designed to withstand the maximum earthquake intensity as per the BIS standards. The study area is considered stable with generally medium seismic activity. Hence the chances of Reservoir Induced Seismicity are rare.

12.5 Impact on Ecological Resources

The baseline data on flora and fauna has been depicted in Chapter- 9. There is no Wildlife Sanctuary / National Park in the project area. Out of 11 floral species six species fall under class Lower Risk (LR) & five species are under class Vulnerable (VU) of IUCN. While 23 recorded faunal species come under schedule I & II of the wild life protection act 1972, as amended up to 2006).

There are no protected areas within the 25 km radius from the command and Catchment area of the Lendi Major Interstate Project.

12.5.1 Impact on Terrestrial Ecology

Construction Phase: The initial construction works at the project site involves land clearance, cutting, filling and levelling. The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, such impacts would be

primarily confined to the project site during initial periods of the construction phase and would be minimized through adoption of mitigatory measures like paving and surface treatment, water sprinkling and appropriate plantation programme. At the project site green belt consisting of a variety of local species will be developed which would enrich the ecology of the area and add to the aesthetics.

The constructional activities will lead to inward migration of a huge labour force in the area and thus there would be pressure on fuel wood trees in the area due to increase in fuel demand. In order to prevent felling of trees in the neighbouring areas, adequate alternate fuel needs to be arranged to meet the fuel requirement of labour force. The increased vehicular traffic coupled with higher noise level due to various constructional activities will drive away the local fauna from the project site to the neighbouring area temporarily.

Operational Phase: A considerable area will be covered under the submergence. The submergence area is required to be cleared off by removing natural vegetation which otherwise may result in creating obnoxious condition in the reservoir. As stated earlier, oxygen depletion, entrapment of nutrients etc. could change the species composition and reduces the species diversity in the reservoir. However, the submergence zone has mostly agricultural area (77.43 %) and the table Nos. 9.12 chapter No.9 show no occurrence of any critically endangered species. The plant species reported from the submergence includes *Azadirachta*, *Annona*, *Acacia*, *Mangifera*, *Prosopis*, *Anacardium*, *Morinda*, *Terminalia*, *Tectona*, *Tamarindus*, *Zizyphus*, *Cocos*, *Madhuka*, *Capparis*, *Manilkara*, etc and are quite common.

The water level fluctuation at the periphery of the reservoir creates a drawdown zone (edge effect), which supports the growth of weedy species along the banks.

The vegetation in general in the project area including submergence, catchment and command in both Maharashtra and Andhra Pradesh is highly degraded and represents poor soil cover. Trees are observed only along the borders of the agricultural areas and along the already existing water bodies. The vegetation predominantly is dry deciduous scrub with many xerophytic elements. Also many secondary forest and

plantation species such as teak, coconut, Neem, Sitaphal, Ber & Mango have been observed during the study and reported elsewhere in this final report. The entire region is dominated by scrub vegetation predominated by floral species.. The tall trees are either planted along the borders of agricultural areas or watercourse.

Most of the natural vegetation is secondary in nature and has indication of high level of human disturbance. Species such as *Acacia nilotica*, *Calotropis* sp, *Ipomoea* sp. and *Vitex negundo*. *Butea*, *Terminalia*, *Wrightea*, *Mallotus*, *Syzygium*, *Lantana*, *Tectona*, *Jatropha*, *Azadirachta* etc are extremely wide ranging and common. People seem to have good ethnobotanical information and practices. Many species of weeds also seems to have local ethnobotanical importance for food or medicinal use, e.g. *Argemone mexicana*, *Portulaca oleracea*, *Sida*, *Tribulus*, *Desmodium*, *Mucuna*, *Momordica*, *Rubia*, *Plumbago*, *Calotropis*, *Hemidesmus*, *Achyranthes*, *Celosia*, *Cyperus* etc.

Animals, which are found within the project area and categorised under schedule I and Schedule II Part II of Wild Life Protection Act 1972 as amended up to 2006, are strictly protected and there is a complete ban for their exploitation for any purpose. The faunal list in table No. 9.21 (Chapter No.9) indicates that there is only White-bellied Heron critically endangered bird species living in the surrounding areas. However, some animal and avian species belonging to Schedule I and Schedule II part II such as flap shell turtle, monitor lizard, checkered keel back snake, cobra, viper, Indian peafowl, desert cat, Leopard, wolf, civet cat, pangolin and Black buck have been reported to use this track at different times for various purposes. Some of these species may be using the track for temporary residing purpose also. Most of these species undertake local migrations to the adjoining safer undisturbed habitats even today due to local threats and/or in unfavourable conditions. They do not remain at the same place for longer time. In such cases the affected populations undertake local migration to the safe and favourable habitats. Therefore the affecting populations of the scheduled species using the proposed submergence and other adjoining areas will shift to the undisturbed and safer regions surrounding the entire proposed project area during the construction phases and even after completion of the proposed project. The construction of dam will create a water body, its impact on ranges &

territories of wild animals will be negligible as they are likely to undertake local migration to the nearby suitable undisturbed habitats. Also development of green belt, biological treatments of the catchment area would provide adequate shelter and habitats for the wildlife. Submergence area is small as compared to the vast catchment and also a private land, which does not support rich wildlife.

Plantation of locally dominated plants will serve as perching sites for avifauna including hawks and peacocks. The canopy of cultivated forest with fruit bearing trees will improve the number of arboreal mammals. The perennial water body will certainly assure the enriched life and even population of aquatic bird species.

Creation of water body will help in creating an environment suitable for breeding of migratory and aquatic faunal elements. Shrubs and bushes around the dam site will provide suitable conditions for nesting and breeding of aquatic and migratory avi-, herpeto- as well as avifaunal elements.

12.5.2 Impact on Aquatic Ecology: The construction and operation of the reservoir may lead to ecological changes locally. The factors that normally govern these changes are temperature, turbidity and dissolved oxygen. These factors are responsible for disturbing the homeostatic mechanism of the ecosystem if their concentration exceeds limits of tolerance of the ecosystem. The assimilative capacity of the ecosystem with respect to addition of pollutants will totally depend upon the ecosystem involved, since each ecosystem is unique in terms of ecological balance between biotic and a biotic component. The impact of proposed reservoir during construction and operation is discussed below:

Construction Phase: The construction activities involving levelling of site, piling, excavation, etc. leads to marginal increase in the turbidity of the river. The present status of the river water shows that the river is without any significant biota, which would undergo any significant change due to the marginal increase in levels of turbidity. Also the river is seasonal.

Operational Phase: Positive impact would be that the water in the reservoir would be beneficial to the reservoir fisheries due to the increase in water volume and nutrients in

the reservoir. Reservoir fisheries would create socio-economic benefit to the resettled land losers and those in the downstream area, who can depend on reservoir fisheries as a supplementary occupation. Since the reservoir will contain water round the year, small scale fishing activities along the shoreline in the catchment area will be encouraging locally.

Another critical factor would be the growth of weeds or floating weeds in the river which causes considerable nuisance and adversely affect the aquatic flora and fauna. In order to avoid eutrophication of the reservoir, due care shall be taken while clearing the submergence site for woody vegetation in order to minimize the organic matter degradation in the reservoir. Since the submergence zone has prevalence of agriculture land, vegetation is extremely scanty.

The present status of the river shows that the river is without any significant and rare biota. In general, small and seasonal rivers support only a few species of specialised fish. The recorded fish catch is extremely low & even not fulfilling the regular dietary needs of people. The river Lendi is seasonal and get almost dry in summer, which restricts the movement & migration of the fishes.

This leaves very little concern for the aquatic biota. In short, no significant changes in the aquatic biota during the project activities are expected. In fact in future, water in the reservoir would be beneficial to the reservoir fisheries as there will be increase in water volume and nutrients in the reservoir. Reservoir fisheries would create socio-economic benefit to the resettled land looser communities and for those in the downstream area, who can depend on reservoir fisheries as a supplementary occupation.

12.6 Impact on Human Use Values

12.6.1 Soils: The soils are clayey and loamy in nature. On the banks of streams & river, alluvial soils were observed. Soil samples from Kolnur, Hatral, Takli, Hoga, Thadi, Sangivi Umer, Tamlur and Selgaon stations are clayey in texture and proper management will be extended for these sites in order to avoid water logging. This is because clayey soils are prone to water logging. This calls for proper scheduling of the

irrigation as per the requirement. The electrical conductivity of the soil is normal and there is no cause for the alarm. The soils of the project area are suitable for deep rooted crops e.g. Pulses, Sugarcane, Cotton, Banana, etc. The overall micronutrients availability is moderate to low and needs to be supplemented. Overall the soils are moderately drained and would assist in draining of excess water from the farm lands.

Proper management is required to avoid waterlogging and salinity in clayey soils. However, the impact of salinity on the soils would be negligible because of their lower electrical conductivity levels. Fertility assessment indicates that the soils are poor in nitrogen and phosphorous while high in Potassium. Soils require amendments of Nitrogen and Phosphorous. Proper irrigation, use of fertilizers and manure practices can yield good crop. Soils are suitable for various crops such as Pigeon pea, Cotton, Banana, wheat etc.

12.6.2 Land Use: Land, which would be inundated by reservoir lies in the river basin where good, soil depth and silt deposition results in high fertility. It is observed that the agricultural activity is mainly monsoon dependant. Of the total catchment area Water body is 5%, Harvested field is 31%, Standing Crop is 21%, Barren land is 2%, Wasteland is 25%, Settlement is 1%, and Scrubland is 15%. As the cultivable land in the submergence is almost negligible (10%) the negative impacts would also be marginal. In addition, there would be intensification of land use, especially around the rim of the reservoir, which will include the cultivation of present wasteland.

12.6.3 Construction at site/ Camp Buildings: This activity involves construction of buildings for office and habitation during the construction period. The construction of colony will be undertaken for accommodation of project personnel in addition to the use of existing colony near the dam site. This may result in destruction of vegetation and pose sanitary and health problems. Due care should be taken to maintain hygienic condition during construction as well as the operation phase. A Health Management Plan is prepared to address any negative impacts on life.

12.7 Impact on Quality of Life

There are 19 villages of Mukhed (Nanded District), Maharashtra under consideration for the project affected families due to the construction of the dam. Out of these, 12 villages are required to be fully resettled and remaining 7 villages only agricultural land is going to be submerged and habitations will remain intact.

12.7.1 Socio-economic and Community Structure: As per the R & R policy of the Government of Maharashtra, for the Lendi Project, nearly 30680 Project Affected Persons (PAPs) across 5731 families will lose their houses and are to be relocated in different resettlement gaothans, which will be subsequently developed for that purpose. Construction of the dam and other related structures has created employment opportunities for unskilled as well as skilled manpower. The overall impacts will be positive and beneficial.

12.7.2 Loss of Productive Agricultural Land: The prime productive agricultural land in the submergence area is negligible, and hence no major negative impacts are envisaged.

12.7.3 Impact on Agriculture: Increase in gross value of agricultural production and increase in marketable surplus of food crops are envisaged. Irrigation facility will lead to shift from cultivation of food crops to plantation and cash crops. Irrigation will make it possible for a farmer to take two crops in a year by the use of irrigation coupled with other agricultural inputs and will result in increased yield at farm level. This will have a direct bearing on household income of a farmer.

12.7.4 Impact on Civic Amenities: The impact of economic development on civic amenities will be substantial. The area will have amenities like water supply, drainage, education, medical services, electricity, and also transport and communication facilities like road and buses. The overall impacts will be positive and beneficial.

12.7.5 Impact on Public Health: Usually due to impoundment of water, there are chances of increase in occurrences of water borne diseases. This situation becomes a serious health issue if the area is endemic to such epidemics. The health survey that

was carried out as a part of present EIA study indicates that the region is not known for any water borne disease epidemic. There are no incidences in the recent period.

People due to various reasons get attracted towards tobacco chewing, gutkha and alcoholism at a very young age. Thus Tuberculosis (TB), Nervous breakdown, 2nd or 3rd stage blood/lung/oral cancer, Sub mucous fibrosis of the mouth, Gastritis, Duodenal ulcer, cirrhosis and alcohol other diseases associated are reported here. Cases of HIV/AIDS are common in the people those are migratory, such as drivers; people who frequently migrate in big cities for jobs or labour work.

Self-medication is rare and, where it occurs is associated with common diseases. Other cases of dog bite, snakebites or injuries due to any accident are scanty and are treated immediately in hospitals and PHC. It is observed that people prefer PHC to private hospitals, as quoted by some of the private doctors. Diseases such as hepatitis, arthritis, skin infections, and malnutrition are observed in vulnerable groups. On the other hand antenatal and post-natal care is observed and people are seen to attach prime importance towards this care. Immunization, food and feeding habits, sanitation are given a priority in larger towns. Private Doctors maintain a follow up procedure with these patients for ensuring a cure, especially at Mukramabad, Degloor, and Khanapur.

Overall the present development activity does not envisage any significant negative impact on the health of local community. Contrary it would contribute to the improvement of hygiene and health.

12.7.6 Impact on Aesthetic Values: Creation of the reservoir and surrounding it by plantation would enhance the aesthetic value of the site. This may attract water birds and create pleasing atmosphere. All this is likely to attract tourists from various places. The local communities here still have good knowledge of traditional medicines and can be asset for developing Health Spa like activities. This may provide additional source of income to the local entrepreneurs. If planned well, the area can emerge as an excellent site for eco-tourism and health tourism due to the conducive climate. The water body could also be developed for aqua-sports or even as a place for hydro tourism.

Table 12.1 Environmental Impacts of the Project

Features likely to be Affected	Roads and Trails	Colony Construction	Blasting Operation	Borrowing of Materials	Importing of Labour	Dam Construction	Soil Conservation and Landscaping	Reservoir Filling
Vegetation	-1P	+1P			-1T	-1P	+4P	-1P
Birds	-1T	-1T	-1T		-1T	-1T	+2P	+4P
Fisheries								+2P
Other wildlife/land animals	-1T		-1T	-1T		-1T	+3P	+2P
Sedimentation/erosion	-1T	-1T	-1T	-1T		+1P	+2P	-1P
Floods						-1P	+1P	+2P
Historical/cultural monuments								
Communications	+2P	+2P						-1P
Land/area development	+1P	+2P				+2P	+2P	+2P
Agriculture	+1P	+1P					+2P	+2P
Food production	+1P	+1P					+2P	+2P
Public revenue/income	+1P	+1P			+1T	+2T	+2P	+2P
Drinking water		+1P			-1T			+2P
Water quality			-1T	-1T	-2T	-2T		+2P
Air quality	-1T		-1T	-1T		-1T	+1P	+2P
Climate							+1P	+2P
Groundwater table								+2P
Industrialization						+2T		+2T
Housing		+1P				+2P		+1P
Employment/training	+1T	+1T				+3T		

Features likely to be Affected	Roads and Trails	Colony Construction	Blasting Operation	Borrowing of Materials	Importing of Labour	Dam Construction	Soil Conservation and Landscaping	Reservoir Filling
Health and safety	+1P		-1T	-1T	-2T	-1T	+2P	+2P
Scenic views	+1P	+1P	-1T	-1P	-1T	+1P	+2P	+3P
Tourism	+1P						+1P	+2P

Notes: Likely effect is symbolized as follows: T = Temporary Effect; P = Permanent Effect

	Mild	Considerable	High	Very high
Beneficial	+1	+2	+3	+4
Detrimental	-1	-2	-3	-4

Leopold et al. (1971) designed a matrix with a hundred specified actions and 88 environmental components. Each action and its potential for impacting each environmental item is considered. The same has been employed here with little modifications. The magnitude of the interaction (extensiveness or scale) is described by assigning a value ranging from 1 (for small magnitudes) to 4 (for large magnitudes). The plus sign indicates positive impact while the minus sign indicates negative impact. The assignment of numerical values is based on an evaluation of available facts and data. Assignment of numerical values is based on the subjective judgment of the interdisciplinary team working on the EIA study. The matrix approach is reasonably flexible. Technically, the Leopold Matrix approach is a gross screening technique to identify impacts. It is a valuable tool for explaining impacts by presenting a visual display of the impacted items and their causes. Summing the rows and columns that are designated as having interactions can provide deeper insight and aid further interpretation of the impacts. The matrix can also be employed to identify impacts during the various parts of the entire project cycle such as construction and operation.

It can be interpreted from the matrix that most of the negative impacts are temporary. Positive impacts both on the environment as well as on the people are of permanent in nature. The project envisages more of positive impacts provided the environment management plan is implemented seriously.

APPENDIX – 1
PUBLIC
CONSULTATION –
MAHARASHTRA

MINUTES OF THE ENVIRONMENTAL PUBLIC HEARING IN RESPECT OF M/S. GODAVARI MARATHWADA IRRIGATION DEVELOPMENT CORPORATION FOR THEIR PROPOSED LENDI MAJOR IRRIGATION PROJECT, GONEGAON, TQ. MUKHED, DIST: NANDED CONDUCTED ON 22/04/2008 AT 11.00 HRS. AT KALAMANDIR, INFRONT OF MUNICIPAL COUNCIL GARDEN, DEGLOOR, DIST: NANDED.

An environmental public hearing in respect of M/s. Godavari Marathwada Irrigation Development Corporation for their proposed Lendi Major Irrigation Project, Gonegaon, Tq. Mukhed, Dist: Nanded was conducted on 22/04/2008 at 11.00 hrs. at Kalamandir, infront of Municipal Council Garden, Degloor, Dist: Nanded.

Following members were present during the public hearing :

1. Shri Prakash Piratwad,
Sub-Divisional Officer, Degloor,
Dist: Nanded. Chairman.
2. Shri A.D. Mohekar,
Regional Officer, MPCB, Aurangabad. Member.
3. Shri B.P. Kalme,
Sub-Regional Officer,
MPCB, Nanded. Convener.

A list of members and public participants present for Public Hearing is annexed herewith. All those present were given welcome by the Convener. Shri B.P. Kalme, Convener & Sub-Regional Officer of the Board at Nanded narrated the procedure to be followed for obtaining environmental clearance from Government of India by explaining the provisions of the Notification of MoEF No. S.O. 1533 dated 14th September, 2006 and Summary of the project right from the date of consent application received till fresh notice issued by MPCB in the local newspapers Daily Lokmat and Daily Lokmat Times dated 19/03/2008 & 20/03/2008. He also briefed the necessity of conducting the public hearing for the proposed Lendi Major Irrigation Project at Gonegaon, Tq. Mukhed, Dist: Nanded of M/s. Godavari Marathwada Irrigation Development Corporation and requested the Chairman of the panel to grant the permission for the proceedings of public hearing. Accordingly, the Chairman of panel granted permission for starting public hearing proceedings.

Prior to start the slide show presentation of the project with the help of LCD Projector, Shri B.V. Kautikwar, the Executive Engineer of Lendi Project, Nanded narrated a brief history and progress of their Lendi Major Irrigation Project. He stated that the Lendi Major Irrigation Project is a joint venture of Maharashtra and Andhra Pradesh Governments and initially it was administratively approved by the Government of Maharashtra in the year 1986. However, after making an agreement between the Maharashtra & Andhra Pradesh Governments

in the year 2003, the construction work of the project started speedily. He further stated that as the project is major, it will benefit the areas largely in Nanded District of Maharashtra and Nizamabad District of Andhra Pradesh and the total expenditure to be incurred on the project will be shared as 62% & 38% between the Maharashtra & Andhra Pradesh respectively and till date the total expenditure incurred on the project is Rs. 169 Crores, out of which the Government of Andhra Pradesh has made the expenditure of Rs. 66 Crores on the said project. He further stated that due to the construction of Lendi Major Irrigation Project, there will be submergence of land, houses, other structures, etc. from 19 villages in Mukhed Tahsil of Nanded District in Maharashtra State, out of which 11 villages will be completely submerged whereas one village will be partially and in remaining 7 villages, only agriculture land will be submerged. Shri Kautikwar stated that M/s. Godavari Marathwada Irrigation Development Corporation has given the compensation towards the damages of land, houses, etc. to the villagers of 5 Nos. of affected villages in first phase whereas in second phase, the compensation is remained to be paid to 2 Nos. of affected villages out of 7 Nos. He further stated that the Government of Maharashtra has decided to start the construction work of Main Wall of the Project (*Ghalbharri*) will be started after one year after complete rehabilitation. He also stated that almost all the infrastructure facilities are provided for the affected village at Khanapur and the project affected villagers those have received the compensation may reside at village Khanapur. Shri Kautikwar further stated that the Right Canal of the Project is for Andhra Pradesh State, however as a statutory requirement, the process of inviting tenders/bids for the construction work from 19 km. onward of the Left Canal is in progress and till date the Government of Andhra Pradesh and Maharashtra have spent about Rs. 73 Crores and Rs. 96 Crores on the above said project.

Dr. Subhash Mali, Head of Department of Environment of Science and Technology Park, University of Pune and the Project Consultant started the presentation of the proposed Lendi Major Irrigation Project at Gonegaon, Tq. Mukhed, Dist. Nanded and its environmental impact. During the presentation, he briefed that the Science & Technology Park, Pune has studied various aspects about the project for about one and half year. The experts in the field and officials from various departments of said institution, like Botany, Zoology, Geology, Statistical, etc. have also visited the site of said project. He further stated that as reported by Shri Kautikwar, the present project will be beneficial for both the Maharashtra and Andhra Pradesh States. After studying for about one and half year on the project, it has been observed that there is less infrastructure of irrigation and about more than 60% of people are under the poverty line and also the quality of land, soil is better in the area than the other and therefore from the point of view of development of the area, the Government of Maharashtra has planned to construct the present project in the area. He further stated that generally dams are constructed into the valley, however, the Lendi Major Irrigation Project is being constructed on some plane land due to which there will be substantial production of aquatic life. And therefore the fisheries business will be developed and also there will be increase in different types of migratory birds. Dr. Mali further stated that while submitting the proposal of project to the MoEF, Govt. of India, New Delhi, there is always a prime question whether there is any sanctuary, reserved forest as well as indigenous species of birds, animals, etc. within the periphery of 100 km. of the project. Dr. Mali stated that during the study period they have not observed such types of sanctuaries, reserved forests, indigenous birds, animals and whatever the species of trees observed are local.

and at the edge (*Bandhara*) of the agriculture farms which are *Babhul*, *Bor*, *Sitaphal*, *Biba*, *Moha*, etc.

While briefing about the capacity of the project, Dr. Mali stated that the total irrigated area of the project is 1594 Sq. km. and the water storage capacity is 145.15 M.cum. The construction type of project is combined, i.e. earthen and concrete. The total irrigation area in hectares divided into Maharashtra and Andhra Pradesh is 15710 & 11214 = 26924. He also stated that there will be one Common Canal of 18.98 km. whereas the Left Canal of 30.84 km. for Maharashtra State and Right Canal of 35 km. for Andhra Pradesh. The total area of submerged land is 3052 hectares. Further, Dr. Mali stated that due to the present project, 11 villages are totally affected whereas one village is partially affected. The estimated cost of the project is Rs. 432.26 Crores out of which 38% of construction cost will be spent by the State of Andhra Pradesh.

Dr. Mali briefed about the physical and biological environment and stated that the river Lendi and Tiru on which the Project is being constructed originate from Udgir in Latur District of Maharashtra State at the height of 650 mtr from MSL and further meets to river Manjra towards East Direction at a distance of 85 km. He further stated that there is a substantial difference in the temperature at the project area that in Winter season, it is 8°C whereas in Summer Season, it is 45°C. He also stated that the annual average rain fall in the area is about 600 to 900 mm whereas during the period from June to September the average rain fall at the project area about 80 to 85%. Dr. Mali while briefing about land use pattern stated that they have studied the project area with the help of satellite pictures and observed that in the area almost all land is unfertile and non-irrigated (*Koradvahu*) and the classification of land use pattern is as 25% unfertile, 31% non-irrigated, 5% water bodies, 15% barren and only 21% irrigated land. He stated that in the project area there are no indigenous species of plants/trees and as mentioned above there are only local trees like *Babhul*, *Bore*, *Palas*, *Biba*, *Custard Apple*, etc. either on the side of farms and except reserved forests, there is no sanctuaries in the said area. He further stated the reptile like, cobra, earthworm, etc. are observed in the project area and about 49 types of species of birds and 18 types of species of mammalian like cat (*Khavle Manjar*), Mouse, Wolf, Deer, etc. are observed in the said area and the photographs of the same are recorded by them. There is no any sanctuary or reserved area in the radius of 25 km. of project. The sanctuary located at Kinwat in Nanded District is at a distance of more than 100 km. from the project area.

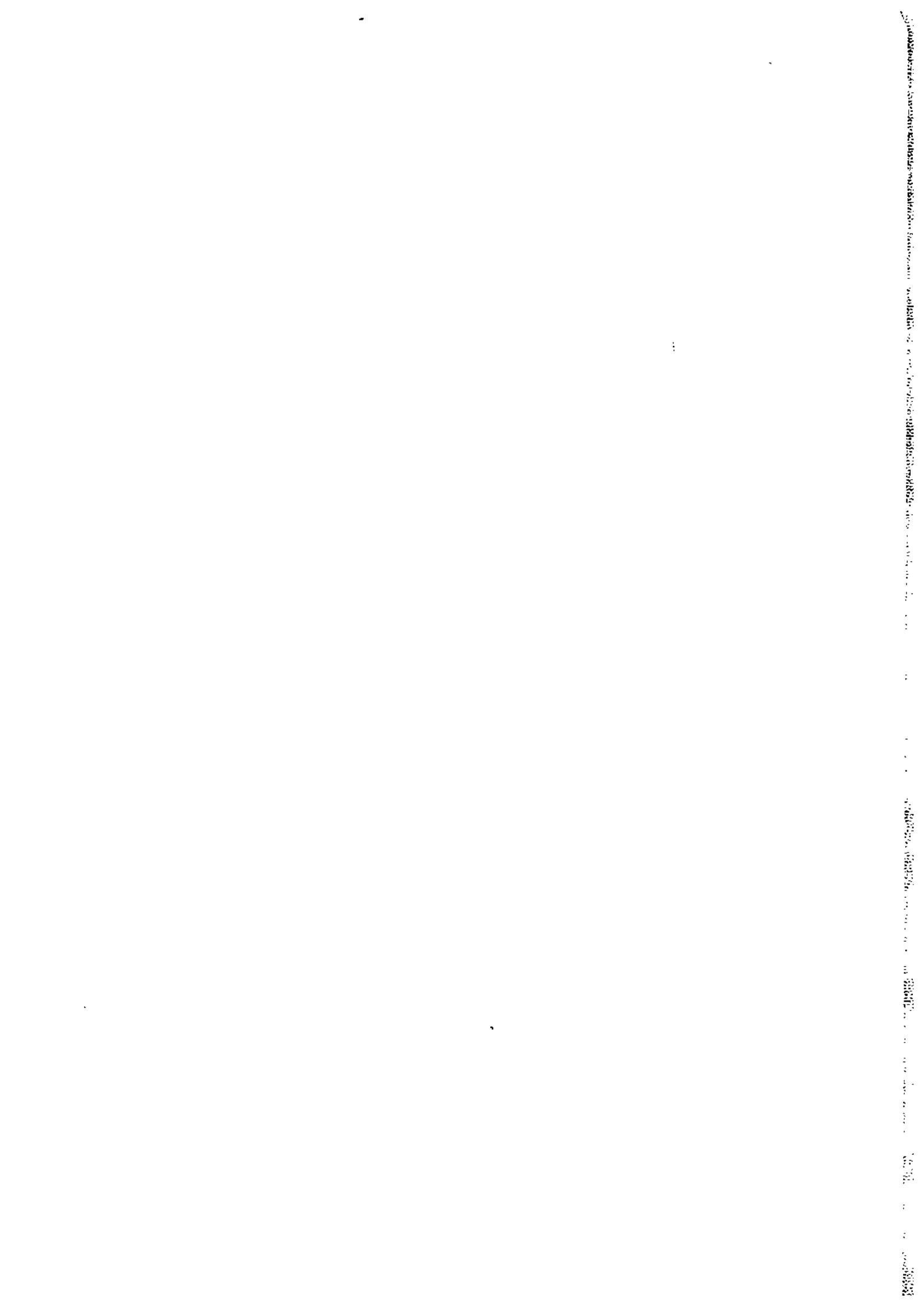
While briefing about the Socio-economic condition, Dr. Mali stated that farming is the only source for the survival of people in the area and about 34% directly and 32.4% of people indirectly depend on the farming and it is also observed that in the project area, instead of animal (Bulls), the people are carrying the activities of ploughing, etc.. There are very less people doing the business or service and about 51.7% of people are under the poverty line in the project area. He further stated that due to availability of water for irrigation and agriculture purposes, there will be the cultivation of cash crops, advanced seeds, horticulture, etc and due to which there will be substantial social and economical development in the area. Due to availability of water, there will be development in fisheries business and thereby it will be the earning source for local people. The main benefit will be especially for the small and medium farmers in the area.

While briefing about the impact on environment due to the establishment of said project and measures to be taken thereof, Dr. Mali stated that geological condition of the area will be changed temporarily during the construction phase of the project, however it will not cause severe damages to the surrounding environment of the project. Due to construction of project and/or storage of water the climate in the area will be changed and thereby the temperature will be reduced. Due to the construction of the project, there will be availability of water for all the time in the area due to which the various types of plants, trees, greenery will be developed and also the number of wild creatures will be increased and the environment in the area will be useful to the migratory birds as well as aquatic life.

Dr. Mali further stated that due to construction of the project, the herbs, bushes, plant species to be submerged are very less, however, Green Belt will be developed along the Canal and in the rehabilitated villages. He also stated that during the construction phase of the project, the local labour alongwith the labour from outside will be engaged due to which there is possibility of using the wood as a fuel in the area, however, to avoid adverse effect on the plants, trees, the Contractor of the project will be directed to manage other type of fuel instead of wood.

Dr. Mali also stated that due to the said project, almost all land will be brought under the irrigation due to which it will be useful for farming and thereby there will be development in the surrounding area and agro base business will be developed and ultimately employment will be available in the area for the educated/uneducated people. He also stated that due to construction of the said project, in the Command Area as well rehabilitated villages, various infrastructural facilities like education, health services, cleanliness, electricity, transportation, etc. will be made available. There will be no any adverse effect on the available land except the submerged land in the project. Dr. Mali stated that during the construction phase of the project due to transportation, excavation work, land leveling, etc there will be generation of particulate matter, smoke and also increase the noise level, however it will be of temporary types for which water sprinkling system is suggested. Due to the availability of water management of the project, the non-irrigated land will be under irrigation and thereby the underground water level will be increased. However, due to the use of chemical fertilizers and insecticides on a large scale the quality of soil and underground water strata will be affected and also due to percolation of water from canal, the nearby land will be affected, however as per suitable guidance, such adverse effects will be avoided. In this context, Dr. Mali stated that necessary guidance from WALMI, Agriculture University, etc. will be taken.

Lastly, Dr. Mali stated that due to the above project, there are adverse effects as well as benefits, however, benefits are more than the adverse effects. After detail representation of the Proposed Lendi Major Irrigation Project by Dr. Mali, Head of Department of Environment, Science & Technology Park, University of Pune, the Chairman of panel requested all the members to explain their views, recommendations, objections, suggestions, if any about the project. Dr. Mali shown various photographs Command Area, Irrigation Area, Non-irrigation Area, existing water bodies, etc. taken during the study period from both the Maharashtra and Andhra Pradesh State with the help of LCD Projector and he also requested the public participants to express their views, suggestions, doubts, etc. During the course of public hearing,

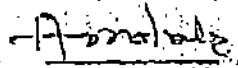


the participants raised certain questions related to the said project and they were answered satisfactorily by the Project Consultant, which are as below :

1. **Shri Shivajirao Nagorao Murkikar, R/o, Mukramabad, Tq. Mukhed, Dist: Nanded** wanted to know that in the project area, there is existence of Peacock, which is our National Bird, so, for the protection of Peacock, whether sanctuary will be created? After testing of soil, which types of plant species will be cultivated so that there will be development of area? Whether there is any scheme due to which there will be employment to the local people and the area will be developed as Tourism Centre? **Dr. Mali** clarified that yes, though the Peacock is our National Bird, we are legally bound to protect it and there is specific Act for the protection of National Bird. However, to develop any of the sanctuary, the action is required to be initiated through Forest Department. For carrying the soil test and cultivation of various plant species, **Dr. Mali** clarified that research on the subject matter will be done with Agriculture University and it will be beneficial to cultivate the local species of plant in the area like *Babhul, Bore, Biba, Moha*, etc. In clarifying to the question whether there is any scheme for tourism and subsequently, employment, **Dr. Mali** stated that if any proposal on the subject matter received, it will be submitted to the Government and due to the development of Tourism, the area will be developed due to visits of various tourists and also employment will be increased.

Before concluding the hearing, the Chairman again requested the public participants to raise their questions, suggestions, doubts, etc. and advised that it shall be in relation with the project and its impact on environment. However, no other public participant has asked any question. Then the Chairman of the Panel said that considering the said project is beneficial for the farmers in the area and it shall be completed as early as possible so as to get the benefit of the same to the farmers. The Chairman also stated that as there is no any objection for the said project from the public participants during the course of Public Hearing, a report of **Endi Major Irrigation Project, Gonegaon, Tq. Mukhed, Dist: Nanded** will be submitted to the Ministry of Environment & Forests, Government of India for necessary consideration.

Lastly, the Public Hearing ended with a vote of thanks to Chair.


(A.D. Mohekar)
Member.


(Prakash Piratwad)
Chairman.


(B.P. Kalme)
Convener.

APPENDIX – 2
PUBLIC
CONSULTATION –
ANDHRA PRADESH

**Minutes of Public Hearing Environmental
R.B. canal in Andhra Pradesh of the
Lendi Inter State Project held on
22 July 2008 at Menoor Village of
Madnoor Mandal Nizamabad District.**



ANDHRA PRADESH POLLUTION CONTROL BOARD

REGIONAL OFFICE: Nizamabad
6-2-116/A, Subashnagar, Nizamabad

Ph:08462-23

M.Chandrakanth Nalk,
Environmental Engineer

Tr No. Gen/PCB/RO-NZB/2008 - 422,

Date: 14.08.2008

To
The Executive Engineer,
I & CADD,
N.S.L.I Divn.No.1,
Nizamabad.



Sir,

Sub:- APPCB - Regional Office, Nizamabad - Minutes of Public Hearing Environm-
Issues pertaining to R.B.Canal in Madnoor & Bichkunda (Mandal), Nizam
District in connection with Lendi Interstate Project - Copies submitted - Reg.

Ref:- Your letter dt 14.08.2008

#

With reference to your letter I am herewith submitting the Minutes copies of the Public Hearing
of the R.B.Canal in Madnoor & Bichkunda (Mandal), Nizamabad District in connection with Lendi
Interstate Project.

Yours faithfully

M. Chandrakanth Nalk
Environmental Engineer

PROCEEDINGS OF THE ENVIRONMENTAL PUBLIC HEARING IN CONNECTION WITH THE PROPOSED RIGHT BANK CANAL IN ANDHRA PRADESH OF THE LENDI INTER STATE IRRIGATION PROJECT HELD ON 22 JULY 2008 AT MENOOR VILLAGE OF MADHNOOR MANDAL IN NIZAMABAD DISTRICT.

The following officials are present:

S. No.	Name of the Panel Member	Department
1.	Mr. C. Ashok Kumar, District Revenue Officer & Addl. Dist Magistrate	Representative of the Collector & Dist Magistrate, Nizamabad.
2.	Mr. P. S. S. Reddy, Environmental Engineer, Andhra Pradesh Pollution Control Board State Office, RC Puram, Medak District	Board Board
3.	Mr. B. Bhikshapathi, Environmental Engineer (FAI) Andhra Pradesh Pollution Control Board, Board Nizamabad.	State Office State Office

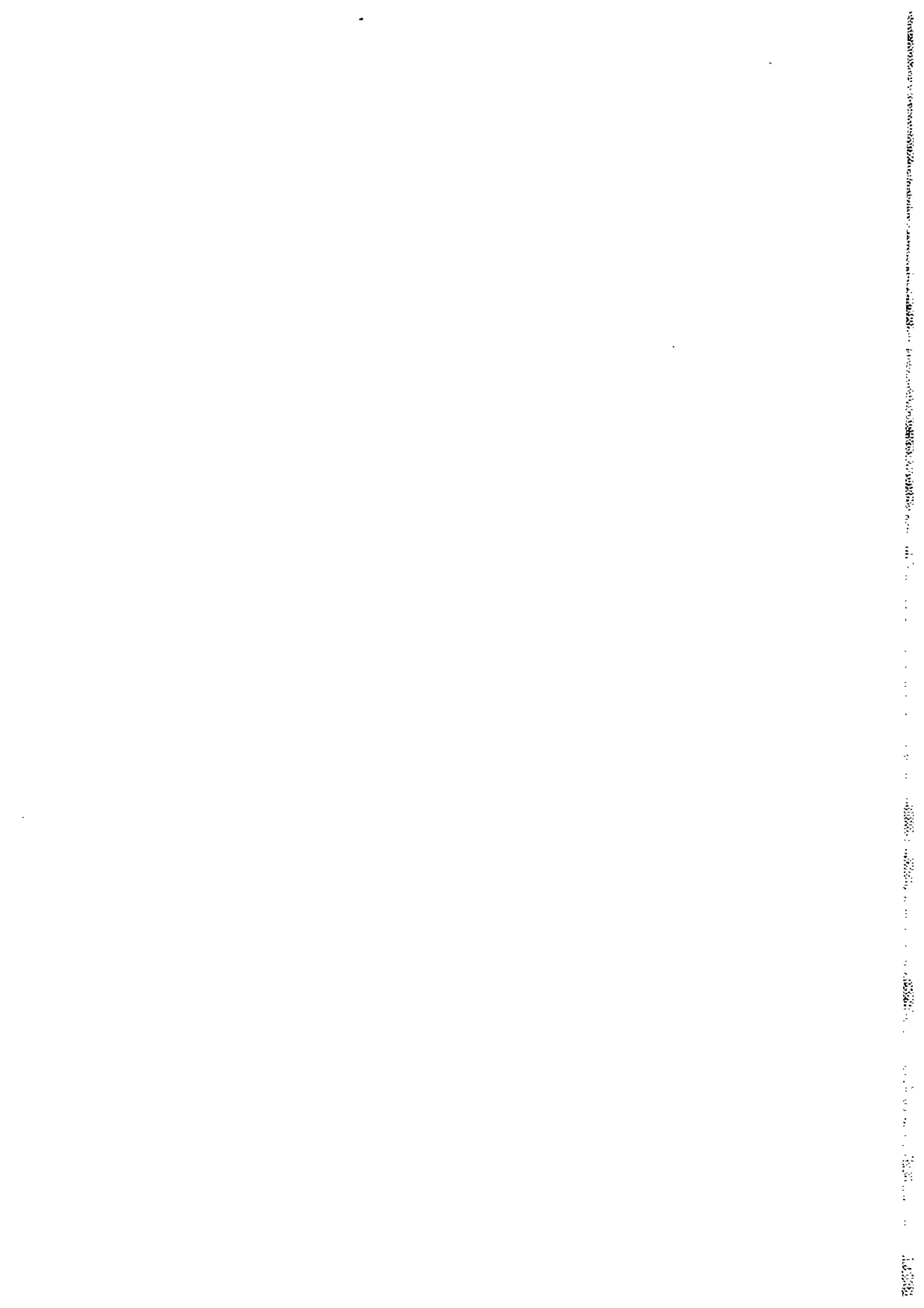
The following representatives of the Project were present:

S. No.	Name & Designation
1.	Mr. B. Balagangadhar Tilak Superintending Engineer, Tizim Sagar Lift Irrigation (NSLI) Circle, Nizamabad.
2.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
3.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
4.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
5.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
6.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
7.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
8.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
9.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.
10.	Mr. P. S. S. Reddy, District Engineer, NSLI, Nizamabad.

At the outset, the Environmental Engineer (FAC), APPCB, Regional Office, Nizamabad while welcoming the public and the Chairman, explained briefly the salient features of the Ministry of Environment and Forests, Government of India's Notification No. S.O. 1533 dated 14th September 2006. He added that the present notification was published in Eenadu & Deccan Chronicle on 14.09.2008 pertaining to the present public hearing. The notification invited public suggestions, consents, comments and objections, if any, on the proposed R.B. Canal of the Lendi Inter State Project in Nizamabad Dist. He added that the public hearing process was made mandatory to obtain necessary environmental clearance under the provisions of EIA Notification. He also added that they received no written representations regarding the project. He then requested the District Revenue Officer, who was deputed by the District Collector, Nizamabad, to preside over the public hearing process.

The District Revenue Officer (DRO) - Nizamabad requested the project authorities of the Nizam Sagar Lift Irrigation (NSLI) Circle, Nizamabad to explain in detail the salient features of the proposed R.B. Canal of the Lendi Inter State Project.

The Executive Engineer, NSLI Circle, Nizamabad stated that the Lendi Inter Irrigation Project is a joint venture of Maharashtra and Andhra Pradesh States. The project was administratively approved by the Govt. of Maharashtra in the year 1956. The project would cater to the irrigation needs in Nizamabad Dist. of Maharashtra and Nizamabad Dist. of Andhra Pradesh. The proposed project is designed to facilitate the progress of social, economic and infrastructure development of the region. Since the area is agri-based, it was decided that development of irrigation facilities would help in the uplifting of the region. The right bank canal would bring some 11214 hectares under irrigation in Andhra Pradesh.



The DRO requested the environmental consultant of the project to brief about the environmental impact and the summary of management plan.

Dr. Subhash Mali, Head - Environment, Science & Technology Park - University of Pune, Pune, Maharashtra stated that there would be no long-term adverse impacts on the environment due to this project, however there would be short-term benefits such as employment in construction activities and many long term impacts leading to prosperity of the region. The area being economically backward region with agriculture as a major occupation bringing water to this region would enhance agricultural productivity. Availability of water would reduce health problems related to poor hygiene and promote agriculture based entrepreneurship. Additionally the proposed project may enhance the infrastructure and facilities such as education, health, health facilities etc.

He explained the technical details of the proposed project:

The River Lendi is tributary of the River Godavari, with its two main tributaries Tiru and Kundrala originates at an altitude 650m near to Bogir in Latur district. Lendi flows 85 km in the eastern direction and joins Manjeera River at an altitude of 362 m below the Nizam Sagar project.

Six alternative sites between village Thana and Marapvan have been investigated by Irrigation Project Investigation (IPI). Out of these 1.5 Km upstream of village Gönegaon found suitable and economical hence detailed survey and investigation was carried out for administrative approval.

The cost of construction under the Lendi Project shall be shared between Government of Maharashtra and the Government of Andhra Pradesh in the ratio of 62:38.

The areas of Mukhed and Degloor Taluka in Nanded District of Maharashtra State and those of Madnoor and Bichkundla Mandal in Amabadi District of Andhra Pradesh were devoid of major irrigation facilities.

The total catchment area is about 1594 sq. km.

The length of the dam is 1651.40 meter with spillway length of 328.60 meters with 14 radial gates.

The full reservoir level is 396.0 m and the gross storage capacity would be 145.15 meter cum while the annual utilization would be 180.11 M cum.

The maximum height of the dam is 27.63 meter.

The capacity of the left bank canal of Maharashtra is 1341 hectares while the right bank canal of A.P is 6485 hectares.

The total area under submergence is 3052 hectares and the total population affected is 12640 individuals.

It is noted that unlike the Maharashtra where construction of dam involves major land acquisition, rehabilitation and resettlement and plan for catchment areas, in Andhra Pradesh the major activities are related to land acquisition for rehabilitation and development of command area. The baseline studies were conducted for the entire command area. There are no protected areas or sanctuaries or wildlife sanctuaries in the command area. The command area is frequent prone with rainfall around 600 mm. The vegetation is moist deciduous and scanty. Agriculture in the command area would lead to increase in ground water levels. He concluded that there would be negligible impact on environment and slight

increase the levels of suspended particulate matter (SPM) during the construction phase, which could be controlled through mitigate measures. The water saved on account of the storage created in Maharashtra would ultimately benefit the drought prone districts of Nizamabad and Mandad. The detailed command area development plan has been prepared in consultation with Agricultural University for enhancing the positive impacts and reducing severity of negative impacts. Overall, the implementation of project would have positive impact on the environment and boost the economic development of the Nizamabad district.

Smt. Dasarath Shobabai, R/o Menoor (V), Madnoor (M) stated that her 5-acre land is affected by the proposed canal of the Lendi project. She highlighted the problems encountered by the affected farmers and noted the people were upset in this regard. She appealed to the authorities concerned to render justice.

Shri Anja Goud, R/o Sulthanpet (V), Madnoor (M) stated that his 4 acres land had been covered in the land acquisition process but the details regarding completing the mapping of the right balance had not yet been submitted to the Government for the compensation package.

Shri S. Bhaskar, R/o Gopanpally (V), Madnoor (M) disputed with the survey report as it hadn't covered their village. He alleged that 100 acres and 1000 people would be affected. He expressed apprehensions over the impact of the project on the cultivators as similar instances were still pending in the case of other irrigation projects. He demanded stoppage of the execution work and pleaded for socio-economic justice.

Shri T. Ashok, R/o Rajula (V), Bichkunda (M) stated that their village was not covered in the mapping of the canal. He narrated that there would be considerable affect to the weaker sections. He urged to conduct re-survey to minimize the loss.

The Superintending Engineer, NSL in response to the above statement stated that the studies were done on technical command ability. They had considered all the aspects and selected the best alignment. The necessary instructions were given to the survey teams for a comprehensive survey. He assured that survey would be carried out in the lands throughout the alignment and the problems would be sorted out. The District Collector would finalise a mutually agreed compensation package as per socio-economic considerations.

Shri K. Mahesh, R/o Rajula (V), Bichkunda (M) disputed with the process.

The DRO noted that all the concerns were circulated around survey process and compensation package. He then requested the Executive Engineer of the NSL to conduct a field visit and look into their demands of re-verification of land and new alignments to prevent loss of fertile lands. It was also announced that all objections are recorded about environmental impact of the project. The villagers and affected persons have requested for liberal land acquisition compensation package and also early completion of the work to avoid further delay.

The EE, APFCB, ZO R.C.Puram, Medak Dist. stated that the public hearing proceedings accurately reflecting all the views and concerns expressed were recorded. He concluded the hearing and assured that the public hearing proceedings along with video-graphy would be forwarded to higher ups for further course of action.

Sr.
No.

Name and Designation of the
panel member

Signature

- 1) Shri. V. Ashok Kumar,
District Revenue Officer & Addl. Dist.
Magistrate,
Nizamabad.

[Signature]

2) Shri. R. Ravinder Reddy,
Civil Mechanical Engineer,
Andhra Pradesh Pollution Control
Board, Zonal Office, RC Puram,
Medak District

[Signature]

- 3) Shri. B. Bhikshapathi,
Environmental Engineer (FAC),
Andhra Pradesh Pollution Control
Board, Regional Office, Nizamabad.

B. Bhikshapathi

STATEMENT OF THE ISSUES RAISED DURING THE PUBLIC HEARING PROGRAMME ON THE RIGHT BANK CANAL OF LENDI INTER STATE IRRIGATION PROJECT ON 22-07-2008 AT 10.30 A.M. AT MENOOR VILLAGE, MADNOOR MANDAL, NIZAMABAD DISTRICT.

Sl. No.	Name of the speaker	Issue raised	Remarks of the proponent
1	Smt. Dasarath Shobabai, R/o Menoor (V), Madnoor (M)	Her 5-acre land would be affected due to the proposed canal of the Lendi project. Appealed to the authorities concerned to render justice.	The studies were done in the canal alignment. They took into consideration all the aspects and selected the best alignment.
2	Sh. Anja Goud, R/o Sulhanpet (V), Madnoor (M)	His 4-acre Farm land had been covered in the land acquisition process. Raised serious doubts about completing the mapping of the right bank canal.	The mapping pattern was done according to water route.
3	Dr. S. Bhaskar, P. Gopapally (V), Madnoor (M)	Disputed with the survey report as it hadn't covered their village. Alleged that only farm land was going to be affected. Demanded stoppage of the excavation work and pleaded for socio-economic justice.	They were not interested in the project any but out to facilitate large benefits.
4	Sh. Shankar Patil, R/o Rusegaon (V), Madnoor (M)	They were not concerned of the environmental issues involved in the project. Demanded full justice for the affected people who prepared to sacrifice for the sake of irrigation benefits.	Offered the villagers to come with comprehensive details as to minimize the loss to the extent possible.

	Appealed to the authorities to take land losers in confidence, so as to avoid unwarranted apprehensions. Sought know the progress in the Maharashtra project and suggested taking up the project before moving with the right bank canal.	The environmental clearance has been awaited. The project, in all likelihood will be constructed within three years.
Mr. K. K. Karam, Villager (V), Villager (M)	Complained that they weren't served any prior notice regarding the excavation work. Expressed displeasure at the survey report. Demanded adequate compensation besides providing pension, house and employment.	The issue is being well considered in addition to proper notification. They were committed to provide a mutually agreed compensation package.
Mr. K. Sridhar Rao, Villager (V), Villager (M)	Pointed out that the earlier alignment had accounted a meager loss since it covered red soil, rocky lands and govt. lands. The present alignment involved black soil in large extent, thus there would be huge investment. Pleaded for the rectification of the deficiencies in survey of such lands. Suggested taking into consideration a feasible alignment by carrying out a re-survey.	Offered the villagers to come with compensation details and a list of demands for consideration. The matter will be taken up with the government.
Mr. M. Shankar Rao, Villager (V), Villager (M)	Exhorted the people to observe restraint and enable the officials with necessary details.	They will pursue the matter and will render their cooperation.

Requested to take the victims in confidence before awarding compensation. Most of the people possess technical knowledge.

Noted that the canal being constructed in the canal were prone to danger. He stressed the importance of technical feasible studies.

Asnok,
(V)

Their village hadn't been covered in the mapping of the canal. Since that applies, it is not necessary to cover the canal.

Noted that there would be considerable affect to the weaker sections.

Urged to conduct re-surveys as it could minimize the loss.

Disputed with the surveyor.

The surveyor was denied the right to conduct a survey in the area.

ENVIRONMENTAL ENGINEERING

2-2-7, 77

క్ర.సం.	ప్రశ్నలు వారి పేరు	సమాధానం	మార్కులు
1.	శ్రీమతి దశరథ్ శోభాబాయి (అం. మేనుమారు. మొదల ముమ్మర్)	లెండి ప్రాజెక్టు కాలువ త్రవ్వకమునకు ఉద్దేశించబడిన భూమిసండు వారి (నర్మ నెం. 87) 5 ఎకరాల 21 గుంటల భూమి బోవుచున్నదని న్యాయము కొరకై పై అధికారులకు విన్నవించుకొనుట జరిగినది.	సాంకేతిక విధంగా అన్ని విధాల అధ్యయనములు గావించబడి. కోణములను అన్ని విధములను క్షుణ్ణంగా పరిశీలించి ఇరవై కాలువ వారిమీద నిర్మించబడినది.
2.	జి.ఎం.బాగోట్ అం. ముమ్మర్ పేజీ అం. ముమ్మర్	భూ స్వాధీన ప్రక్రియనందు వారి 5 ఎకరముల భూభూమి ప్రభుత్వానికి గురి అగుచున్నది. కుడిగట్టుభూమి నిర్ధారణ నిజయము అయినచో ప్రకటించినారు.	నీటి వాడుక కాలువ నిర్మాణ అం. ముమ్మర్
3.	శ్రీమతి. భానుమతి అం. గురిగనపల్లి అం. ముమ్మర్	1. వారి భూములు పరిశీలించి రాజ్ దని పరిశీలన నిజమైనది మృతిరేఖించినారు. 2. లోటు భూమి పూర్తిగా ప్రభుత్వము గావించబడుచున్నది అధోపదించినారు. 3. సామాజిక ఆర్థిక న్యాయము కొరకై కాలువ త్రవ్వకమును నిలిపి వేయువలసిగా కొరినారు.	అందరినీ అలాగే లోటు కావించి పై గురి ప్రా కారముల నిర్మించబడినది నిజమైనది అయినచో
4.	శ్రీమతి. సునీల్ అం. ముమ్మర్ అం. ముమ్మర్	1. ప్రాజెక్టు తట్టుబడులను భూమి రాజ్ పణి పరిశీలన నిజమైనది గురించి చరిత్ర సంబంధము లేదు 2. స్వేచ్ఛాయు పుట్టికై లాభాలు గో భూమి ఉద్యోగములను పోగొట్టుకొన్న వారికి పూర్తి స్వేచ్ఛయం కొరకై నిర్మా నించబడును. 3. భూ స్వాధీన ప్రక్రియలో గోగుట్టుకొనబడి. భూమిలో ఉన్నది తెలుసు	నిజమైనది అయినచో 1. భూమి పూర్తిగా ప్రాజెక్టులో నిమగ్న లాభాలు గోభూమి నిర్మించబడి నిజమైనది అయినచో భూమి పూర్తిగా నిర్మించబడినది నిజమైనది అయినచో భూమి పూర్తిగా నిర్మించబడినది నిజమైనది అయినచో

సంఖ్య	అభ్యర్థి పేరు	సమస్య	మార్కులు
1	అ. సుబ్బాబాబు	అ. సుబ్బాబాబు దూరము చే. ప్రశ్నలకు కలుగజేయువలసినదిగా కోరినారు. 4. మహారాష్ట్రనందు ప్రాజెక్టు పుగటి గురించి తెలిపాలని మరియు కుడిగట్టు చాలుకు పని మొదలు పెట్టబడినదిగా అభ్యర్థి సమస్యను పేర్కొనినదిగా కోరినారు.	
2	శ్రీ లక్ష్మణరావు ప్రొ. వేణుగంటి మొలమందుర్	1. తన అమ్మ పేరు 1140. 18వేల సంకు ప్రతి కాలుకు ప్రవృత్తికి విషయము ప్రకటన తమకు అవ్వల అకోపించినారు. 2. పరిశీలన నివేదిక అసంపూర్ణ వ్యక్తపరిచినారు. 3. బృతి, గృహము ఉద్యోగములే కాక సప్తపరిహారము అవ్వల కోరినారు.	
3	శ్రీ. శ్రీధరరావు బెన్నెల (ప్రొ.)	1. క్రితము గుర్తించబడిన కా మార్గమునందు ఎర్రమట్టి కొండలు మరియు ప్రాంతము ఉండదని వలన నక్కడ గలదిగాను, ప్రస్తుతము గుర్తించబడిన కాలువ మార్గము నందు పల్లముల్ని నేలలు ఉండదని వలన సప్తము అవుతుందని ఆరోపించారు. 2. సర్వే రిపోర్టు లుండు లోపాలను, మార్గములకు, మరియు భూములను సరిచేయవలసిగా కోరినారు. 3. అమోదయోగ్యమైన మార్గమునకై మరియు వేయువలసినదిగా కోరినారు.	
4	శ్రీ. శ్రీధరరావు బెన్నెల (ప్రొ.)	1. సాంకేతిక విషయాలను మూలము అధికారులు అన్ని విధాల కోరినారు. 2. సాంకేతిక విషయాలను	

మూల్యాదీన వారి పేరు	సమస్య	వివరణ
	తెలియని కారణమున, స్వస్థపరిచోరము చెల్లించే విషయం వారికి అన్ని విధములుగా ప్రాజెక్టు గురించి వివరించి వారి నందే హామీని నివ్వలేకపోవడం వలనగా కోరినారు. 8. కల్యర్లు నిర్మాణములో తగు సాంకేతిక నిపుణులతో మరియు తగు జాగ్రత్తలతో ప్రజలకు ఇబ్బంది లేకుండా చూడవలసినదిగా కోరినారు.	
శ్రీ బి. ఆశోక్ గ్రా. రాజుల్ల మం. బి. చుకుంద	1. కాలువ తవ్వకం వలన వారి గ్రామముకు లబ్ధి చేకూరటం లేదని ఆరోపించారు. 2. అట్టడుగు వరాల వారికి జరుగు లబ్ధి గురించి వివరించాలని కోరారు. 3. నష్టాన్ని తగ్గించడానికై తిరిగి సర్వే జరపాలని కోరారు.	అట్టడుగు నిర్మాణ ప్రయోజనాలను కూడా ఉంచుకొని అభ్యయనం జరిపినది
శ్రీ కె. మల్లేశ గ్రా. రాజుల్ల మం. బి. చుకుంద	పరిశీలన కార్యక్రమము విషయంపై అనుమానము వ్యక్త పరిచినారు.	పరిశీలన అర్హత ఉన్నవారిలో పరిశీలన కార్యక్రమం గాదు.

E. Prasanna Reddy
పర్యావరణ ఇంజనీర్ (పబ్.ఎ.సి.)

