Government of India

CENTRAL WATER COMMISSION (CWC)

ENVIRONMENTAL IMPACT ASSESSMENT DIRECTORATE

REPORT ON

ENVIRONMENTAL EVALUATION STUDY OF SINGUR MAJOR IRRIGATION PROJECT

FEBRUARY 2012

Consultant

AGRICULTURAL FINANCE CORPORATION LTD
HYDERABAD

List of Acronyms

Acronym	Meaning
AE	Adult Education
AFC	Agriculture Finance Corporation Ltd
AISLUS	All India Soil and Land Use Survey
AMASR	Ancient Monuments and Archeological Sites and Remains
ANM	Auxiliary Nurse Midwife
ASI	Archeological Survey of India
CAT	Catchment Area Treatment
CBA	Cost Benefit Analysis
CBD	Convention on Biological Diversity
CHC	Community Health Centre
CMS	Convention on Migratory Species
CWC	Central Water Commission
DM & HO	District Medical & Health Officer
DPR	Detailed Project Report
EAC	Environmental Appraisal Committee
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plans
FCC	False Color Composite
FGD	Focus Group Discussion
FRL	Full Reservoir Level
GCA	Gross Cropped Area
GIS	Geographical Information System
GO	Government Order
GoAP	Government of Andhra Pradesh
GoI	Government of India
GP	Gram Panchayath
GPS	Global Positing System
ha	Hectare
HDI	Human Development Index
HH	Household
HIV	Human Immunodeficiency Virus
HMWSSB	Hyderabad Metropolitan Water Supply and Sewerage Board
HRD	Human Resources Development
I&CAD	Irrigation and Command Area Development
IAIA	International Association for Impact Assessment
IMD	India Meteorological Department
IUD	Intrauterine Devise

IVI	Importance Value Indices
LEAP	Livelihood Enhancement Action Plan
LMC	Left Main Cancel
LMI	Large and Medium Industries
LPCD	Liters per Capita per day
LULC	Land Use and Land Cover
m^3	Cubic Meter
MCM	Million Cubic Meters
MLD	Million Liters Per Day
MoEF	Ministry of Environmental and Forests
MPN	Most Probable Number
MW	Mega Watts
MWL	Maximum Water Level
NCA	Net Cropped Area
NLM	National Literacy Mission
PAF	Project Affected Family
PAV	Project Affected Village
PCCF	Principal Chief Conservator of Forest
PDF	Project Displaced Family
PHC	Primary Health Centre
PRA	Participatory Rural Appraisal
Q	Quintals
R & R	Resettlement and Rehabilitation
REET	Rare or Endangered or Endemic or Threatened
RMC	Right Main Canal
RS	Remote Sensing
RSI	Remote Sensing Imageries
SAR	Sodium Absorption Ratio
SC	Schedule Caste
SHG	Self Help Group
SoI	Survey of India
sq km	Square Kilometer
ST	Schedule Tribe
SYI	Silt Yield Index
TB	Tuberculosis
TMC	Thousand Million Cubic Feet
ToR	Terms of Reference
VAS	Vaccine Associated Sarcoma
WCD	World Commission on Dams
WRD	Water Resource Development

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SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

INDIA
ANDHRA PRADESH
STUDY FOR ENVIRONMENTAL EVALUATION
OF
SINGUR PROJECT
ON
MANJIRA RIVER

CONTENTS

List of Annexures

List of Annexures

List of Annexures

List of Annexures

List of Annexures

List of Annexures

List of Maps

EXECUTIVE SUMMARY

The Singur project was constructed on river Godavari near Singur Village in Medak District. The project was aimed at as providing additional drinking water to the twin cities of Hyderabad and Secunderabad at the rate of 4 TMC per year and to regulate releases to downstream systems and to arrest silt transportation bodies, irrigating 16000 hectares of command area and generating 15 MW power through 2 units of 7.50 MW each.

The main components of the project consisted of construction of two earthen dams on the left and right flanks measuring 3993 m and 3110 meters respectively along with irrigation channels of 12 km and 48 km length on the right and left main canals respectively. The total water spread area is 523.6 m. The reservoir submerged 16540 ha due to which 69 villages in Andhra Pradesh, 17 villages in Karnataka and 7672 structures got submerged. The total cost of the project was ` 231.83 crores of which till 2008 and expenditure of ` 220.83 crores was spent including cost of civil works out ` 98.80 crores and cost of land acquisition ` 122.48 crores.

The basic objective of this study is to evaluate the environmental changes and the impact of the project on Resettlement and Rehabilitation, Socio-economic conditions, agriculture, irrigation and drainage, bio-diversity, land environment, public health and water environment during and past construction phases. Based on the findings suggestions and recommendations are made to lead to formulation of redesigned environment management plan. Primary and secondary level data was extremely used to arrive at the factual situation. The study is presented in 14 chapters covering each area in detail. The first two chapters cover introduction and project area details.

It is seen that the livelihoods of the displaced farmers and the water and sanitation provisions in the project affected villages is affected and suitable recommendations are made. It is also found that the compensation paid in installments to the affected farmers could not be productively utilized by them to acquire new fixed assets or to repurchase similar size of the submerged land and as a result they lost their earliest status of holding. The details are presented in Chapter III.

The socio-economic conditions revealed that in both fully affected and partially affected villages the absolute income levels at present had gone up due to time gap of two decades but the real incomes and savings are more or less stagnant due to decrease in money value and higher expenditure. The details are presented in Chapter IV.

The effects on Agriculture revealed loss of land holding loss of productivity of crops due to poor soil conditions. The specific reduction in population of cows and increase in population of buffaloes in seen due to changed preferences of farmers. No special programs exclusively for the project affected villages were implemented. Suitable recommendations are made based on the above observations and presented in Chapter V.

The groundwater scenario revealed that though the water level in the bore wells had gone down due to impervious nature of soil below, the total water discharge capacity of bore

wells is satisfactory. The need for effective and efficient conjunctive use of water in felt due to scanty rainfall in the project area. Chapter VI enlisted a plan for development of groundwater and drainage scenario in the project area based on the findings.

The seventh chapter focused on the impact on forest flora and fauna. It is found that more than 81.6 per cent of species are common in both catchment and command areas. There are no thick forests or wildlife sanctuaries in the project vicinity. Overall, the reservoir has not contributed to any undesirable changes in flora and fauna.

The impact on public health and drinking water is presented in Chapter IX. The incidences of diseases like Malaria, TB, Cholera and Typhoid during post project situation are found to be less comparatively. Health care has improved. However, sanitation requires attention of the authorities. The drinking water is inadequate and the affected villages may be connected to the reservoirs directly by direct pumping.

The changes in land use pattern in catchments area presented in Chapter X revealed that increase is seen in crop lands, current fallows, water bodies and built-up land whereas decrease is observed in respect of forest land, double crop land and water lands.

The benefits from the project have not trickled down to command area as the work in regard to distributaries for left and right canals and the main branch canal is still under progress. The present status of the command area as seen from the primary and secondary data is given in Chapter XI. The total cost of providing field channels or subsidized basis to the farmer's fields is estimated at ` 400 lakh and the same is recommended.

Singur project was sanctioned prior to 1978 and there was no stipulation for preparation of environment management plan for projects prior to 1978. However, specific stipulations were given to protect the environment, while sanctioning the projects which were more or less adhered to. The Forest Department had submitted a revised plan for 3905 hectares of green belt development and awaiting approval so for only 95 hectares could be completed in the initial plan.

The details of the status of Catchment Area Treatment Plan are discussed in Chapter XIII. No such plan (CAT) was prepared earlier. The catchments area of Singur project is located in 5 districts in Maharastra and one district each in Karnataka and Andhra Pradesh. The total catchment area spreads to 16097 hectares of which 85 per cent is under cultivation followed by waste land in 3.98 per cent and grazing land is 3.96 per cent. Good vegetation cover was developed in Maharastra and Karnataka through active afforestation measures. Therefore, the present study recommended proposals to consider afforestation and soil conservation measures largely in Andhra Pradesh and to some extent in Karnataka. The total cost of the catchments area treatment plan is estimated at 16991.4 lakh.

The report is concluded by giving salient observations in each area and suitable recommendations in Chapter XIV. The salient recommendations made by the study include the following.

- The compensation in future be paid in lump sum and at a time
- Measure to improve income of the oustees need to be initiated by enhancing livelihood skills and LEAP model.
- Measure to improve productivity of crops, introduction of special agriculture schemes to be taken up.
- Breed improvement programmes for dairy and sheep to be taken up.
- Conjunctive use of water is recommended for crop planning in the command area.
- Pressure irrigation systems are recommended.
- Introduction of participatory irrigation management and created of water users associations recommended.
- Proper drainage outlets to be created to the fields.
- The Archeology Department is advised to salvage the lost and misplaced idols and structures and protect them.
- Farmers in command area are assisted for constructing field channels up to their lands an subsidized terms.
- Greenbelt development to be completed in catchment areas of AP.
- The integrated catchments area treatment plan now recommended has to be implemented.

The Annexures are also attached as Part-II of this report.

Part – I

1

Introduction

1 INTRODUCTION

Backdrop

1.01 There has been a global rise in growth of population over the years, necessitating the urgent need for rapid development in all fields to meet the requirements of the growing population. As a sequel to this situation there has been an all-round development in industrialization / urbanization both in the developed and the developing countries. This rapid development is causing a serious concern in providing and maintaining pollution free environment. An analysis of the present situation has brought to light that industrialization and urbanization, particularly in the developing countries has been creating more stress on the natural resources due to over exploitation and associated depletion of plant and animal wealth. Keeping in view the biotic stress in the recent past, protection of natural environment has been gaining highest priority while planning for any developmental projects like river valley projects, road projects, industrialization and power, drinking water projects, etc.

1.02 It is an established fact that nature's stability is dependent on bio-diversity and environmental sustenance. Therefore, during the last couple of decades there has been a spurt in the awareness on the need for environmental protection and environmental management for improving the global ecology. Serious efforts are, therefore, being put into conserve and regenerate the nature as the poor live in by 'Gross Nature Product' and the bio-mass developed in various forms in different regions along the hills, plains, rural areas and in other parts with dense human habitation. To meet the challenges of environmental pollution, the developed countries in the world have taken concrete steps and have established separate Departments/Ministries exclusively for this purpose. Falling in line with the developed countries, the Government of India (GoI) has established an exclusive Ministry of Environment and Forests (MoEF) for taking care of environmental protection needs. Safeguarding the interests of environment is done through proper identification of environmental impact and preparing suitable Environmental Management Plans (EMP) while sanctioning the establishment of industries, reservoirs/dams, railways, thermal power plants, etc. In other words, the Environmental Protection Act enacted by the GoI during 1986 governs any project having interference with the environment. The MoEF, GoI is therefore, the nodal agency for sanctioning the environmental clearance for developmental projects after 1986.

Present Scenario

1.03 During the past two decades efforts are being made for protecting the environment while implementing the river valley projects by insisting on formulation of a

suitable Environmental Management Plan (EMP) after undertaking a detailed Environmental Impact Assessment (EIA) study before construction of the project. While formulating irrigation development projects, the Government of India has initiated suitable measures for implementation of the EMP as well as Resettlement and Rehabilitation (R&R) plan. Now the time has come to evaluate the implementation of the EMP in the completed project areas to assess the level of environmental Impact Assessment and also to make suggestions for furthering the environmental improvement through modified EMP redesigned for the project. With this in view, the Central Water Commission (CWC) has entrusted the Agricultural Finance Corporation Ltd (AFC) the work of conducting a detailed post environmental evaluation of the Singur project in Andhra Pradesh, which was constructed nearly three decades ago.

Objectives

1.04 The basic objective of the study is to assess the environmental changes that have taken place during construction and post construction phases of the project after a detailed review of the implementation of the Environmental Management Plan (EMP) leading to formulation of a redesigned EMP for the project.

1.05 In the light of the above, the present evaluation comprises the study of impact of the project on Resettlement and Rehabilitation, socio-economic status, agriculture, irrigation and drainage, bio-diversity, land environment, public health, water environment including groundwater, etc. Suggestion of and additional EMP involving compensatory afforestation, green belt development, health systems, fisheries development, catchment area treatment, reservoir rim treatment, landscape restoration, muck disposal, ecological conservation etc. is also part of the post evaluation studies. The study would also identify the possible constraints and limitations in implementation of EMP for not having achieved desired outcomes in the post project scenario in consultation with project stakeholders and stakeholder institutions.

Scope

1.06 The present report, thus, focused on the current status of EMP, as the study is undertaken based on the data collected at this juncture. Thus, the scope of the study is to assess:

i) The post environmental impact due to the project compared with the pre-project situation on land environment including changes in cropping pattern, overall development in the command area, improvement in production, etc.

ii) Analyse the impact of the project on water environment in the present scenario on surface and groundwater and impact on the reservoir due to sedimentation, etc.

iii) Present impact on biological environment including changes in

forest cover comprising of flora, fauna, aquatic life, endangered species, migratory birds, etc, and compare to the situation prevailed in the pre-project stage and effectiveness of wildlife conservation programs, etc.

iv) The public health hazards during pre and post project conditions including drinking water supplies, health status, health services, occurrence of diseases, communication and transportation facilities, quality of life, etc.

v) Study the effects on agriculture such as changes in cropping pattern, cropping intensity, improvements in production, etc.

vi) Analyse the impacts on drainage including identification of waterlogged and saline areas.

vii) The impacts on socio-economic conditions such as changes in literacy, employment, improvements in quality of livestock and poultry, development of industries, health care infrastructure, etc.

viii) Effects of rehabilitation including amenities, infrastructure facilities, sanitation status, and living standards compared to the pre-project baseline.

ix) Assess the impacts on archeological monuments, economically important minerals and places of worship.

x) Study of catchment area treatment measures, their progress, areas affected due to soil erosion and sediment yield arrest and modified plan proposals form part of the study scope.

1.07 The study also aims at assessment and evaluation of implementation of Environmental Management Plan (EMP) in respect of

(i)	R & R Plan
(ii)	Compensatory Afforestation
(iii)	Greenbelt Development
(iv)	Catchment Area Treatment
(v)	Reservoir Rim Treatment
(vi)	Landscape restoration
(vii)	Ecological conservation
(viii)	Fisheries development
(ix)	Muck disposal, and
(x)	Free fuel provision plans.

1.08 The objectives of the study also include evaluation of the outcomes of EMP. It is also proposed to assess its confirmation to anticipated outcomes and develop a modified EMP involving the above aspects, besides suggesting any modifications / revisions to performance indicators. The detailed Terms of Reference (ToR) for the study, as

suggested by CWC are presented in **Annexure - I.1**.

Limitations of the Study

1. The main limitation of the study has been absence of EMP due to which the study has been handicapped for assessing post plan impact and has to be limited to presenting the situation as obtained from primary and secondary sources of data.

2. The pre-project scenario has to be built upon recall memory and the time gap of more than two decades between pre and post project scenario would have, to some extent disabled the illiterate sample respondents to accurately recall certain facts satisfactorily.

3. The command area could not get the benefits contemplated under the project so far in view of repeated occurrence of scanty rainfall in the region resulting in unsatisfactory water levels more often than the years of surplus due to non-completion of distributaries in the command area. This fact confined the study only to give the present scenario in command area instead of effectively utilizing the study to analyze the impact.

4. Comparison of income of two periods which are 2 decades apart without having the consideration of inflationary index data of the region would not have succeeded in giving the general trend of standard of living.

5. The retrieval of some data from a wound-up R and R cell erstwhile headed by Office of Special Deputy Collector (R & R) and reported to have been handed over to Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) was to a large extent made difficult.

6. The cooperation extended by various departments during the study for providing of relevant information could have been more inspite of the fact that the study demanded 2 decades old data in order to enable the team to draw in-depth findings especially in regard to attributability of the project on development parameters. Therefore, the baseline data was collected to the extent available.

Study Design

1.09 Any new reservoir project is expected to cause impacts on the surrounding environment at the project site, command area, drainage etc. during construction phase and operation phase after construction. Thus, the Environmental Impact Assessment (EIA) and formulation of necessary Environment Management Plan (EMP) form an integral part of reservoir projects where there are large-scale inundation of land due to submergence under the reservoir, and development of command area for irrigation needs.

1.10 The EIA for Water Resources Development (WRD) projects has been in practice since 1978 only. Also carrying out EIA for WRD projects costing more than `.100

crore and subsequent preparation of EMP has been made mandatory as per the EIA notification 1994. Thus, for the projects sanctioned prior to 1978 there was no stipulation for the preparation of comprehensive EIA studies and preparation of EMP. Therefore the Central Water Commission (CWC), GoI thought it would be worthwhile to get comprehensive studies carried out to analyze the environmental issues related to WRD projects implemented prior to 1978 also. Singur Project in A.P. is one of such projects which was sanctioned prior to 1978 needing comprehensive studies on environmental issues.

Study Components

1.11 The main component is evaluation of the impacts after implementation of Environment Management Plan during the post-project period in the Singur project. This exercise facilitates the Central Water Commission to redesign its strategy for implementation of EMP in similar irrigation projects as well as for the same project facilitating its further extension of its coverage in the area. With this focus, the study is designed for identification of key monitoring indicators through suitable verifiable measures. Some of the components of the present study are:

- Impact of Rehabilitation
- Socio-economic impacts in the project area
- Impact on Agriculture
- Impact on Groundwater and Drainage
- Impact on Archeological Monuments, Minerals etc. if any
- Impact on Flora and Fauna
- Impact on Public Health
- Changes in Land use pattern including Catchment Area Treatment
- Over all implementation of EMP.

Approach and Methodology

1.12 Since the above study components are of multidimensional and multi-disciplinary in-nature, the individual monitoring and evaluation indicators along with verifiable-measures are presented in **Statement–I.1**. The comprehensive study is made duly comparing with the baseline data i.e., prior to the construction or during the construction of the project. The baseline data has been collected to the extent of availability from the various concerned line departments of the Government of Andhra Pradesh. The following environmental components are considered for the impact assessment.

(i) Land Environment including agriculture;
(ii) Water Environment including hydrological and groundwater studies
(iii) Biological environment including flora, fauna and pisiculture
(iv) Public Health
(v) Socio-economic environment including Resettlement and Rehabilitation

1.13 The above components are studied in detail through various means by conduct of ground level investigations and by collection of secondary data relating to baseline status and present situation. Discussions are held with officials at state, district and project levels. Information and data such as topo sheets are collected to generate required maps through remote sensing and GIS technologies.

1.14 The primary data collection from the affected households through conduct of detailed socio-economic survey of sample household is undertaken in respect of the Rehabilitated households as well as partially affected ones. Village level information on various infrastructural facilities, which were affected due to submergence, is also collected.

1.15 Utilization of toposheets of 1:50,000 scales is essential for studying the catchment area, command area and also the submergence area for identification of land use / land cover/slope and soils. A detailed note indicating the ToR for the study and corresponding verifiable measures used for the generation of required information are presented in **Statement–I.2.**

Report Preparation

1.16 The study report is prepared in single volume. Necessary recommendations for improvement of the adverse environment situation will be made duly preparing the modified Environment Management Plan with costs.

The Team

1.17 The team constituted by AFC comprises specialists drawn from different fields with experiences such as Environmental Sciences, Agronomy, Hydrogeology, Water Management, Forestry, Fisheries and Agriculture. The team also comprises of Remote Sensing and GIS specialists supported by large number of field level personnel for collecting primary and secondary data, computerization and computer operators for processing and generation of reports.

Chapterisation

1.18 The report is organized into two parts. The Part-I consists of main report, whereas, Annexures are presented in Part-II. The main report deals with Baseline data and Environmental evaluation study. It also consists of additional Environment Management Plan including recommendations regarding R&R plans. The proposed Chapterisation is as follows:

I. Introduction
II. Project Area
III. Effects on Rehabilitation
IV. Socio-Economic Impact including

changes in Literacy and Employment

V. Effects on Agriculture
VI. Impact on Groundwater and Drainage
VII. Impact on Archeological Monuments, Minerals and Places of Worship
VIII. Impact on Forests, Flora and Fauna
IX. Impact on Public Health, Drinking Water Supply and Communication
X. Changes in Land Use Pattern
XI. Status of Command Area
XII. Assessment and Evaluation of Implementation of EMP
XIII. Status of Implementation of CAT
XIV. Conclusions and Recommendations

Statement – I.1

SINGUR PROJECT MONITORING AND EVALUATION FRAME WORK

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
1	Effects of Rehabilitation	• Details of rehabilitation sites where rehabilitation has been carried out; • Actual photographs of rehabilitation sites and houses and details thereof; • Environment and sanitation status; • Details of amenities and infrastructure facilities provided to the rehabilitated families; • Progress of economic rehabilitation programmes; • Details of the occupational training programmes conducted for project affected persons; • Details about health status and health services provided in the project area; • Response of the outstees to the process of rehabilitation and constraints • Status and living standards of the outstees at new location	• Structural features related to housing and other infrastructure • Photographs taken in the field • Drainage, Sanitation • Physical structures related to roads, electricity, drinking water etc. • Income generating activities • Training skill development • Health Status • Opinion of the displaced households on the resettlement and rehabilitation • Socio-economic conditions of the households
2	Socio-Economic Impacts	• Details of status of schools / teaching staff, student turnover; • Improvement in male - female literacy, evaluation of adult education programmes, provided if any;	• Educational institutions, students, teachers, students-teacher ratio. • Adult literacy programmes if any and their impact.

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
		• Response to education provisions and assessment of constraints;	• Problems and constraints
		• List of post project occupational options that have arisen in the region and also make a statement what occupations are attributable to project benefits;	• Occupational diversification in the new locals
		• List all the new educational , cultural, recreational and commercial (markets, banks, etc.) institutions accessed that have come up in the post project situation and state how much of it is attributable to the project;	• Development of cultural, recreational and commercial activities in and around the project area.
		• Compare the incidence of some important diseases in post and pre project situations;	• Prevalence of diseases in pre and post project conditions
		• Compare the health care infrastructure in the post and pre project situation;	• Health infrastructure related to dispensaries, clinics, hospitals, doctors, beds etc.
		• Compare the Human Development Index (to the extent that the data is available) in the post and pre project situations.	• Arrive at HRD index based on socio-economic indicators
3	Affects on Agriculture	• Improvement in Production	• Productivity and area under principal crops
		• Changes in Cropping Pattern and improvement in cropping intensity due to the project on agricultural / horticulture / animal husbandry	• Crop diversification in post project situation
		• Improvement in quality of livestock and poultry	• Improvement in livestock population

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
		• Assess agriculture cooperative and agriculture finance programmes if initiated • Details of the steps taken to prevent contamination of ground and surface water due to fertilisers, pesticides, runoff, etc. • Development of industry in command area • Development in the command area	• Development of cooperatives and farm productivity centres. • Use of manures, bio-fertilisers and other measures • Command area development • Command area development
4	Impacts on Groundwater	• Quality and quantity of groundwater • Changes in groundwater table in recharge zones.	• Groundwater quality • Groundwater levels
5	Impact on Drainage	• Increase in the waterlogged area and mapping of specific area • Arriving at an understanding of how the waterlogging has increased • Estimation of increase in the salinity effected soils and mapping of the same.	• Identification of waterlogged areas • Study of waterlogging • Identification of salinity in the command area
6	Impact on archaeological monuments, economically important minerals and places of worship	• List of the archeological monuments and places of worship that are restored as part of EMP, record their status and enlist reasons. • List new places of worship and monuments that have come up during the post project period • List the new recreational opportunities that have come up in post project situations	• Restoration of places of worship, archaeological monuments if any by the Government • New places of worship if any in the relocation settlements • New parks play grounds, etc.

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
		• List the pre-project and post project status of economically important minerals and the means and activities of harnessing the same.	• Mineral extraction by the Government and type of minerals
7	Impacts on Forests	• Assess changes in the forest cover, forest types; • Assessment of change in IVI & Shannon diversity index • Assess effectiveness of forestry programmes, contribution to sustaining local population needs (in eco development perspective); • Contribution to economic activities related to medicinal plants in sustaining livelihoods of local population, if any • Status of endemic and endangered species and evaluation of conservation programmes, if any.	• Changes in the forest cover in the new afforestation areas. • Forest development programmes in sustaining livelihoods of the indigenous population • Promotion of medicinal plants • Promotion of medicinal plants • Protection of endangered species in the new environment
8	Impacts on Fauna	• List terrestrial, avi and aquatic fauna • Assess changes in terrestrial fauna and their migratory patterns, if any • Assess changes in avi fauna and their migratory patterns, if any • Assess affectivity of wildlife conservation programmes, pisci-culture development programmes, and other activities contributing to sustaining local population livelihoods.	• Identification relevant species • Study the changes if any on migratory pattern of birds, fish, etc. • Study the changes if any on migratory pattern of birds, fish, etc. • Wild life conservation if any in the project area and other programmes implementation

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
9	Impacts on public health, drinking water supply, communications and quality of life in general.	• Study the occurrences of diseases such as, typhoid, diarrhea, malaria, jaundice and other water borne & water related diseases in pre and post project implementation scenario;	• Water borne and vector borne diseases in pre and post project situations
		• Ascertain impacts due to reservoir impoundment, water logging and spread of such diseases, if any;	• Water borne and vector borne diseases in pre and post project situations
		• Improvements in water supply provisions in pre and post implementation scenario;	• Improvement in provision of drinking water
		• Improvements in communication and transportation facilities in post implementation scenario;	• Transparent and communication infrastructure development
10	Changes in Land use pattern	• Using image processing carry out land use / land cover classification and map on GIS;	• Land use and land cover in pre and post project conditions
		• Using overlays identify new development triggering land use changes;	• Land use changes in irrigation command
11	Evaluation of EMP Implementation	• Assess and evaluate R & R , compensatory afforestation, green belt development, health systems, fish development, catchment area treatment, reservoir rim treatment, landscape restoration, much disposal; ecological conservation, free fuel provision plans, etc. in terms of	• Implementation of EMP in the project on various components
		• Evaluate the outcomes of EMP, assess its conformance to anticipated outcomes, understand the departures if any;	• Impact of EMP and its performance on land, crop production etc.

Sl. No	Component	Monitoring and Evaluation Indicators	Verifiable Measures
		• Develop a modified EMP involving compensatory afforestation, green belt development, health systems, fish development , catchment area treatment, reservoir rim treatment, landscape restoration, muck disposal, ecological conservation, free fuel provision plans;	• As already discussed above
		• Suggest any modifications / revisions to performance indicators and institutional measures;	• As already discussed above
		• Identify needs in revisions to financial arrangements.	• As already discussed above
12	Status of implementation of Catchment Area Treatment (CAT) Plan	• Study the catchment area treatment measures suggested;	• Vegetation and engineering measures undertaken
		• Progress of the bioengineering and civil works carried out so far;	• Vegetation and engineering measures undertaken
		• Identify areas where soil erosion and sediment yield arrest has been successful;	• Vegetation and engineering measures undertaken

Part – I

2

Project Area

2
PROJECT AREA

Introduction

2.01 Singur River Valley Project was constructed across Manjira River, a tributary of Godavari River, near Singur Village of Medak District in Andhra Pradesh. The Project is primarily intended to provide additional drinking water requirements of the twin cities of Hyderabad and Secunderabad. Besides, the project is expected to derive the following benefits.

- Regulate releases to down stream irrigation systems viz, Ghanpur anicut and Nizamsagar Project;
- Arresting silt transportation in Manjira River to Nizamsagar Project which is heavily silted up and could not cater to the contemplated irrigation benefits.
- Power generation of 15.00 MW (2 Units of 7.50 MW each).
- Serve a command area of 16,000 ha in Medak District which was not identified till 2006.

The River

2.02 Manjira River is one of the largest tributaries of Godavari River originating from Balaghat range in the Pathoda taluk of Beed district of Maharastra at an altitude of about 823 m. The river is joined by about 40 tributaries having their sources in the uplands of Beed, Osmanabad and Lathur districts of Maharashtra, Bidar district of Karnataka, Medak and Nizamabad district of Andhra Pradesh. The major tributaries are the Amba, the Tewarja, the Tirna, the Karanja, the Peddavagu, the Nallavagu, the Kaulas, the Lendi, the Tiru and the Manar. The river confluences with Godavari River near Sangam village in the Biloli taluk of Nanded district. The total length of the river from its origin till its confluence with River Godavari is about 686 km.

2.03 Manjira is a typical peninsular river originating from low altitudes and running through deep courses. Flow is characterized by heavy discharge during monsoon and very low during the rest of the period. The principal tributaries of Manjira River which join the river upstream of Singur dam are Tairna, Karanja, Nandiragh, Haldi and Allair. The average fall of the river is 0.71 meters per km.

Location

2.04 Singur project is located on Manjira River near Singur village, Andole taluk of Medak district in Andhra Pradesh. The site is located at about 100 km from Hyderabad and 130 km upstream of Nizamsagar Project. The project site is located about 290 km

from the origin of the River Manjira. The Latitude and Longitude of the project are as follows

i)	Latitude	17^{o}-45'-0"
ii)	Longitude	77^{o}-56'-0"

2.05 The project site is accessible from Hyderabad, the state headquarter, via Sangareddy by road. It is also accessible from Medak, one of the important towns in the district by road. Bibipet on Hyderabad- Nizamabad rail line is the nearest rail head from the project site and is about 45 km from reservoir. The nearest airport of the project site is Hyderabad.

2.06 The Singur Reservoir is located in the border area of Bidar district in Karnataka state and Medak district in Andhra Pradesh. Part of the submergence area of the reservoir is in Bidar district.

Project Components

2.07 The main aim of the project is the drinking water supply to an extent of 113.25 MCM to the twin cities of Hyderabad and Secundrabad. In addition, it is also intended to achieve the following goals.

- Supply irrigation water supply to Ghanpur Anicut and Nizamsagar project;
- Arrest the siltation of Nizamsagar project; and
- Production of 15.00 MW hydro-electric power.

2.08 The project envisaged an earthen dam of 3993 meters on the left flank and 3110 meters on the right flank with TBL at +527.850 meters. Ogee spillway was constructed in the gorge portion of the river for a length of 327 meters with crest level + 513.60 meters. The computed maximum flood discharge is 23103 cumecs. Seventeen radial crest gates of size 15.00 m x 13.00 m were erected. The FRL and MWL of the reservoir is 523.60 m. Length of power blocks are 81.00 meters. Two head regulators one on left flank and another on the right flank were constructed for release of water to irrigate a command area of 16,000 ha to be identified later. Total length of canal for irrigating the proposed command area of 16000 ha is assessed to be 60 km consisting 12 km Right Bank main canal and 48 km Left Bank main canal. Salient features of the project are shown in **Annexure II.1.**

Water Utilization

2.09 The existing usages down below the Singur Project site considered in the DPR are as in **Table 2.1**

Table 2.1 Singur Project water usage		
Sl. No	**Name of the Scheme**	**Water use in MCM**
1	Manjira water supply scheme 1st and 2nd phases	84 (2.97)
2	Ghanpur anicut	
	a.) Fateh Nahar Canal	38.511 (1.36)
	b) Mahaboob Nahar Canal	76.49 (2.70)
3	Nizamsagar Project	1642 (58.00)
	Sub Total	1841 (65.03)
4	Singur Project Command Area (16,188 ha)	57 (2.013)
5	Additional Water Supply to Hyderabad & Secunderabad Twin Cities (3rd Phase)	13.25 (4.00)
6	a). Transmission losses for Command areas of Ghanpur anicut and Nizamsagar Projects	351.35 (12.41)
	b). Drinking Water Scheme	15.00
	Total	2277.60 (83.453) Or 2278 (84)
Note: Figures in the parentheses are water use in TMC.		
Source: DPR of the Singur Project Report		

Study Area

2.10 Even though no study area has been demarcated in the terms of reference for the Environmental Evaluation Studies, the following are considered as part of the study area.

- Area within10 km radius from the periphery of the project site.
- Free draining catchment area duly deleting the catchment area of the upstream projects in Maharastra and Karnataka States.
- No command area has been delineated initially, since the project is meant basically for drinking water supplies to the twin cities of Hyderabad and Secunderabad. However, I&CAD Department identified the command area only during 2006.
- Submergence area of the existing project.

General Features

2.11 Singur Project is located on Manjira River near Singur Village in Pulkal mandal (Andole taluk) of Medak district.

Climate

2.012 The district has semi arid to tropical type of climate. Mean annual rainfall is around 830 mm and mean temperature is 29.2^{o}C during summer and 23.4^{o}C in winter. Out of the total annual rainfall, 88 percent occurs during the southwest monsoon.

Topography

2.13 The study area is slightly undulating. The overall drainage pattern of the area is sub-dendrites. The soil composition of the study area comprises light black cotton soils, moderately deep to deep and Laterite soils.

Medak District

2.14 The minimum temperature recorded during 2007–2008 is 9.25°C in the month of December against the normal temperature of 13.60°C. The maximum temperature recorded in the same year is 37.87°C in the month of May against normal temperature of 44.20 ° C. The mean minimum temperature during 2007-2008 year is 19.84 ° C against normal minimum temperature of 23.02 ° C. The mean maximum temperature during the above period is 31.45 ° C against normal maximum temperature of 37.3 ° C.

Relative Humidity

2.15 The minimum Relative Humidity of the district – varied between a minimum of 48.60% in January 2008 to 78.33% in September 2007. The maximum relative humidity during January 2008 was recorded as 54.80% and that of September 2007 stood at 89.23%. The minimum Relative Humidity in September and January respectively had a deviation of -18.70% and +11.03%. The mean RH stood at 67% for the year 2007-08. The maximum relative humidity in September 2007 has a deviation of +12.22% from the mean where as the maximum relative humidity in January 2008 has registered a deviation of -22.21% from the mean. The mean, RH stood at 77% for the year 2007-08.

Rainfall of Medak District

2.16 The total annual rainfall in the district during 2007-2008 is 805 mm against the normal rainfall of 868 mm. Maximum precipitation occurs in the months from June to September. About 71.6% of the precipitation is received in the southwest monsoon from June to September. Normally 91% of the rainfall occurs during the southwest monsoon period. Season wise district monthly rainfall for the years 2001-2002 to 2007-2008 is shown in **Annexure II.2.** Considering the mean total annual rainfall for seven years from 2001-2002 to 2007-2008, the season wise rainfalls are as in **Table 2.2**.

Table 2.2 Season-wise Mean Rainfall of Medak District (2001-02 to 2007-08

Sl. No	Monsoon	Season	Rainfall		Deviation	Percentage 2007-08	Mean
			2007-08	Mean for 5 years			
1	South-West	June-Sept	591.1	555.9	+36.2%	73.5%	77.40%
2	North -East	Oct-Dec	24.6	81.0	-56.4%	3.5%	11.30%
3	Winter	Jan-Feb	37.3	15.4	+21.9%	4.5%	2.10%
4	Hot Weather	March-May	152.2	65.1	+87.1	18.5%	3.20%
	Total		**805.2**	**716.4**		**100.00**	**100.00**

2.17 The rainfall for the year 2007-08 is compared with that of mean rainfall for the last 8 years from 2002 to 2008. It is seen that during South-West monsoon (June-September) the annual rainfall during 2007-08 was more by 36.2 per cent to the mean rainfall for last 8 years. During North-East monsoon (October – December) it was less by 56.4 per cent, the winter rainfall deviated by +21.9 per cent and the hot weather received an excess rainfall of +87.1 per cent. When compared to the mean for last 8 years. The study area of Singur Project lies in Pulkal mandal of Medak district. The normal annual rainfall in the mandal is 1032 mm, whereas the actual total annual rainfall occurred during 2007-2008 is 1012.0 mm with a slight variation of 1.9%. Total rainfall during SW monsoon is only 612.0 mm, against the normal of 812.0 mm during 2007-2008.The rainfall in different seasons is shown below.

Season	Actual during 2007-08	Normal
• South West Monsoon Period	612.0 mm	812.0 mm
• North East Monsoon Period	96.2 mm	96.2 mm

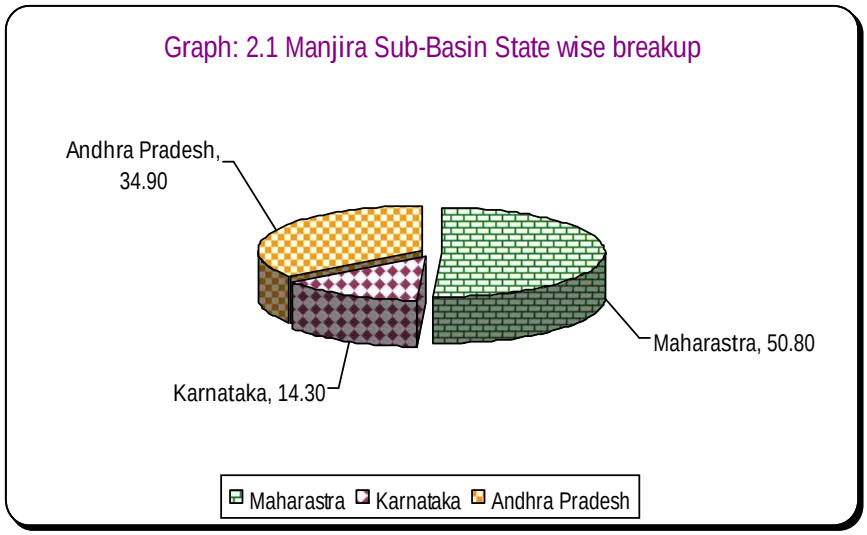
Catchment Area – Manjira Sub Basin

2.18 The Manjira River rises at an altitude of about 823 m in the Beed district of Maharastra and joins Godavari near Sangam village in the Biloli taluk of Nanded district. In its total length of about 686 km, it is joined by forty tributaries. The course of the river can be divided into 4 distinct reaches. The first reach covers the high lands of Beed and Osmanabad districts. The second reach covers the Bidar district of Karnataka State. The third reach is up to Nizamsagar reservoir in Andhra Pradesh. The last reach is the tail reach below Nizamsagar reservoir up to its confluence with the main River Godavari. The index map of Manjira Sub-basin is presented in **Fig. 2.1**

2.19 The Manjira sub basin has a catchment area of 30,844 Sq. km., which constitutes 9.86% of the total of Godavari basin area.

2.20 The catchment of Manjira sub basin lies in the states of Maharastra, Karnataka and Andhra Pradesh. State wise break up of this area is as in **Table 2.3.** Maharashtra state accounted for maximum (50.8%) of the total sub basin area and is followed by Andhra Pradesh and Karnataka states with 10773 sq. km (34.9%) and 4406 sq. km (14.3%) respectively (**Graph 2.1).**

Table 2.3 Manjira Sub-Basin State wise breakup				
Sl. No	**State**	**No. of Districts**	**Area falling in the sub basin sq.km**	**Percentage to the sub basin area**
1	Maharastra	6	15665	50.80
2	Karnataka	1	4406	14.30
3	Andhra Pradesh	3	10773	34.90
Total		**10**	**30844**	**100.00**
Source: DPR of the Singur Project Report				

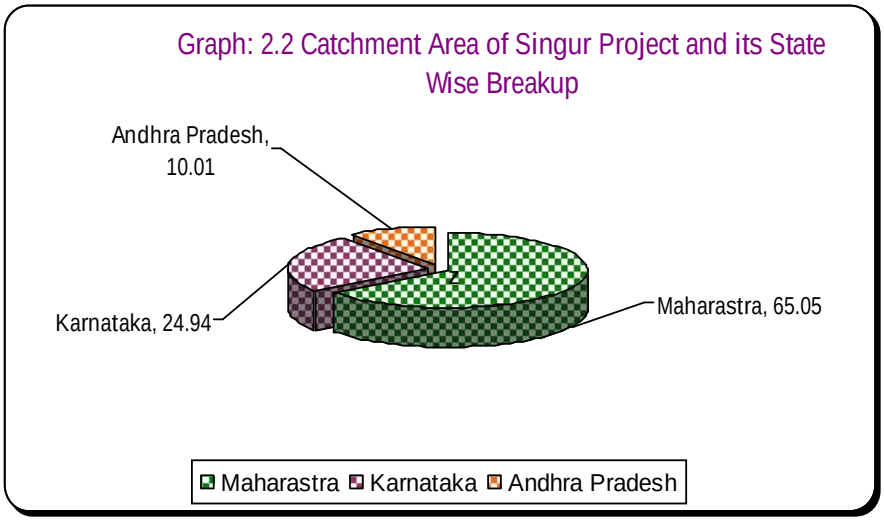


2.21 Catchment area of Singur project is 16,097 sq.km. The catchment area is spread over three states viz., Maharashtra, Karnataka and Andhra Pradesh. The state wise distribution of catchment area of Singur Project is shown in **Table 2.4**. Among the three states, Maharastra state is having more catchment area (**Graph 2.2)**. The catchment area of the project in Andhra Pradesh accounted for just 10.01 per cent of total catchment of the project.

Table 2.4
Catchment Area of Singur Project and its State Wise Break Up.

Sl.No	State	No. of. Districts	Area falling in the sub basin sq.km	Percentage to the sub basin area
1	Maharastra	5	10,472	65.05
2	Karnataka	1	4015	24.94
3	Andhra Pradesh	1	1610	10.01
Total			16,097	100

Source: DPR of the Singur Project Report



Characteristics of the Catchment Area of Singur Project

2.22 The catchment area of Singur Project is more or less linear lines in shape. The topography, Physiography, geology, hydrogeology, climate, rainfall and other characteristics of Singur Project's catchment are discussed in the following paragraphs

Topography

2.23 Most of the catchment area is flat to gently undulating except for a few hillocks. About 5.5% area lies in the hilly and intense forest area and this area has long ridges, valleys and isolated hills with a number of small streams.

Physiography

2.24 The catchment area is fan shaped and more or less a quadrilateral. The northern boundary is the common ridge between the Godavari and Manjira basins. The eastern boundary is up to Singur Project. The southern boundary runs through a common ridge between Manjira and Krishna river basins. The western boundary is a common ridge of Manjira and Bhima rivers. The administrative map of Singur Project's catchment area is presented in **Figure 2.2.** There are two well-defined physical regions in the sub basin namely (a) high lands of Beed and Osmanabad districts of a length of about 160 km from the river origin, and (b) plains from Bidar district.

Geology

2.25 The main geological rock formations of the sub basin are the peninsular granites, the Puranas and Gondwanas. These formations have considerable effect on the run off in the catchment area. The types of soils generated from these formations are mostly permeable. The surface is covered with Kankar and Mooram and as such the run off is

moderate in the catchment.

Hydro geology

2.26 Hydro geological studies in the catchment area of Singur Project by Central Groundwater Board and State Ground Water Department of GoAP, GoK and GoM. The presence of Zeolites in the cavities of rock and moorum indicates abundant water circulation. The porous moorum layers are generally called 'aquifers'. Groundwater occurs under both the confined and un-confined conditions in the catchment area of Singur Project. Thus, these is greater scope for development of groundwater in the catchment area of Singur Project. Hydro geological and groundwater potential map of Singur catchment area is presented in **Figure 2.3.**

Climate and Rainfall

2.27 The climate in the catchment area is characterized by hot summer and a mild winter. The monsoon sets early in June and continues up to end of October. Winter is from November to mid February. Summer is from mid February to end of May.

2.28 The catchment area lies in the medium rainfall zone and is situated between 700 mm and 900 mm isohyets. Most of the rainfall is received during the south-west monsoon from June to October. The rainfall during the other period is small. The maximum average annual rainfall of 906 mm occurs at Bidar (Karnataka) rain gauge station while minimum of 688 mm occurs at Patoda rain gauge station (Maharastra). The average annual rainfall in the catchment area is 797 mm. Map showing Rain gauge stations, IMB observatories, G & D Sites and isohyets in Singur catchment area is presented in **Figure 2.4.**

Temperature

2.29 There are five IMD observatories located in and around the catchment area. They are Beed and Nanded in Maharastra, Bidar in Karnataka, Nizamabad, and Hyderabad in Andhra Pradesh. The annual mean maximum temperature in the catchment area is 32.7^{o}C and the minimum temperature is 20.0 ^{o} C. The monthly average maximum and minimum temperatures of the five IMD observatories are given in **Annexure II.3.**

Relative Humidity

2.30 The Relative Humidity is high during the southwest monsoon and low during the non monsoon period. In summer, the weather is dry and the humidity is low. The annual mean relative humidity at 08.30 hrs is 65 percent and at 17.30 hrs it is 45 percent. The average monthly relative humidity data for the different IMD observatories are given in **Annexure II.4.**

Wind Velocity

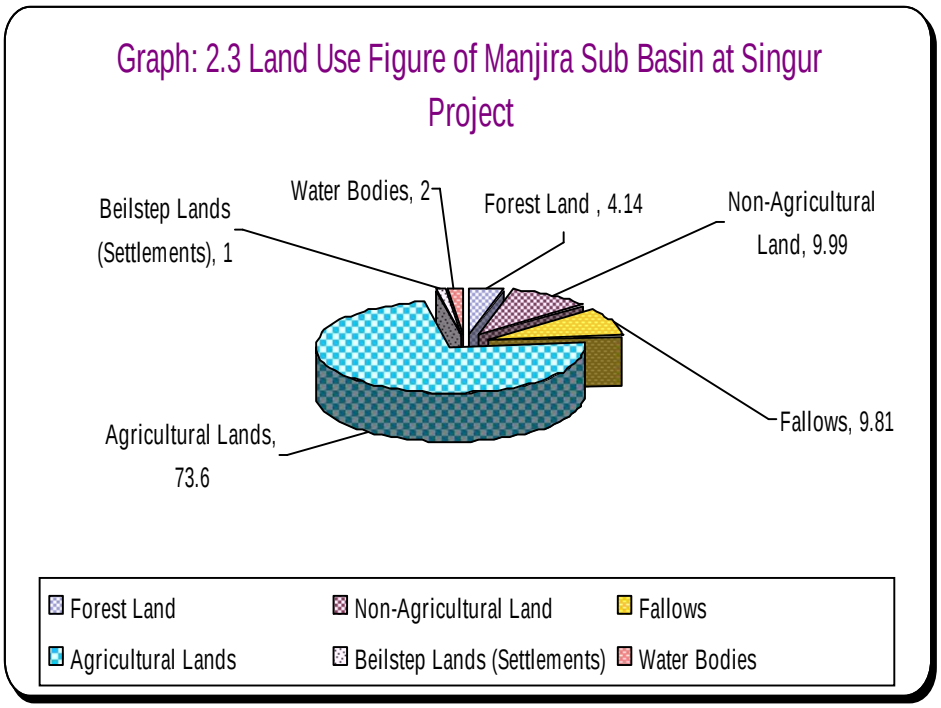
2.31 The catchment area is influenced by winds from South-West and North-West during the monsoon season. In the non-monsoon period winds blow from North-East and South–East are common. The annual average wind speed in the catchment area is 8.8 kmph. The average monthly wind speed data for the observatories are given in **Annexure II.5**.

Land Use

2.32 The catchment area of Manjira basin at Singur project is spread over Maharashtra, Karnataka and Andhra Pradesh states. The land use particulars for the catchment of Singur project are presented in **Table 2.5.** About 74 per cent of the catchment area of Singur Project is agricultural land. The forest lands in the catchment area of the project accounted for only 4.14 per cent of total area. Water bodies and settlements accounted for 1.00 per cent and 2.00 per cent respectively. Land use details in graphical form are presented in **Graph 2.3**.

Table 2.5
Land Use figures of Manjira Sub basin at Singur Project

Sl. No	Land use	Area (ha)	Percentage of total CA
1	Forest Land	66689	4.14
2	Non-Agricultural Land	160544	9.99
3	Fallows	157992	9.81
4	Agricultural Lands	1176184	73.60
5	Beil step Lands (Settlements)	16097	1.00
6	Water Bodies	32194	2.00
Total		1609700	100
Source: DPR of Singur Project Report			



Soils

2.33 The soil map of catchment area of Singur Project is presented as **Figure 2.5**. Majority of the catchment area of the project is occupied by medium blocks soils. The other types of soils available in the catchment of the project include laterite soils, Shallow black soils and deep to moderately deep black soils

Submergence Area

2.34 With the formation of reservoir across Manjira River near Singur village, an area of 16,540 ha was submerged of which 15632ha was in Andhra Pradesh and balance (908ha) was in Karnataka state. The Survey of India (SoI) toposheets extraction of submergence area and proposed command area are presented in **Figure 2.6.** Majority of the submergence area was crop land. No forest area got submerged due to the formation of reservoir at Singur Village in Medak District. The area of settlements which got submerged due to the project accounted for about 11 per cent of the total area of submergence.

2.35 **Existing, ongoing and Proposed Irrigation Projects in the catchment:** After the construction of Singur project, number of major and medium irrigation projects was developed in the catchment area of the project falling in Karnataka and Maharashtra states. In addition there were number of ongoing and proposed major and medium irrigation projects in the catchment area in Maharastra and Karnataka states. The location of existing, ongoing and proposed major and medium irrigation projects in the catchment area of Singur Project is presented in **Figure 2.7.**

Fig 2.1
Index Map of Manjira Sub-Basin in Godavari Basin

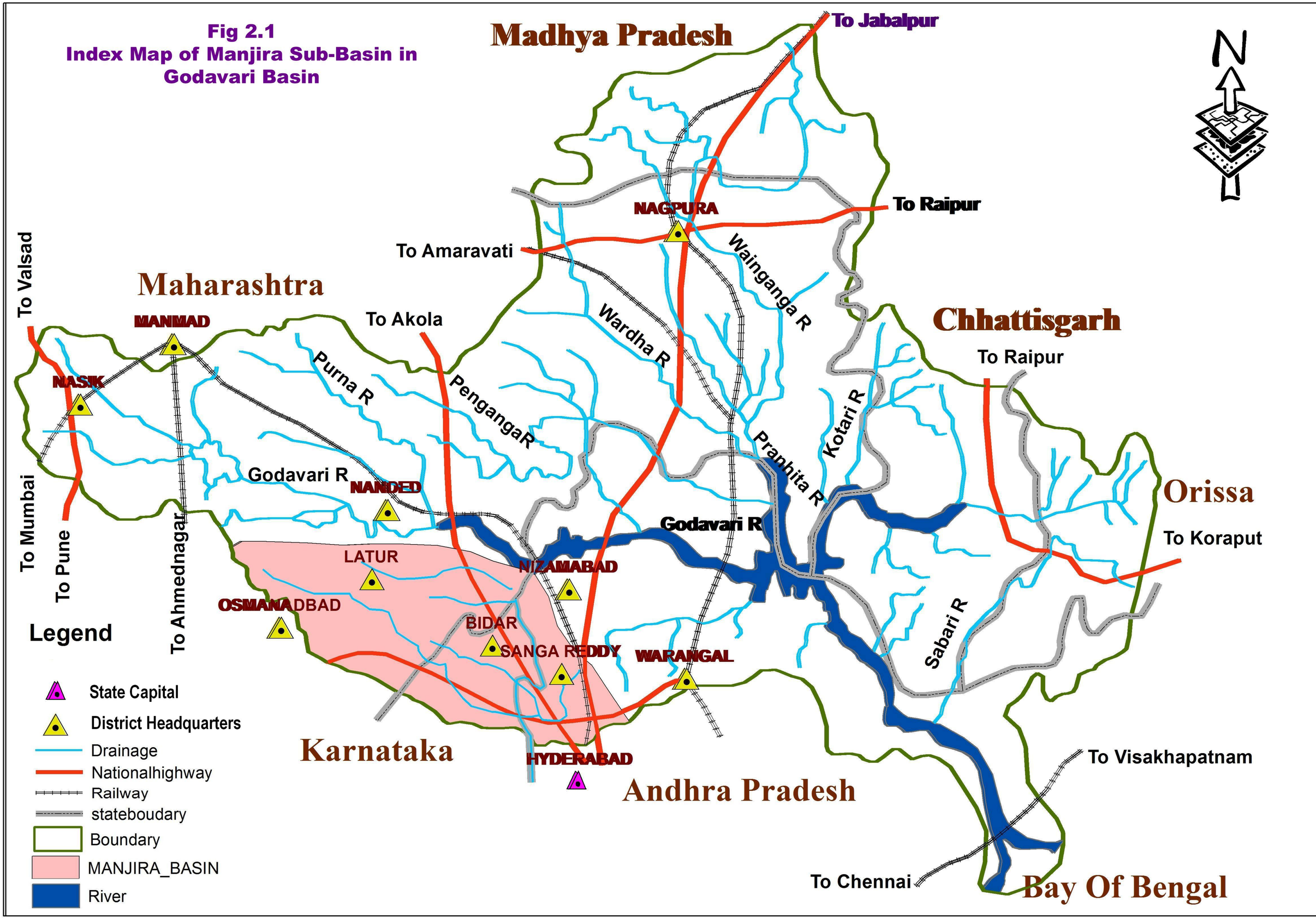


Fig 2.2
Administrative Map of Singur Project Catchment Area

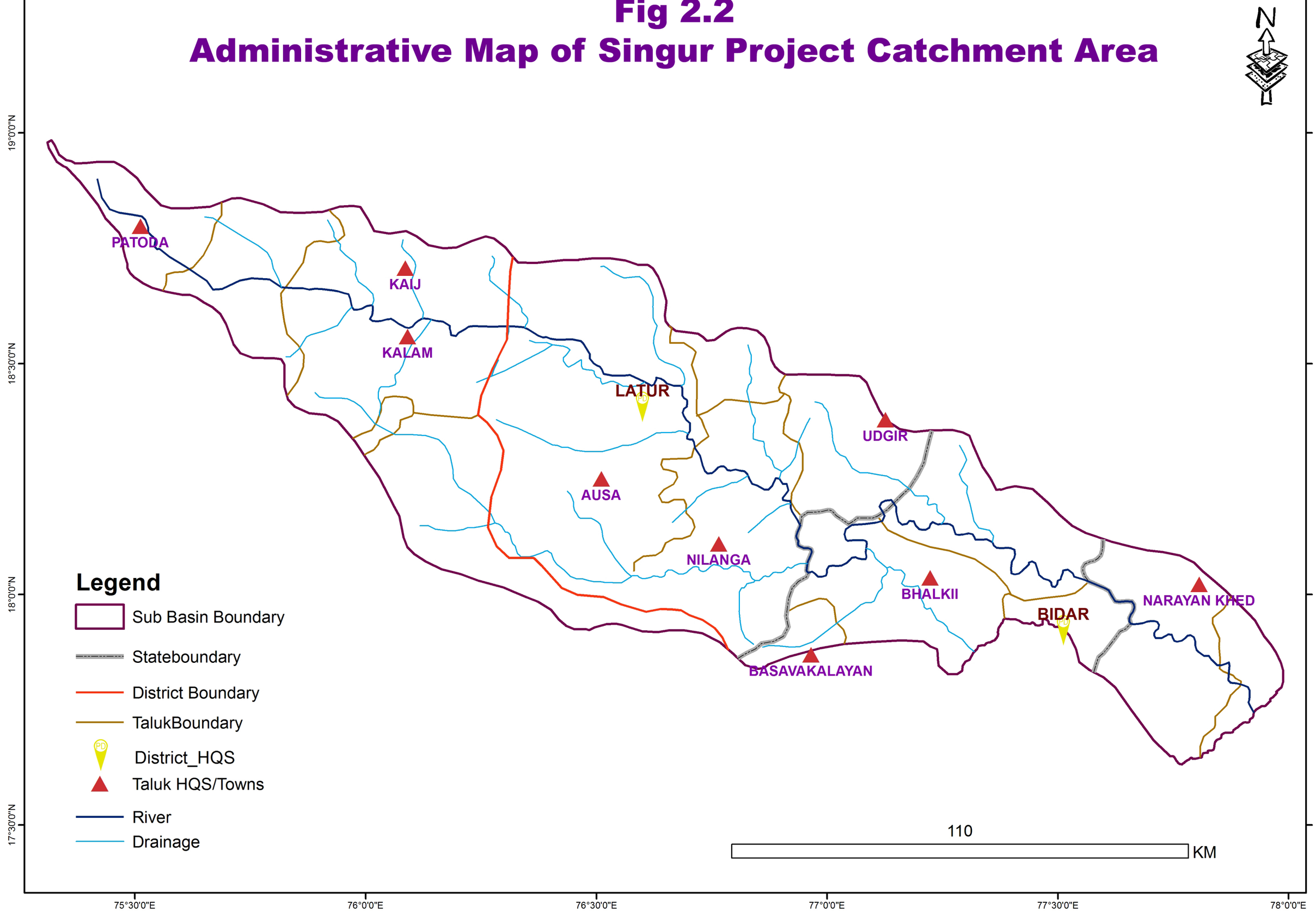


Fig 2.3
Hydro Geological and Groundwater Potential Map of Singur Catchment Area

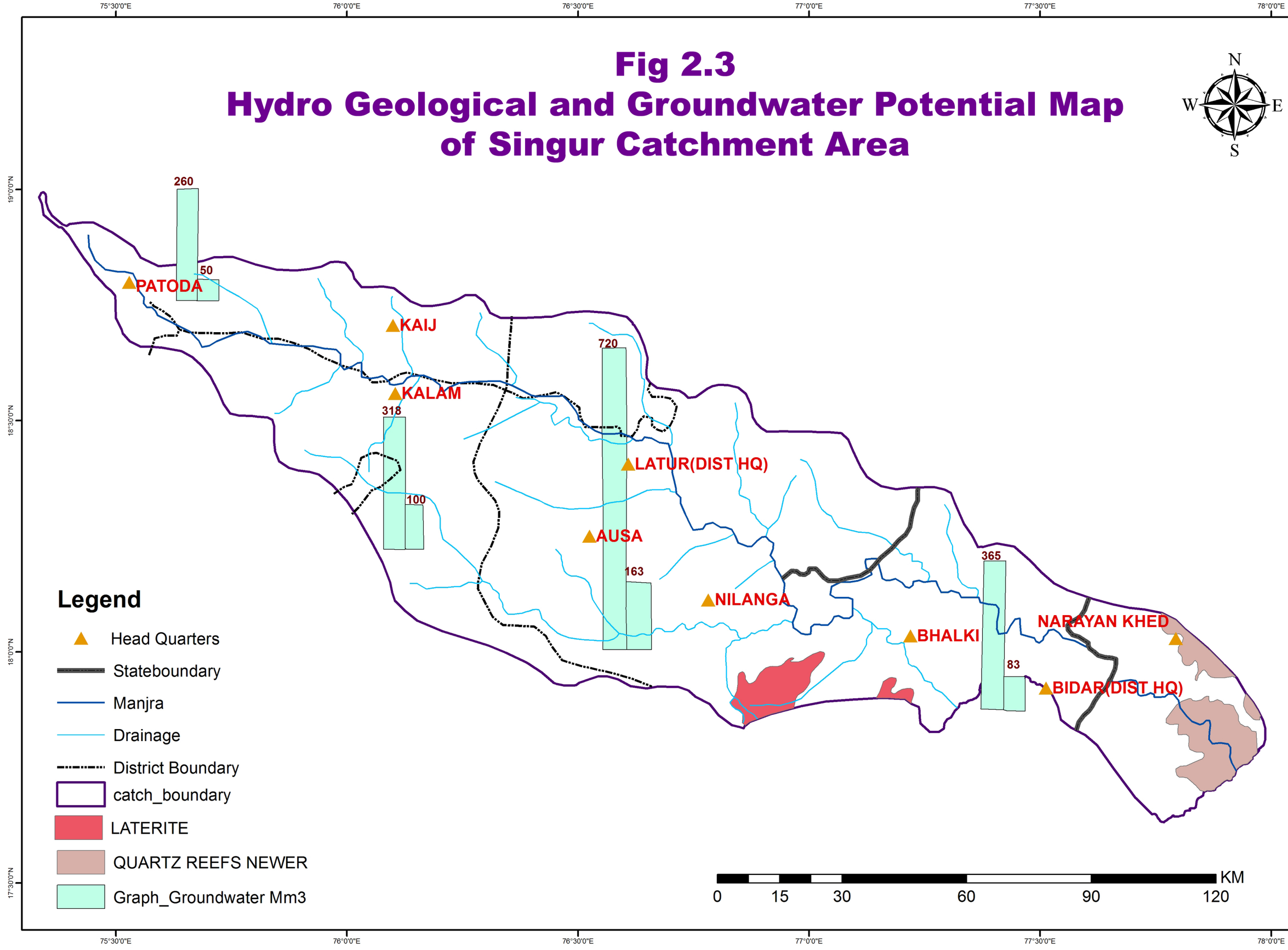
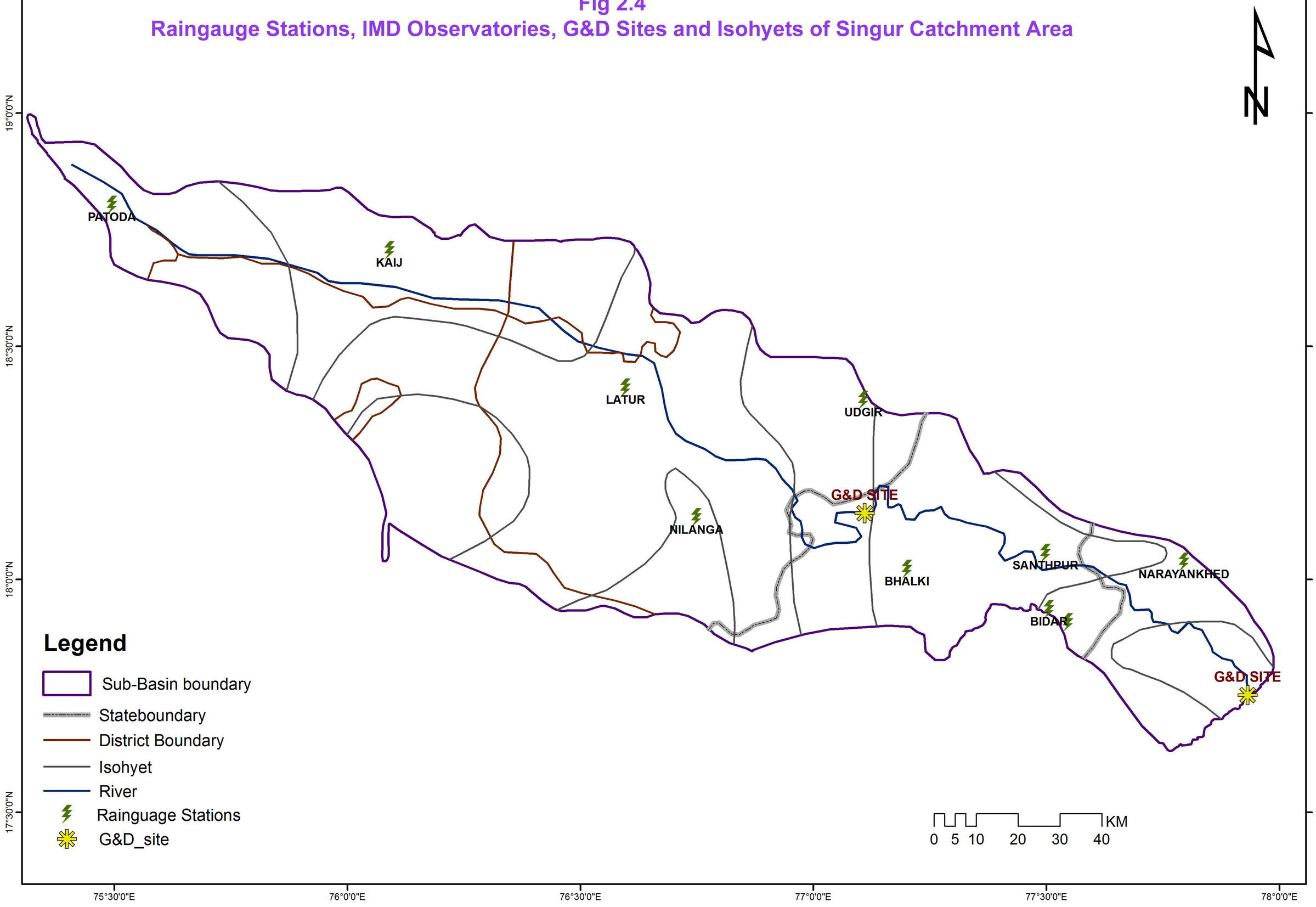


Fig 2.4
Raingauge Stations, IMD Observatories, G&D Sites and Isohyets of Singur Catchment Area



Flg 2.5
Soil Map of Catchment Area of Singur Project

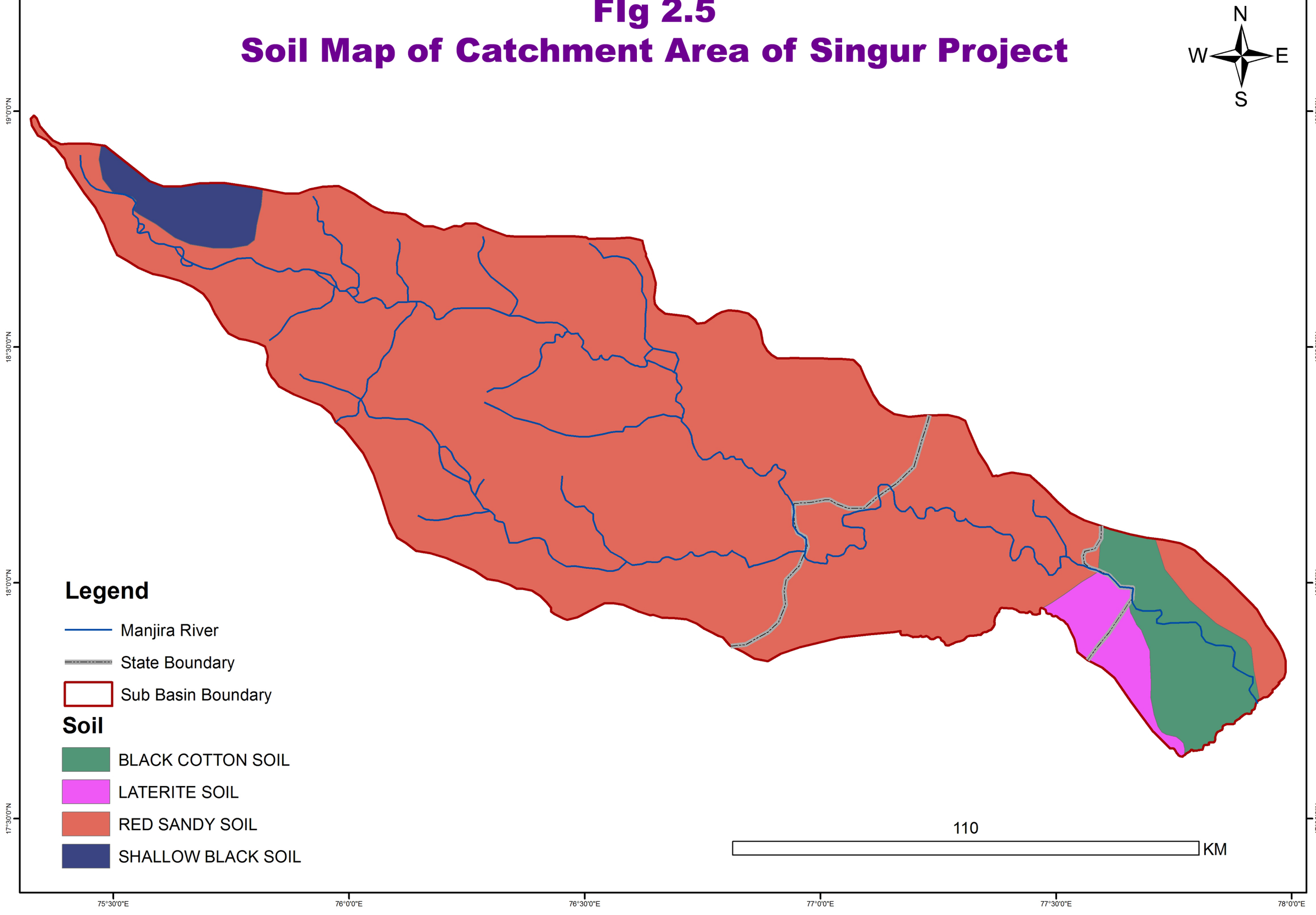


Fig 2.6
Survey of India (SoI) Toposheet of Submergence Area of SIngur Project

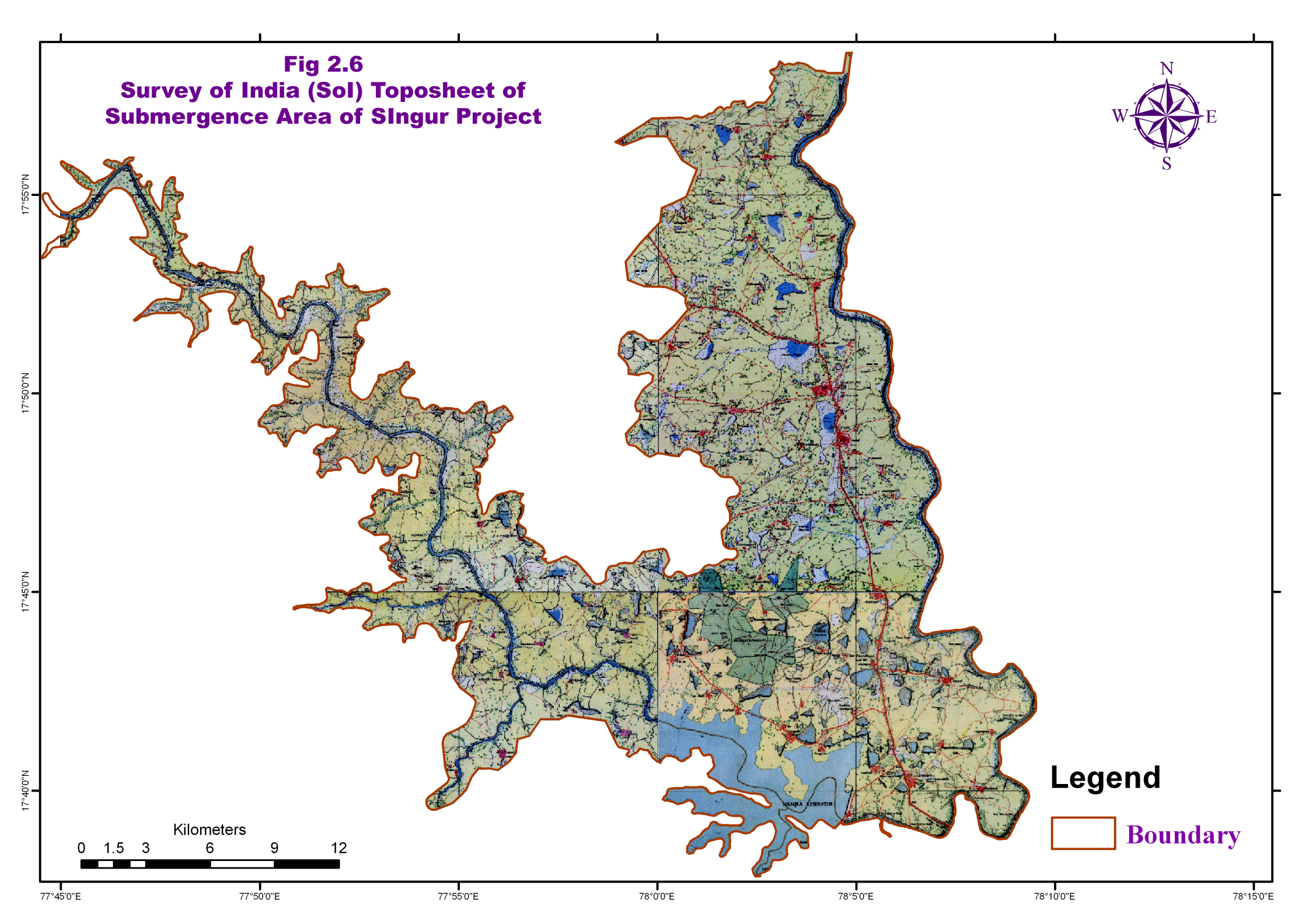
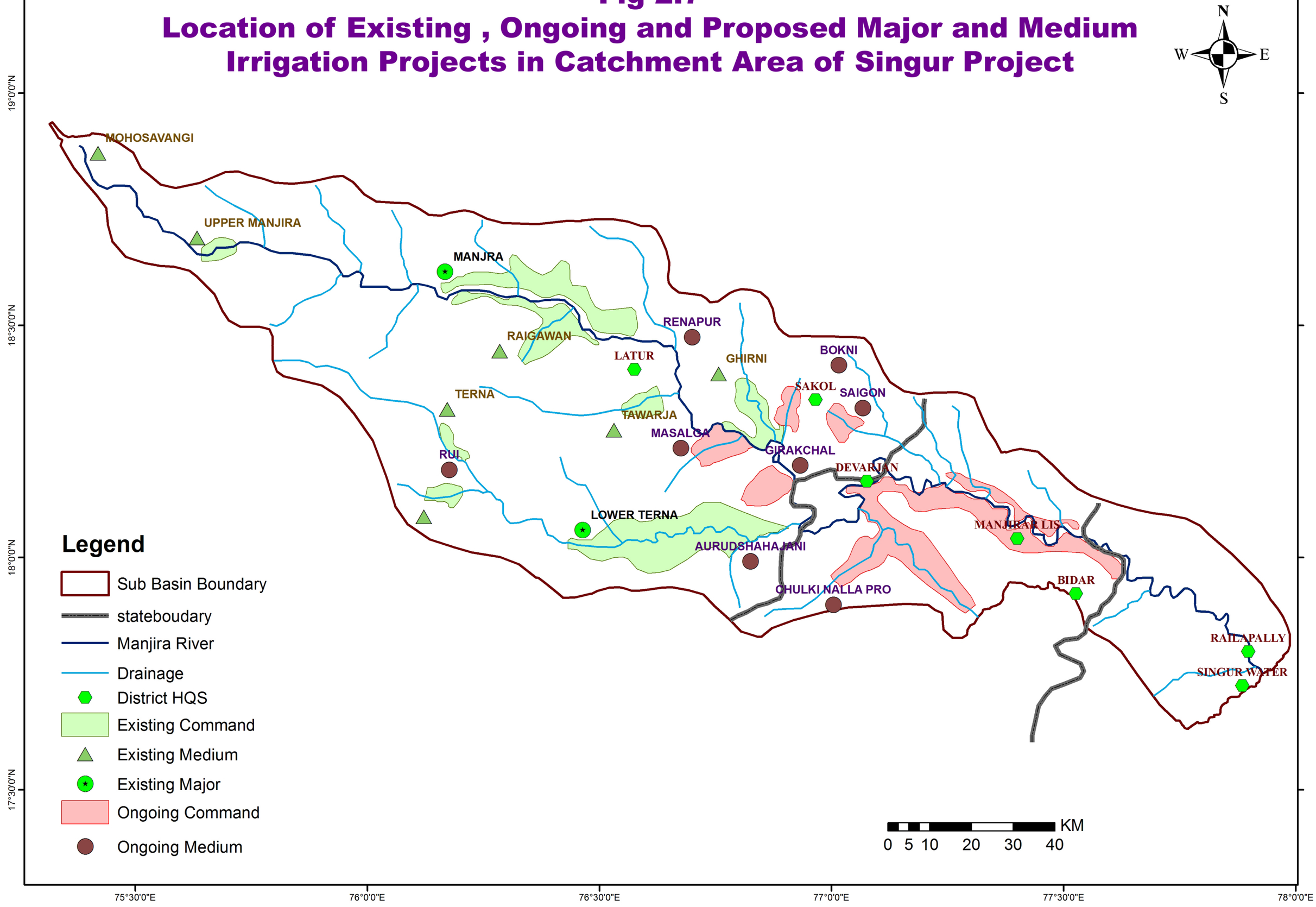


Fig 2.7
Location of Existing , Ongoing and Proposed Major and Medium Irrigation Projects in Catchment Area of Singur Project



Downstream View of Dam Site

Left side View of Dam Site

Submergence Area

Tourist Resort

River Course Downstream

View of Right Canal

View of Left Canal

Left Embankment

Powerhouse Entry

Over all view of Powerhouse

Powerhouse Transformer

Part – I

3
Effects on Rehabilitation

AFC, Hyderabad

3

EFFECTS ON REHABILITATION

Dams and Displacement – A Preamble

3.01 Millions of families throughout the world have been and continue to be forced out from their lands and / or homes. Some are uprooted from their lands and / or homes as a result of deliberate government development policies. Almost all of them suffer **severe** hardships and they hardly get proper rehabilitation. Among the various kinds of developmental projects executed all over the world involving natural resources like water, forest and minerals, large dams across rivers submerging fertile or forested valleys have displaced maximum number of families from their traditional lands and homes. No reliable statistics regarding the number of families evicted by various development activities is available. Researchers from Indian Social Institute[1], New Delhi estimate, "conservatively", that more than 14 million have been displaced by reservoirs and associated river valley projects between 1948 and 1993 in India. World Bank researchers calculated in 1994 that 4 to 4.5 million are evicted by dams every year with an average of 14000 people per dam. Multiplying this average by 40000 (the number of large dams in the world) indicated that a total of 560 million[2] had been evicted due to large dams all over the world. As pointed out by Mc Cully P [3](1996), the annual estimate is therefore, probably too high. The World Commission on Dams (WCD) estimated that the world had built more than 45000 large dams by the year 2000 and have physically displaced "some 40-80 million people World wide[4]".

Objective of the study

3.02 The cause and consequences of the Singur project resulted in submergence of 72 villages located in 6 mandals of Medak District. In specific terms 33 villages got fully submerged and 39 villages were submerged partially. The submergence ultimately led to displacement of the peoples living there as well as loss of land affecting the physical and socio-economic environment of the concerned area.

3.03 This chapter focuses on the study of effects on the lives of the displaced and affected families in the fully and partially submerged villages in the post-project scenario. The study aimed to track the change in socio-economic environment of the project affected area. The specific objectives are as follows:

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[1] Panjiaar, P., "Refugees of Progress', India Today, 30th September 1993.
[2] World Bank, Resettlement and Development: The Bank wide Review of Projects Involving Involuntary Resettlement, 8th April 1994.
[3] Mc Cully, P (1996), Silenced Rivers: The Ecology and Politics of Large Dams, (London: Zed Books),
[4] WCD (2000), Dams and Development: A New Frame Work for Decision Making: The Report of World Commission on Dams: An Overview November 2000, (Earthscan Publication) P. 28

- To study the process of Rehabilitation and details of Rehabilitation sites / centers
- To study environment and sanitation status in Rehabilitation centers.
- To study the amenities and infrastructural facilities created in the rehabilitation centers
- To study status of progress in socio-economic development (Economic Rehabilitation) schemes for the project affected families
- To study the occupational training programmes conducted for project affected persons,
- To study the details of health status and health services provided in the Rehabilitation centers.
- To study the response of the oustees towards the process of Rehabilitation and constraints, if any and
- To study the living standards of the oustees in the Rehabilitation centers

3.04 To trap the relevant and needed information (as stipulated in study objective) a detailed methodology was adopted which is presented in the following paragraphs.

3.05 The study is based on both primary and secondary sources of data. Collection of data from secondary sources i.e., authentic and published / documented data at official levels–office of Chief Engineer (Major Irrigation), office of Chief Engineer (Singur Project) and other concerned line departments at district level besides collecting data from Directorate of Economics and Statistics was undertaken. The primary level data collection involved direct interactions with concerned officials involved directly/ indirectly in the project at district level through personal interviews which helped in understanding the process of project implementation aspects as well as in collection of qualitative data. Thirdly the required data was collected at field level (Village level primary data) through survey method with the help of pre designed data collection tool (Schedule).

Sampling Design

Selection of Mandals

3.06 It is to be mentioned here that in Andhra Pradesh state the district is sub-divided into mandals for the purpose of administration and implementation of developmental programmes. The villages from six mandals got affected due to the Singur project. They are as follows:

1.Pulkal	4. Manoor
2. Munipalle	5. Regode
3. Raikode	6. Nayalkal

For the purpose of Primary data collection, out of six mandals, 5 are selected for the household (HH) survey. In Nyalkal mandal the impact of the project is negligible and insignificant as only 9 villages are submerged that too partially out of total 73 affected villages. Hence, the household survey was confined to only 5 mandals.

Selection of Villages

3.07 There are 72 villages from the above mentioned mandals which got affected either fully or partially. The fully affected villages are defined as those villages which are totally submerged (land and structure numbering 33) and that of partially affected (39) as those villages whose lands only got submerged due to project. For the purpose of field study 30 per cent of the fully affected villages and 15 per cent of partially affected villages were selected. Thus, in all 10 fully affected and 6 partially affected villages were randomly selected for the purposed of household survey. The mandal-wise listing of these villages is presented in **Table 3.1**.

Table 3.1 Mandal wise selected villages for Household (HH) Survey

Sl. No	Name of Mandal	Name of the selected villages of HH survey	
		Fully Affected	Partially affected
1	Pulkal	Singur and Kodur	Pulkal
2	Munipalle	Betur and M.Kwswaram	Chilapalli
3	Raikode	Sirur and Doulatabad	Pamphad
4	Manoor	Pulukurthy and Bellapur	Badalgam
5	Regode	Nrijapla and Usirkikapally	Shapur and Tatipally

Selection of Household / Respondents

3.08 It is assessed that on an average 250 household got fully affected in each of the submerged village. Thus, it was decided to select 10 per cent of them for detailed household survey from the selected villages. It was made mandatory to select 25 respondents from each of the selected village / Rehabilitation center. Similarly it was decided that 10 per cent of partially affected households be selected from the selected village with the assumption that on an average 100 households got affected in each of the partially affected villages. The details of sampling design adopted for Household survey is presented in **Table 3.2**.

Table 3.2 Sampling methodology adopted for Household Survey

Village Affected	Village Sampling			HH Sampling		Total Sampling		
	Total No of Villages	% of village selection to the total village affected	No of villages selected	Average No. of HH affected in each village	% of households to total households	No of HH sample from each village	No of Sample village selected for study	Total HH sample
Fully	33	30	10	250	10	25	10	250
Partially	39	15	6	100	10	10	6	60

Development of Data Collection Tool

3.09 A comprehensive household schedule was developed keeping in view the objectives of the study. While preparing the schedule care was taken to make it very simple which can be comprehended by the rural community respondents easily. The schedule so developed covered entire gamut of process of resettlement and rehabilitation covering pre and post project scenarios.

Pre-testing of household schedule

3.10 A pilot study was carried out for household schedule in three villages (Rehabilitation centers) and based on the observations made during the course of pre-testing of schedule, necessary modification, deletions; additions were carried out for finalizing it for the detailed study. A mention has to be made here that it was difficult for the respondents to recapitulate the happenings and scenario of pre project situations (almost 20 to 25 years back situation). However, with the help of other members of household information could be trapped to a largest extent which consumed a little longer time for the survey.

Data Collection

3.11 The study team along with field investigators visited the selected rehabilitation centers (New village's settlements) and contacted the village elders and village local social leaders for helping in contacting / interacting with the project affected families. The project affected households were selected randomly in consultation with village elders and others. During the course of data collection, the respondents and family members were found to be more enthusiasts in sharing their views on the various aspects of resettlement and rehabilitation (R and R).

3.12 Besides household survey, village transact walks were also undertaken by the study team and observation made during this walk also became part of data collection. In addition to this, in five villages (Rehabilitation centers) detailed focus group discussion were also held with the project affected people who provided an in-depth understanding of the process of rehabilitation and their living environment in the new settlements.

Data Analysis and Tabulation

3.13 The data thus collected from primary and secondary sources is tabulated in the pre designed tabular format and the analysis is done using simple statistical tools such as mean, averages and percentages. An attempt was also made to use qualitative data to supplement the quantitative data. The report is presented as far as possible in the same order as given in the term of reference.

3.14 To sum-up, the approach and methodology adopted for this study viz., household survey (primary data collection) compiling relevant information through scanning of secondary data source, gather information through field observations, formal and

informal discussions, focus group discussions, transact walks and use of simple statistical analysis, tools for analysis resulted in drawing necessary inferences and presenting the same in the report.

Dam Displacement: A Case Study of Singur Project

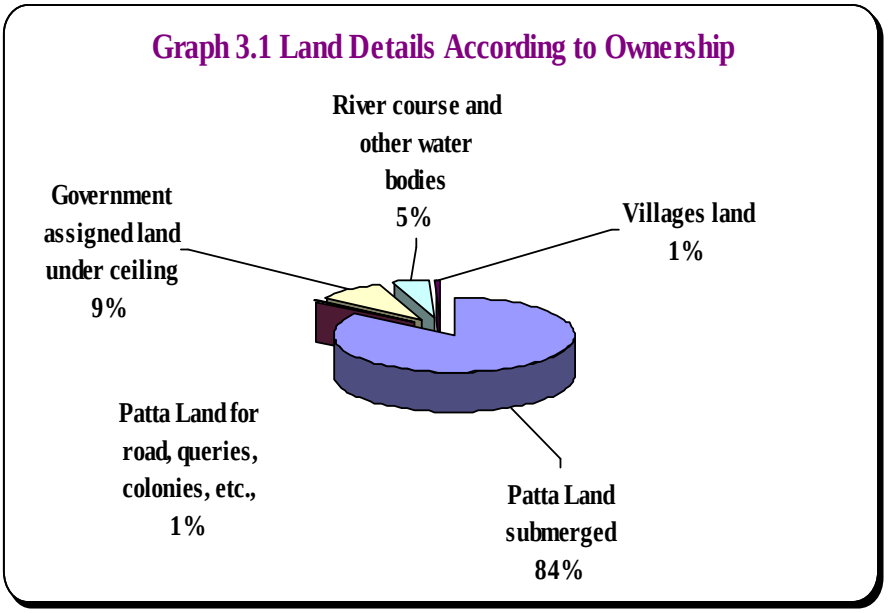
3.15 Singur River Valley project on Manjira River in the border area of Andhra Pradesh and Karnataka states was conceived with dual objectives of providing drinking water to twin cities of Hyderabad and Secundrabad and irrigation facility to about 16,000 ha of lands in Medak district. The catchment area of Singur project is 16,097 sq km and the submergence area, including area under other project components, is 16,540 ha. In addition about 138 ha of land were acquired for roads, quarries, colonies, etc. Thus, the total land acquired for the project is assessed to be 16,678 ha. The break up of this land according to ownership / land use is presented in **Table 3.3**. The village-wise land acquisition for the purpose of Singur project and corresponding payment of compensation are presented in **Annexure III.1**.

Table 3.3
Detail Break up Details of Land Acquired for Singur Project

Sl. No	Particulars	Land / Acquired (ha)	% in Total
1	Patta Land submerged	14072	84.37
2	Patta Land for road, quarries, colonies, etc.,	138	0.83
3	Government assigned land under ceiling	1560	9.36
4	River course and other water bodies	819	4.91
5	Villages land	89	0.53
Total		**16678**	**100.00**

Source: Compiled based on the basis of information provided by Special Deputy Collector, Singur Project (Refer Appendix –B)

3.16 Majority (85.20%) of the land acquired for Singur River Valley Project was Private Patta Land. Land area under habitations, acquired for the purpose of submergence due to the project accounted for only 0.53 per cent of the total land acquired for the project. No forest land was submerged due to the formation of Singur 1reservoir. Further, about 1560 ha of Government assigned land under land ceiling Act was also acquired for the purpose of the project and this land accounted for about 9.36 per cent of total land acquired / required. These details in graphical form are presented in **Graph 3.1.** The land acquired from the households in Karnataka accounted for 2.5 per cent of total land acquired for the project with 418 ha.



3.17 In addition 7103 structures / houses got submerged due to the project upto FRL. All the structures / houses which got submerged due to the project were from Andhra Pradesh only and no structures from Karnataka state got submerged due to the project. The Government of Andhra Pradesh (GoAP) during 2007 modified the definition of project affected zone to classify owners having houses falling within 100 m of surface distance from FRL water line as PDFs[5] and Government Order (GO) was issued vide G.O Ms No. 76 I and CAD (PW-LA-IV, R and R) Department dated 13.4.2006 for this purposes. The PAFs owning houses / structures in between the above cited limits of Singur project requested GoAP to acquire their houses / structures also in view of certain difficulties faced by them. Accordingly the GoAP accepted their request and initiated measures to acquire the houses / structures falling within the above specified limits. The number of structures, that need to be acquired as per the above cited GO in case of Singur Projects is assessed to be 569. Thus, the total number of structures / houses to be acquired due to the formation of Singur reservoir is estimated to be 7672.

Project Affected Villages

3.18 The villages in which the houses or land or both are acquired for project purpose are defined as Project Affected Villages (PAVs). There are 72 villages, which got affected due to Singur River Valley Project. The villages in which houses or houses and land got submerged are defined as fully affected villages. On the other hand the villages where in only land got submerged are defined as partially or partly affected villages. The Singur River Valley project affected 33 villages fully and 39 villages partially in Andhra Pradesh. These 72 project affected villages are spread over six mandals viz., Manoor, Munipalle, Pulkal, Raikode, Regod and Nayalkal of Medak

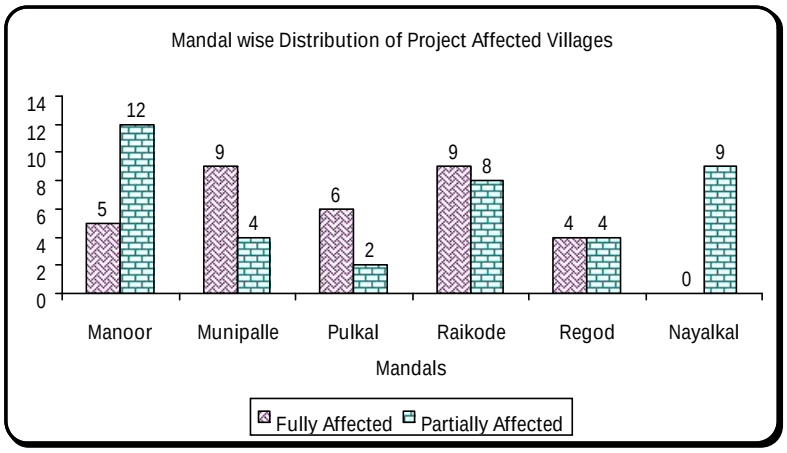
[5] http://www/aprr.gov.in/RANDR/jsp/chapter3.jsp

district. The mandals wise distributions of the project affected villages is presented in **Table 3.4.**

Table. 3.4 Mandal wise Distribution of Project Affected Villages

Sl. No	Name of the Mandal	Number of PAVs		
		Fully Affected	Partially Affected	Total
1	Manoor	5	12	17
2	Munipalle	9	4	13
3	Pulkal	6	2	8
4	Raikode	9	8	17
5	Regod	4	4	8
6	Nayalkal	-	9	9
Total		**33**	**39**	**72**

Source: Compiled on the basis of information obtained from special Deputy Collector of Singur Project



3.19 Village wise land acquired for the project is presented in **Annexure III.1**. The land acquisition in Kadirabad village accounted for 6% of total patta land acquisition for submergence in Andhra Pradesh due to the project. The extent of land acquisition for submergence of the project was over 100 ha in 42 villages.

3.20 In all 7672 structures i.e., houses and cattle sheds were required to be acquired in view of the submergence due to the project. The village wise acquisition of structures in Andhra Pradesh is presented in **Annexure III.2**.

3.21 The number of structures already acquired as at the end of March 2007 was 7103 and the remaining 569 structures are yet to be acquired. The remaining 569 structures fall with in the range of FRL+100 m for which guidelines were issued by state government in the year 2002. The process of acquisition has been therefore under progress.

3.22 As per the DPR the compensation package is worked out assuming that 3 % of submerged area would be wet land, 2% would be garden land and 95% would be

irrigated dry land pending full detailed information from the Revenue Department in regard to the composition of the net submersed area. For payment of compensation the initial estimates for wet land is taken as Rs 4000/ acre; Garden land (single crop) Rs 3500/ acre; Dry lands Rs 2500 / acre and Dry chalka to be Rs 1500/ acre. The total cost for payment of compensation is worked out to be ` 3.85 crores as per Letter no. 9278/72 of district collector dated 10/8/73.

In addition to the above following provisions were also made:

1.	Compensation for private property :	1.00 crore
2.	Acquisition of new village site for rehabilitation :	0.50 crore
3.	Infrastructure like Roads, Drinking water, School, Committee halls, at new sites @ Rs 2 lakhsper village:	8.95 crores
4.	Revenue establishment charges for land acquisition and rehabilitation works	0.65 crores
	Total Provisions:	**11.10 crores**

3.23 The year- wise budget and expenditure particulars are given in **Annexure. III. 3**. As per the available details of expenditure for land acquisition and works, it is observed that till 2007-2008 the expenditure for land acquisition stood at Rs 12247.929 lakh and towards works at Rs 9880.131 lakh. The total expenditure till 2007-2008 is Rs 22128.060 lakh against budgeted amount of Rs 23183.94 lakh.

3.24 For assessing the affect of rehabilitation of project-affected families due to Singur Project, a sample survey was carried out covering about 20 percent of affected villages. For analysing the changes in infrastructure facilities in project affected families Rehabilitation areas, the information was collected from all Rehabilitation villages.

Policy of Resettlement and Rehabilitation

3.25 Involuntary displacement and resettlement of the people due to project has been a concern for economic and social development at all times. Installing major hydropower dams, irrigation and drinking water systems has entailed displacements attended with hardships and deprivation of livelihoods when people are displaced. Their livelihood system may be dismantled, kinship groups are scattered, and long established residential settlements are disorganized under the unavoidable circumstances. In the process of resettlement of these affected persons, earlier scenario of their settlement can not be created once again as it is, than an effort can be made to minimize its magnitude to the extent possible which needs a policy direction.

3.26 In the case of Singur project, there was no clear cut policy existed that time either at National or State level for R & R. However, sporadic attempts were made to address this issue. In the meanwhile World Bank had evolved the resettlement policy to address the concerns of affected families.

3.27 The World Bank happens to be one the partners for funding the Singur project and as such, as reported, World Banks policy for R and R has been adopted. The salient feature of World Banks R and R Policy is presented in Box 1.

Box 1. The Bank's Resettlement Policy: Salient Features

- Involuntary displacement should be avoided or minimized whenever feasible, because of its disruptive and impoverishing effects.
- Where displacement is unavoidable, *the objective of* Bank policy is to assist displaced persons in their *efforts* to improve, or at least restore, former living standards and earning capacity. The *means* to achieve this objective consist of the preparation and execution by the Borrower of resettlement plans as development programs. These resettlement plans are internal parts of project designs.
- Displaced persons should be: (i) Compensated for their losses at replacement cost, (ii) given opportunities to share in project benefits, and (iii) assisted in the transfer and in the transition period at the relocation site.
- Moving people in groups can cushion disruptions. Minimizing the distance between departure and relocation sites can facilitate the resettler's adaptation to the new socio-cultural and natural environments. The tradeoffs between distance and economic opportunities must be balanced carefully.
- Resettlers' and hosts' participation in planning resettlements should be promoted. The existing social and cultural institutions of resettlers and their hosts should be relied upon in conducting the transfer and reestablishment process.
- New communities of resettlers should be designed as viable settlement systems equipped with infrastructure and services, able to integrate in the regional socio-economic context.
- Host communities that receive resettlers should be assisted to overcome possible adverse social and environmental effects from increased population density.
- Indigenous people, ethnic minorities, pastoralists, and other groups that may have informal customary rights to the land or other resources taken for the project, must be provided with adequate land, infrastructure, and other compensation. The absence of legal title to land should not be grounds for denying such groups compensation and rehabilitation.

Source: World Bank , Resettlement and Development, March 1996

Process of Resettlement and Rehabilitation

3.28 As indicated in earlier chapter, the construction of Singur project resulted in submerging 16540 ha of land spread over 72 villages. In the process of impounding of water in the Reservoir up to +523.60 m (FRL) 33* villages were fully submerged while in other 39 villages only land got partially submerged. Number of families affected due to submergence of 33 villages fully and 39 villages partially are 6357 and 5276 respectively.

*****It is to be mentioned here that actually in 32 village's land and structures got submerged under the project. Whereas, in Singur village, only land got submerged partially. When the water started impounding in dam area, the Singur village which lies in the down stream side of dam (embankment) started getting water seepage in the area and affected almost all dwelling units resulting in collapsing of majority of the structures there. Due to this, the project authorities declared it as fully affected village, after due consideration. Thus, in all 33 villages declared as fully affected.

Resettlement and Rehabilitation of Project Affected Families

3.29 For Resettlement and Rehabilitation of project affected families, Government of Andhra Pradesh in G.O.MS.No.300M, Housing and Municipal Administration and Urban Development (A_2) dated 2.6.1989 have constituted two committees, one at District level with District Collector, Medak as the Chairman and other at state level with Secretary to Government, Housing and Municipal Administration and Urban Development as Chairman, for implementation and reviewing the rehabilitation under Singur Project. The rehabilitation Programmer has been entrusted to District Collector, Medak[6]. One Rehabilitation Officer of the rank of the Special Deputy Collector with district headquarter at Sangareddy is made responsible for implementing the R and R Programme with the assistance from 3 Sub-Division Offices.

3.30 For the rehabilitation of displaced families a master Action Plan was worked out. Accordingly 29 new settlement sites were identified and for resettlement of fully submerged village families (PAFs) on the outer periphery of the project water spread area. Town Planning Department prepared the village layouts for the new villages. These new resettlement sites (centers) are located near old village sites as far as practicable. The Index Map showing the Rehabilitation Centers in depicted in **Figure 3.1**. Each family has been provided with 200 sq m of the house plot free of cost, irrespective of financial status of the Project affected families[7].

3.31 The Comprehensive Action Plan on Rehabilitation of oustees provided for sinking of drinking water bore wells, approach roads, internal roads, electricity, buildings for Primary School, Community halls, Primary health Care Centers, Veterinary Clinic, etc., besides construction of houses for weaker sections.

3.32 The work of Rehabilitation and Resettlement (R and R) was initially taken up under the control of District Collector Medak with Special Rehabilitation Officer (Special Deputy Collector with Divisional headquarters at Sadasivpet). The rehabilitation and resettlement works are dealt by Hyderabad Metro Water Supply and Sewage Board, Hyderabad.

[6] Status Note on Implementation of Environmental Aspect, (Government of Andhra Pradesh, Irrigation and CAD Department) 1996.

[7] Special Deputy Collector, Singur Project, Sangareddy, Medak District.

3.33 Thus, the Rehabilitation work was initiated, under the overall control of District Collector in phased manner. The process of Rehabilitation initiated at the village level by adopting various approaches viz., (a) Creating awareness about the project and areas coming under submergence among the likely Project Affected Families. (b) Conduct of series of meeting in the affected villages, (c) Serving notifications, (d) convincing exercise etc., for relocation of displaced families at the selected rehabilitation centers. Choice was given to PAFs to select their sites for house construction and constructed houses (incase of weaker section).

3.34 The R and R Activities are implemented in the phased manner i.e., based on the Project affected villages which were coming under the submergence gradually. The dam water impounded for first time in 1989[8]. However, the land acquisition and compensation has started much before i.e., from 1980 to 81[9].

3.35 The phase–wise number of villages that came under submergence are presented separately for full and partial submergence in **Table 3.5**.

Table 3.5
Phase-Wise Submergence of No. of Village under Singur Project

Sl. No	Phases	Fully Submerged villages	Partially Submerged villages
1	1st Phase Villages	10	Nil
2	2nd Phase Villages	7	6
3	3rd Phase Villages	16	33
Total		**33**	**39**

Land Compensation Assessment

3.36 Though, in general, the affected families are always declare to get their compensation from the concern competent authorities, but assessment of land values and fixation of the compensation is a ticklish issues, mostly subjective on both the sides i.e., affected land owners as well as assessment valuators which are governed by many internal and external factors and other complications. In the rural settings a very few land owners are involved in selling and buying process based on the type/category of land. This can not become a base for fixation of land values. On the other hand the land owners whenever they need money, mortgage their lands against the loan they borrowed. If the land owners are asked to fix the land value, they will go by that have taken place in the area in process of selling and buying of lands locally which may not be registered. The land acquisition authorities may not accept these prices. In such many cases, one sided decisions are taken in assessing and fixing the values of land and other properties for acquisition under the project, which in turn makes the situation complicated from owner side.

[8] Explanatory note of Department of Major Irrigation Projects, Government of Andhra Pradesh.
[9] Land Acquisition, Singur Project, Medak District, SDC, Singur Project, Sangareddy Medak District (23.06.2008)

3.37 In case of Singur Project, also the same observation is made during the field study. As per the Project DPR the compensation package was worked out assuming that 3 percent of submerged area would be wet land. 2 per cent would be garden land and 95 per cent would be irrigated dry land, 2 pending full detailed information from the Revenue Department in regard to the compensation of the net submerged area.

3.38 For payment of compensation the initial estimates for wet land was taken as `.4000 per acre; Garden land (Single Crop) Rs.3500 per acre; Dry lands Rs.2500 per acre and Dry Chalka to be Rs.1500 per acre. Thus, the total cost for payment of compensation was worked out to be `. 3.85 Crores as per the letter no.9278/72 of District Collector dated 10/8/73.

3.39 During the informal discussions held with oustees at the field level revealed that land owners of the submerged villages were not satisfied with for the compensation they received for their land from the Government. In many cases they were paid @ Rs 3000 to 4000 per acre for the submerged lands. The scanning of office records on compensation also revealed that the Pattadars of agricultural lands which were already acquired by the department have opted for legal redressal mechanism to settle their grievances with regard to land prices. As such they approached and sought the courts (both at District level as well as High Court) directions for enhancement of land compensation.

3.40 It is reported that in many cases, through court/s interventions, compensation issues have already been settled with enhanced per acre cost in almost all cases. Besides, as many as 488 cases are still found to be pending in the courts for the settlement as per the office document as on 23.06.2008. Details of pending cases in this regard are presented in **Table 3.6**.

Table 3.6
Acquired Land compensation cases filed/pending in courts of Singur project as on 23.06.2008

Sl. No	Particulars	No. of Cases
1	Pending cases	163
2	Appeal cases	36
3	Stay granted	5
4	Appeal Pending	36
5	SLPs Pending cases	3
6	W.P/W.A Pending in High Court	13
7	EP's Pending	148
8	Decrials Pending	33
9	Section 18 Pending	50
10	Section 28 A Pending	1
Total		**488**

Structural Property Compensation Assessment (Valuation of Structures)

3.41 In case of assessment of structural properties which came under submergence due to project (in addition to lands) following criteria, as reported, was taken into consideration.

a) Plinth area
b) Materials used (walls): mud / Bricks, type of wood etc.
c) Year of construction
d) Type of roof – Thatched / tiles / slab / tin etc.

3.42 Based on the above criteria, the structural property valuation of affected families was carried out by R and R division of the project. Thus, based on assessed value, the displaced families were paid compensation for structural properties, in general, in one installment only.

Rehabilitation of displaced families:

3.43 About 2800 families out of 6357 displaced families in 29 centers who were below poverty line were provided with two-room pucca tiled houses free of cost. The remaining 3557 families were allotted plots of 200 sq m size free of cost besides providing Rs. 15000/- a grant towards construction of house on the plot. The displaced families were also given resettlement grants in the form of cash. In addition to the above Rs.5000/- was given to those who lost both land and house and Rs 1000/- was given to those who lost either of the above. About 3000 families were also supplied with livestock in kind in the form of buffaloes, goats or sheep valued at Rs 8000/- free of cost.

Environmental and Sanitation Status in R and R Centers

Sanitary Facilities Provided

3.44 The primary field data indicated that in all the settlements pacca drainage line network has been laid. However the field visits and informal discussion held with settlement dwellers revealed that the constructed drain lines are very shallow and do not have enough depth. As such in due course of time these have been silted. From the Transact walk, it is noted that most of the drain lines were over flowing thus, polluting the settlements' environment as well as creating unhealthy living conditions. Further it is noted that mosquito's menace resulted in spread of malaria diseases in the area. It was also reported that after the drains siltation, no de-siltation work has been carried out till date (study period). During the focus group discussions it was revealed that the common diseases are malaria and typhoid due to prevalence of mosquitoes. However, exact statistics of malaria is not available.

Communication Facilities

3.45 It is observed that out of 29 Rehabilitation centers metal approach roads have been laid in 19 centers. In the remaining 10 centers, roads were existing, hence no new roads were laid. In all the 29 centers a network of internal roads was laid. However, it is reported by the settlers that after laying the roads, no road repair is carried out. Further, it is brought to the notice that during rainy season, it becomes difficult for them to have smooth movements. Nevertheless, majority of settlers have the feeling that present roads are comparatively better than that of old settlement roads in width and motorability. The details of roads laid are presented in **Annexure III.4 and III.5**.

3.46 With regard to road transport it is observed that majority of settlements were initially connected with bus facilities. However in some cases, it was withdrawn at later stage. To site eg., Busireddy pally. The dwellers of settlement were of the opinion that the bus frequency should be increased.

Drinking Water Facilities

3.47 Drinking water facilities have been found created in all 29 rehabilitation centers. In all 106 bore wells with hand pumps are provided in rehabilitation centers. During the field visits, it is observed that a good number of households, who could afford, connected their houses with running water tap facility from the main water pipe line. The details of these are presented in **Annexure III.6**. The informal interactions with oustees revealed that, in good number of cases, main pipe lines have developed leakages, affecting smooth water supply, however, as reported by the dwellers, their main source of drinking water has been bore wells with hand pumps.

3.48 Further it is also observed that some of the rehabilitation colonies have been connected with central water supply scheme, (eg, Mantoor village). However, according to dwellers, the supply through this system, remained irregular. In other cases, for drinking water supply NGOs are also involved, for example Peddareddypet, where Satya Sai Trust is managing supplies of drinking water. It is also observed that in the colonies in Left flank area of the dam, level of groundwater table is very deep and as such the bore well water yields are meager and highly fluctuating. In case of Right Flank area of the dam, the water table is very shallow, as such, in this area there is no problem of water yields of bore wells.

Plantations in Rehabilitation Colonies

3.49 In this regard it is reported that in all Rehabilitation centers, seedlings were provided to each of the families for plantation in their dwelling area as well as for avenue plantation. The Focus Group Discussion (FGD) held with dwellers revealed that majority of dwellers had planted the seedlings, which were observed also during transact walk. The common types of plant seedlings supplied are Neem, Jamun, Mango and Coconut

and the survival rate was above 80 per cent at the time of planting. Since proper care was not taken by the villagers in the later stage the current survival rate is reported to be 20 to 30 per cent. However, the health of the survived plants was observed to be very good.

Details of Amenities and Infrastructural Facilities

Rehabilitation Facilities

3.50 This aspect has already been discussed in the preceding paragraphs. However, the observations of the field study team are presented in the following paragraphs.

Following steps were followed for rehabilitating the oustees:

- ⇒ Identification of oustees.
- ⇒ Identification of weaker section among the oustees.
- ⇒ Making special provisions for the resettlement of weaker section.
- ⇒ Identification of rehabilitation sites for oustees.
- ⇒ Acquisition of land for rehabilitation.
- ⇒ Preparation of Plan Layouts for plots in acquired land involving experts (each plot of 200 sq m size)
- ⇒ Marking planned layouts of plots on sites fallowing the choice of oustees
- ⇒ Actual Rehabilitation.

3.51 The discussion held with concerned R and R implementing officials revealed that lot of efforts were put in to finalize R and R plan and accordingly process of rehabilitation of oustees was initiated in phased manner.

3.52 Further it is noted that oustees were categorized into two categories viz., (a) No. of oustees who fall under weaker section category and (b) Others i.e., General Category. It is reported that among weaker section oustees about 2328 of them were selected for the allotment of constructed houses. Thus, in all 2328 houses were constructed (two room house with tiled roof) which are spread over 29 rehabilitation centers. For general categories of oustees Rs.15000 grant was given to each of them for the purpose of house construction. The FGD held with the oustees revealed that the grant given to them for house construction was just not enough for the purpose. Further, it was informed that the oustees had to spend a good amount of their earnings for completing the house construction. A majority of them also told that the extra amount for house construction was used from the land compensation they received.

Electrification of Rehabilitation Centers

3.53 It is reported that all 29 rehabilitation centers have been provided with the power connectivity. Electricity poles were installed for street lighting. It was left with the oustees to have domestic power connectivity if they desire.

Construction of School Buildings

3.54 Out of 29 rehabilitation centers, in 25 centers new school buildings have been constructed **(Annexure III.7).** In these buildings, mostly primary schools were established. In the remaining 4 centers oustees are observed to be sending their children to the earlier schools which are located in the main village. The FDGs held with the oustees during field study revealed that some of the newly constructed school buildings developed cracks in the roof slab and as such during rainy season it has become difficult to conduct the class room sessions. One of such buildings was observed in Allapur rehabilitation center. Beside this, in Rapally, Indoor, Kadirabad and Mallikarjunapally, one exclusive building in each of these rehabilitation centers was found constructed with the library facility.

Community Hall

3.55 Among rehabilitation centers, 90 per cent of them have been provided with community hall facilities. In all, 26 buildings (with concrete construction) have been built for the purpose of conducting community meetings **(Annexure III.7)**. However, it is observed and reported also that the plinth area of these buildings is small and is not sufficient for conducting such meetings. According to locals the community hall hardly serves the purpose of conduct of meetings.

Grampanchayat Buildings

3.56 In the newly established rehabilitation centers wherever, it was needed, a separate new grampanchyat (GP) building has been built. Thus, in all 19 new G.P. buildings have been constructed **(Annexure III.7)**.

Veterinary Service / Facilities

3.57 To extend the veterinary service / facilities for animal population of newly established Rehabilitation centers, veterinary dispensary buildings have been built, in 8 centers Viz, Garlapally, Kodur, Sirur, Bagulampally, Mantoor, Kadirabad, Itkapally and Bellapur **(Annexure III.7)**. Beside this, in each project affected mandal there are minimum 2 rural live stock units functioning to cater to the needed animal health care services in rehabilitation centres.

3.58 However, the fields study visits revealed that some of the established veterinary dispensaries have become defunct (eg, Mantoor Rehabilitation center) due to lack of man power and infrastructural facilities. It is reported that due to this, the locals are facing lot of inconvenience for getting animal health care as well as other needed services.

Irrigation facilities

3.59 Out of 29 rehabilitation centers, 26 centers were selected for surveying the groundwater potential for sinking bore wells with a view to extend irrigation facilities to PAFs. Further, it is noted that out of 26 rehabilitation centers surveyed only 24 centres were selected for drilling bore wells. As such, 238 sites were surveyed in the area for sinking bore wells and 139 sites were recommended for drilling. Out of 139 drilled bore wells, in 122 bore wells water yield was found to be adequate. However, in due course 10 drilled wells either collapsed or became defunct leaving only 112 bore wells with good yields and in use. Finally 110 bore wells were electrified and commissioned. In remaining two bore wells, beneficiaries have been permitted to utilize the drilled bore wells, after energizing them on their own, for the purpose of irrigation **(Annexure III.8)**. The existing bore wells are however not sufficient and hence direct pumping from the reservoir to the un-irrigated areas would fill the gap.

Progress of Economic Rehabilitation

3.60 The Progress on implementation of economic rehabilitation for the displaced persons as reported by rehabilitation officer, Singur Project, Sanga reddy is furnished below[10].

3.61 For economic rehabilitation 5,611 families were identified and out of this 2993 families have already been rehabilitated by implementing various economic schemes by the end of 1995. Besides new economic schemes for 1418 families were planned and implemented by June 1996. In addition to this, 1100 families were provided economic rehabilitation after June 1996. The Rehabilitation Division has also taken up the following projects outside rehabilitation and resettlement programmer for socio-economic development of affected families:

1. Raising of fodder crops in the foreshore area of Singur Project for the Milch Animals and Bullocks supplied under Economic Rehabilitation Schemes.
2. Artificial stocking of fish seedlings in the reservoir to boost the fish production to enable the fishermen to earn more income.
3. Low-cost latrine under Vimukthi Programme.
4. Fan assembling units at Hunnapur village providing wage employment to thirteen rural women.
5. Two Woollen Blankets weaving units at Mantoor and Busireddypally villages providing part – time income to ninety (90) rural women hailing from Kurma Community.
6. One Ethenic Garments manufacturing unit at Mantoor village providing employment to forty (40) rural girls.

[10] Andhra Pradesh, Krishna and Godawari Basin Organisation, Monitoring and Appraisal Directorate Status Report an Environmental Aspects of Singur Project, Hyderabad, 1996.

Conduct of Training Programmes for Project Affected Families

3.62 In general, no skill (Vocational) based trainings, as reported by project affected families, were provided to them. However, under economic rehabilitation scheme, at few selected Rehabilitation centers, i.e, Hannapur, Manthoor, Busireddypally, vocational trainings were imparted to a selected few women. The areas in which the training was conducted are presented in the following **Table 3.7**

Table 3.7 Skill Trainings Conducted For Women Under Resettlement And Rehabilitation Programme.

Sl.no	Training Particulars	Rehabilitation centers	No. of persons trained	Wage employment
1	Electric Fan Assembling	Hunnapur	13	Full-time
2	Weaving (Woolen blankets)	Mantoor, Busireddypally	90	Part-time
3	Garment manufacturing (Tailoring)	Mantoor	40	Part-time

3.63 Besides above, it was also reported that under other income generating activity, selected dairy farmers in Mantoor village were given training in Dairy farming at the initial stage of rehabilitation which was discontinued at a later stage. In addition to this, in Peddareddypet, 40000 fish seedlings were provided to fishermen for artificial stocking of fish seedling in the reservoir to boost the fish production to enable them to get more income. For this initial skill training as well as, infrastructural facilities were also provided to them.

Health Status and Health Services:

Incidence of diseases

3.64 The common diseases which are reported from Rehabilitation Centers are as follows

Water Borne Diseases	Vector Borne Diseases
Malaria	Cholera
Chickenguenea	Jaundice
Dengue	Typhoid
	Diarrhea

Besides this, arthritis, cough is also found to be very common in the Rehabilitation areas.

Medical Facilities

3.65 Each of the project affect mandal has the facility of Primary Health Center (PHC) which is equipped with medical staff and infrastructural facilities. The details of these are presented in **Annexure IV.22 to IV. 27.** In addition to this, under the Singur Project in eight (8) Rehabilitation centers–viz Marthakeswaram, Kodur, Siroor, Manthoor, Kadirabad, Itkapally, Pulkurthy and Bellapur **(Annexure III.7)**, new buildings have been constructed and Health Sub-Centers were established. These Health Sub-Center have para medical staff along with medical facilities. Beside each of the Rehabilitation center also has been tagged with Auxiliary Nurse Midwife (ANM) visit, who covers each center, minimum once in a week under regular medical care scheme. The ANM, in general as reported, concentrates on health aspects of mother and child, pregnant women in particular and sick persons of the area in general.

3.66 Besides, as reported, regular immunization programmes are also in vogue in the Rehabilitation centers also. The details of immunization carried out in Project Affected Mandals are discussed in **Chapter IV**.

3.67 With regard to functioning of newly established health sub – centers, the field visits and focus – group – discussions revealed that some of these sub – centers have become defunct. According to District Medical and Health Officer (DM&HO) Sangareddy, there is a shortage of required Para medical staff. Therefore, these sub – centers are unable to cater to needed services and the medical services have been suspended temporarily in those centers. They are of the opinion that, if medical facilities are made available within 2 – 5 km, it would be of a great service to them.

3.68 The field survey also revealed that majority of population mostly depended on government dispensaries (allopothy) followed by private medical practitioners. However, particularly older generation, still believed in traditional rural base herbal medicines. In this regard it is noted that out of six project affected mandals, only one government Ayurvedic female doctor is available at Chowtakur (Pulkal mandal), where 13560 patients were treated during the year 2007 – 2008.

Findings of Filed Survey: Fully Affected Households

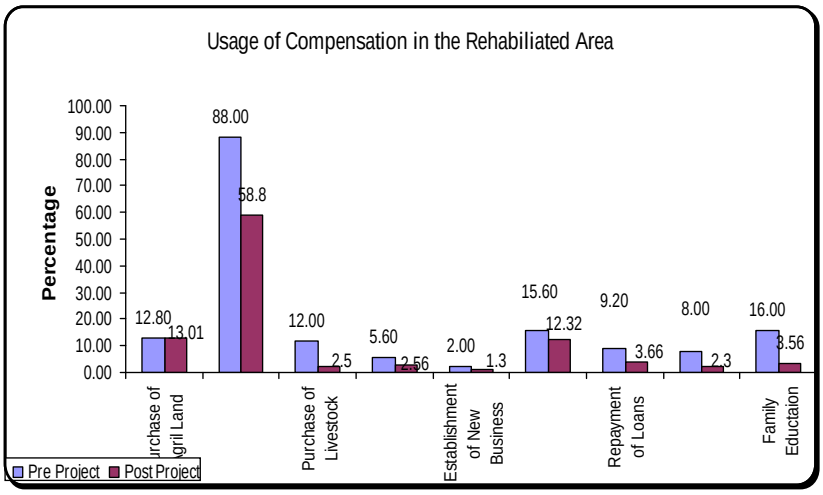
Process of Resettlement and Rehabilitation:

3.69 **Dissemination of Information about submergence of Villages under the Singur Project:** As discussed earlier, the findings of field data also revealed that the majority of project affected families received information for vacating their respective villages (which were coming under submergence) through village meetings (86%), public announcement (71%) notices (62%) and advertisement (31%): in other words, project authorities had taken initiatives to keep them informed about submergence of villages using formal and informal media. The data further revealed that people's response to this was negative as majority of them (83%) expressed the same. However, about six percent

has positive attitude for evacuating their lands and structures and about 11 percent had mix response to it **Annexure III.9**.

3.70 The informal chatting / discussions held by the study team during data collection revealed that, till last minute oustees resisted evacuating the village. However, they ultimately had to evacuate their respective villages as water started entering in their areas (as a result impounding of water in the reservoir).

3.71 **Utilization of Compensation Received:** The study attempted to find out how the compensation amount paid to project affected families has been utilized by them. It is interesting to note that 88 percent of sample oustees have utilized the amount for house construction at Rehabilitation centers to the tune of about 59 percent of their compensation. Besides, 13 percent oustees used the compensation amount for purchasing agriculture lands. Further the data revealed that 16 percent oustees parted their compensation amount (12%) in celebrating marriages.



In addition to this oustees also utilized the compensation amount for family education (16%) purchase of live stocks (12%) and household assets (8%). Twenty three of them used compensation for repayment of loans. About 6% oustees made use of this money in improving their agriculture lands. The details of compensation money utilization are presented in **Annexure III.10** for ready reference.

3.72 **Promises made to oustees for Rehabilitation by Project Authorities:** The project authorities during village meetings, to convince / motivate the villagers to evacuate their village, had made certain promises. The promises made by project authorities included cash compensation for their lands, allotment of house sites, land for land, facilities like road, electricity, health education supply of drinking water, free transport for shifting, providing skill training, constructions of houses, etc., The informal discussions held with the oustees during data collection revealed that to the largest extent these promises have been fulfilled. The infrastructural facilities provided in rehabilitation centers for which they have shown their appreciation during field visits. However, there

were overall dissatisfaction among the PAFs, which could be linked to meager compensation they received for land and structures **(Annexure III.11)**.

3.73 **Difficulties faced in getting Compensation and fulfilling the Assurances:** The detail of this aspect is presented in **Annexure III.12**. From this table it can be noted that for more than 85 percent oustees it was not a smooth transaction, since lot of delays in paying compensation (84%) and harassment in paying compensation (68%). It is to be mentioned here that the oustees, at the time of evacuation, were paid the land and structures compensation, for which they were not happy. As such, to redress their grievances, they sought courts intervention in their matter, and it has taken its own time in settling the matter.

3.74 **Oustees satisfaction towards infrastructural facilities created in Rehabilitation centers:** Oustees of rehabilitation centers, in general have shown their satisfaction towards the infrastructural facilities created by project authorities. This has been discussed earlier also. The data collected on individual items of infrastructure, and sample respondents satisfaction is presented in **Annexure III.13**. It can be noted from this table that sample oustees have shown their satisfaction with regard to roads laid (93%), establishment of Schools (100%), Anganwadi centers (98%), electricity connectivity (82%), street lights (82%) and PDS distribution (98%). However, further analysis of data indicated that about 50 percent have shown their satisfaction for drinking water supply through taps. It is further noted that the sample respondents are not happy with the facilities of veterinary services and health services. During the field visits also it is observed that some of these services have failed to cater to the demands of oustees.

People's Response to the Rehabilitation Programme

3.75 To know the Project Affected People's response towards Resettlement and Rehabilitation programmes implemented under the Singur project, AFC's study team visited about 20 per cent rehabilitation centers (colonies) and held number of Focus–Group–discussion sessions as well as had transact walks in the different wards of Rehabilitation settlements. The observations made during the Focus Group Discussion are presented in **Appendix – A**. The summary of findings on various issues discussed at length and the observation made during transact walk are presented in the following paragraphs.

1. ***Displacement:*** Project affected people were not ready to part with their landed properties (land and structures) despite of lot of efforts from project officials. The key reasons sited by PAPs are:

    - It is our birth place–don't want to leave it–exhibiting their belongingness towards their home lands.
    - Had put their lot of energy in developing their properties.

    They resisted till last minute to leave the place. However when dam water started entering in their dwellings and lands, started leaving the area with displeasure as water level gradually increasing. According to them it was a forced evacuation.

2. ***Loosing fertile lands*:** Majority of the PAPs are found to be very critical about the agricultural lands they are possessing in new settlement. In one voice during FGD pointed out that they lost fertile lands and are now owning lands with very low fertility and settling with most unfertile.

3. ***Loss of irrigation facilities:*** In the old settlement, a good number of acreage of agricultural lands used to be under irrigation from minor irrigation tanks, dug well and bore wells etc., in the new settlement majority of them become depended on rains only, due to lack of adequate irrigation sources.
4. ***Food sufficiency:*** In the old settlement majority of them used to have surplus food grains for domestic consumption, whereas in the present situation it is hand to month situation.

5. ***Compensation paid:*** FGD revealed that their land compensation was very meager which ranged between `. 3000 to 4000 per acre. To redress their compensation grievances, they were forced to take legal support and ultimately in majority cases they were successful. In the process of settlement, they parted to good amount from the settled amount for legal services.

6. ***Loss of land holdings and livelihood:*** From the informal discussions held with oustees it is observed that in many cases due to acquisition of their livelihood based farming lands has affected them. In some of the cases they (marginal and small farmer's), have become landless as they could not purchase land from the compensation they received, which affected their livelihood. In other cases, the big farmers turned into medium farmers. The medium farmers become either small or marginal farmers. It is also noted that the oustees paid a heavy price (`.10,000 to 20,000 per acre) to purchase agricultural lands in new settlement against what they were paid (`.3,000 to 4,000 per acre) initially.

7. ***Infrastructural facilities:*** It was informed and observed also that the drainage lines laid in the new habitation are very shallow and in many cases got silted also.

Additional Observations

3.76 Besides above concerns, the oustees also had appreciation for the new environment created in the Rehabilitation centers by the project which is as follows:

- ⇒ Planned residential layouts.
- ⇒ Laying of new wide roads.
- ⇒ Pacca drainage
- ⇒ Establishment of health – sub – centers.
- ⇒ Establishment of Veterinary dispensaries
- ⇒ Street and Domestic power connectivity.
- ⇒ Bus Connectivity

⇒ School facility

3.77 Oustees expectation from Project included the following

- Adequate drinking water supply.
- De-siltation of drainage lines laid.
- Improvement in medical and health services.
- Improvement in veterinary health services.
- Constructions of Worship places.
- Bus connectivity on regular basis.
- Adequate irrigation facilities from Singur dam (Lift irrigation).
- Full Settlement of compensation at an early date for those whose cases are still pending.
- Regular agriculture extension guidance for improving crop yields.

Findings of Filed Survey: Partially Affected Households

Land Acquisition in Partially Affected Areas

3.78 As stated earlier, the partially affected households are those whose only land has been acquired by the project authorities, which ultimately got submerged under water spread, area of Singur reservoir.

3.79 The lands which come under submergence (Partially affected areas) are found to be of two types i.e., irrigated as well as rainfed. From the data analysis it is noted that 21 household's irrigated land and 43 farmers' rainfed lands came under submergence. Some of these 21 and 43 households' irrigated as well as dry lands together have come under submergence. Besides, there are 3 dry land owners whose total land has been acquired due to submergence.

3.80 Further, analysis of data on land acquisition indicated that about 66 per cent irrigated land and 49 per cent dry lands have been acquired by the project authorities from the total land holdings of the sample households. The details of the land acquisition of the sample are presented in **Annexure III.14 and III.15**. In all to the extent of about 54 per cent of land holdings (Irrigated and Rainfed lands) have been acquired which came under submergence of water spread area of Singur reservoir.

Utilization of Compensation money by the Partially Affected Households

3.81 The partially affected households were compensated against the acquisition of land in cash into two to three installments, in most of the cases, as per the court directions. It is to be mentioned here that earlier, the affected households were paid the amount as per the decision taken by the project authorities and varied from ` 2500 to ` 4000 initially for which affected persons were not satisfied and sought the courts

interventions. As such ultimately they were paid compensations as per the court decisions.

3.82 Through study it is tired to find out in what way the compensation received has been utilized by the concerned.

3.83 In this regard, inferences drawn from data analysis indicated that compansation beneficiaries invested the compansation amount in repairs / construction of houses (36%) and celebration of marriages / functions (21%). Besides, about 23 per cent sample farmers utilised their compansation amount (9%) in improving their land capabilities. In addition to this about 28 per cent of sample respondents invested their compansation in purchase of land (7%) and livestock (4.2%) which indicates meaningful investment which is directly related to their livelihood.

3.84 Data further revealed that the sample households (22%) also used the money received (7% of it) in repaying loans they had borrowed. The other items on which they spent the compansation amount were such as education, household assets etc. The details of utilization of compansation amount are presented in **Annexure III.16 and III.17.**

Standards of Living of Oustees in New Location

3.85 Standard of living denotes a level of quality or excellence of living conditions and sometimes it is measured between two different time spans. In general, it referred to the level of quality of everyday life with regard to wealth and comfort.

3.86 In the present context, the oustees of submerged villages 33 of Singur reservoir have been rehabilitated in 29 new locations. These oustees re-established themselves in their new locations after their displacement from old habitation.

3.87 To compare the pre and post project scenario of oustees regarding the changes in living standards, the following variables have been considered.

1. Family size
2. Literacy
3. Housing condition – Pacca, Semi pacca, katcha
4. Asset position – Bicycle, Two wheeler, Television, Mobile
5. Livelihood base – Landholdings, wages
6. Income' Expenditure and Savings

3.88 Taking all the indicators mentioned above into consideration, it is observed to be mixed picture positive changes as well as negative when these are compared with pre and post project situations. These are presented here under.

1. Family Size: No changes are observed in sample families in total population in two situations i.e., pre (1460) and post (1462) project scenario. Similarly average family size was during pre project stage 5.84 and 5.85 during post project stages. This indicates the average size remained constant.

2. Literacy: An impressive improvement and changes in literacy rate is found among the sample households. The literacy rate of pre-project period was 20 per cent which increased to 45 per cent during post project situation. This indicated an improvement of 25 per cent during post-project period. During this period the female literacy rate has gone up by only 24.45 per cent while there was an increase of over 33.23 per cent among males. However, overall literacy has gone up by 25 per cent as stated earlier.

3. Housing conditions: Housing conditions is one of the important variables of living standard. Positive changes with regard to housing conditions in post project situation over the pre project are found. From the data analysis it is noted that 23 per cent of dwellers who lived in Katcha houses during pre-project period started dwelling in semi pacca houses in post project situation indicating positive changes in their dwellings which is a sign of improvement. In case of pacca houses, the number is just doubled in post-project situation (21) over the pre-project (10). One of the important factors in improving the housing conditions is economical conditions of the subjects and this has happened due to allotment of free sites, constructed houses to identified weaker sections, grant for house construction as well as utilization of part of compansation amount in improving / constructions of houses. The changes as described above can therefore be attributed to the project impact.

4. Household Assets: Positive changes in possession of materialistic articles from pre-project to post-project situations are observed which have multiplied several times among the sample household. The improvement in ownership was observed in case of Television (from 9 to 125 in nos.,), mobiles (from 0 to 101 nos.,), bicycle (from 49 to 98 in nos.,), two wheelers (from 6 to 25 nos.,), four wheelers (0 to 8 in nos.,), refrigerators (0 to 3 in nos.,), etc. This indicates improvement of economical conditions of oustees. The sudden improvement of economical conditions of subjects can be attributed to compansations they received for their landed properties (land and structural) and grants which was utilised for purchase of the articles they possessed during post project situations.

5. Loss of land and livelihood: From the study it is observed that in many cases due to acquisition their cultivable land this livelihood is badly affected. In some of the cases they (marginal and small farmers) have become landless as they could not purchase land from the compensation they received. In other cases, the big farmers became medium farmers. The medium farmers become either small or marginal farmers. Further, it is also noted that the oustees paid a heavy price (`.10,000 to 20,000 per acre) to purchase agricultural lands in new settlement.

3.89 From the field survey it is observed that the total holding of sample farmers came down from 559.86 ha to 228.14 ha during post project. The average size of landholding during pre-project was 2.24 ha which came down to 0.79 ha per sample farmer. It is to be mentioned here that 31 landholders of pre-project became landless during post-project.

3.90 The artisans and wage labourers were affected even though, as their professions have been intact even after implementation of the project. This was mainly because the

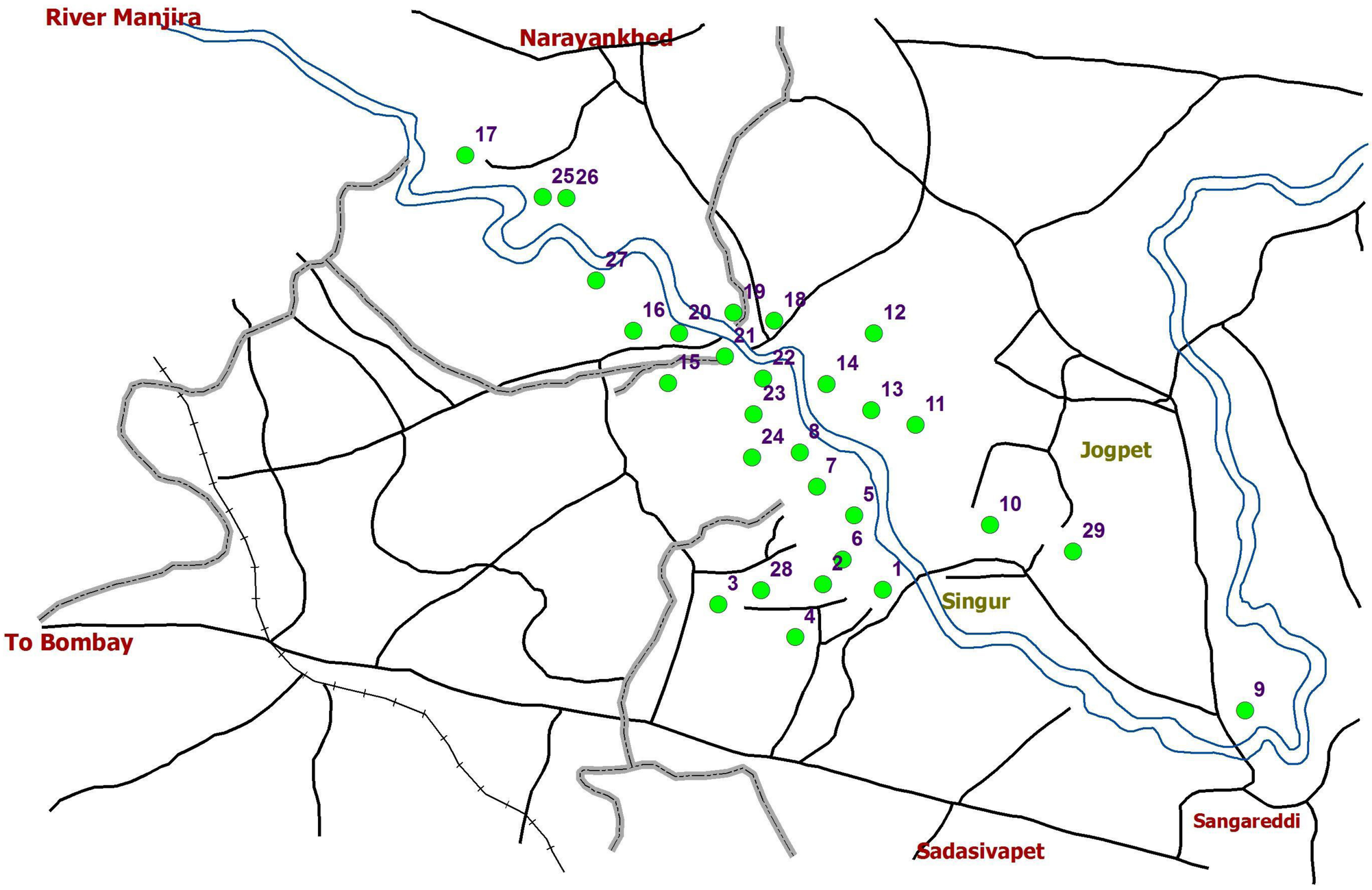
wage employment at the village level in rehabilitated villages due to decreased landholding. Further, the same number of wage employment days was shared by increased number of wage seekers.

6. Income Expenditure and Savings: It is a difficult task to collect and ascertain one's income and expenditure. Reliability of data has been at stake for its validation due to the limitations already expressed. However, it gives some trend of this variable.

3.91 Thus, the data collected and analysed on this variable from sample households revealed that on an average income per household during pre-project was ` 32495/- whereas, the same after project raised to ` 49403/-. However, the increase in absolute terms is insignificant, if we take the inflation rate of 20 years in to account which has multiplied several times from the base year (pre-project), indicating no change or negative change.

3.92 With regard to expenditure savings the data revealed that on an average income per household during pre-project was ` 32491/- and average expenses were only ` 19,125/- leaving a saving of ` 13366/- which had some meaning to them. But when we look at the post project situation, the average income per household is ` 49403/-, the average expenditure per household is ` 46579/- leaving hardly a meager saving of ` 2824/-. This indicated a trend of dwindling savings.

Fig 3.1
Index Map Showing the Rehabilitation Centers of SIngur Irrigation Project



SNO	Descriptio
1	BUSSAREDDIPALLI
2	MALLIKARJUNAPALLI
3	TAKKADAPALLI
4	ALLAPUR
5	MAKTHAKYASARAM
6	GARLAPALLI
7	BELOOR / KALAPALLI
8	KODUR
9	CHAKRIYAL
10	MANTHOOR
11	KHADIRASAD
12	OSRIKAPALLI
13	NIRJIPALLI
14	PALADUGU
15	PEEPALPALLI
16	SIROOR
17	ATIMIYAL
18	RAIPALLI
19	JANGAM OSRIKAPALL
20	DOULTHABAD
21	MORATGA
22	MAMIDIPALLI
23	SOGULAMPALLI
24	INDUR
25	PULKURTHI
26	BELLAPUR
27	ITKEPALLI
28	LONIKURDH
29	PEDDAREDDYPET

PHOTOGRAPHS OF REHABILITATION CENTRES OF SINGUR PROJECT
(As on 12/8/2009 & 18.12.2009)

Approach Road of Rehabilitated Center

Drying the Produce by Project Affected Farmers

Water Troughs constructed by the Project Affected Farmers

Drinking Water Cistern erected in Rehabilitation Centre

Poor Drainages in Rehabilitated Area

Worship place constructed by Oustees in Rehabilitation Area

Survey Team gathering information from PAF's

Gram Panchayat Building Constructed by Project Authorities in Rehabilitated Centre

Hand Pump installed in Rehabilitated Centre

Primary School building constructed in Rehabilitated Center by Project Authorities

Housing colony of Rehabilitation Centers

Construction of Houses by Project Authority

Bi-lane Internal Road of Rehabilitated Centre

Electricity connectivity in Rehabilitated Centre

Health Sub-Centre constructed in Rehabilitated Centre

Veterinary Health Clinic constructed in Rehabilitated Centre

Pucca House constructed by Oustees in the Rehabilitated Centre

Silted of Drainage Channels in Rehabilitation Area

Part – I

4
Socio-Economic Impact

AFC, Hyderabad

4

SOCIO-ECONOMIC IMPACTS INCLUDING CHANGES IN LITERACY AND EMPLOYMENT

Introduction

4.01 Singur River Valley Project commenced in the year 1976 is intended to augment drinking water supply to the twin cities of Hyderabad and Secunderabad. As per the history of the project, water was first impounded in the Reservoir in the year 1989.

The construction of Dam resulted in the submergence of 72 villages situated in six mandals of Medak district. They are as follows:

- Pulkal;
- Munipalle;
- Regode;
- Raikode;
- Nyalkal; and
- Manoor

4.02 However, out of 72 villages, 33 villages got fully submerged and the balance 39 villages were submerged partially. While land and houses were submerged in 33 villages, only lands got submerged in the balance 39 villages. In all nearly 11633 families got affected. The project-affected families were resettled in the peripheral and adjoining villages and rehabilitation plans were implemented. An attempt is made in this chapter to assess the impact of the project in the project-affected zone.

4.03 Further, these aspects are not studied in the command area, since the project did not support any command area development until date. However, a detailed project plan was prepared for providing irrigation to 16, 000 ha of command area under the project which is still under implementation. Hence, socio-economic impacts due to the project are studied in the villages / mandals adjoining the submerge area.

4.04 The submergence of the villages in the affected mandals and the consequent displacement of the project-affected persons caused impact on the socio-economic conditions of the persons. As per the terms of reference, the following sub-indicators of socio-economic importance are studied and presented in this chapter.

a) Details of status of schools / teaching staff, student turnover,
b) Improvement in Male-Female literacy, evaluation of adult education programs provided if any.
c) Response to education provisions and assessment of constraints

d) Post-project occupational options that have arisen in the region and their relevance to the project impact
e) New educational, Cultural, Recreational access and commercial (Markets, Banks etc.,) facilities that have come up in the post-project situations and their relevance to the project impact
f) Incidence of some important diseases in post and pre-project situations
g) Health care infrastructure in the post and pre-project situation
h) Human development index (to the extent the data is available) in the post and pre-project situations.

4.05 The changes in the conditions are also brought about in the surrounding environment due to increased economic opportunities wherever available or due to deprivation of the same. Thus, the study aimed at trapping the changed environment in respect of economic and commercial activities.

Methodology

Approach

4.06 The socio-economic study is conducted keeping in view the scenario as described in the introductory narration. Accordingly the year 1989-90 when the water was first impounded is taken as the pre-project period since by that time the affect on the then existing habitats was full and complete. The study is confined to the 6 affected mandals as indicated above in respect of the indicators mentioned above. The situation obtained in various areas (Sub-Heads) is compared with that of the recent agricultural year from the secondary source of information. Computations for the post project period is made with the year 2007-08 and the situation before and after completion of the project are analysed.

Selection of Sub-Heads / Indicators

4.07 In order to understand the improvements or deprivations in the main and prime indicators, studies are conducted on various sub-indicators related to the main indicator. The relevance of the item and its relation to the main indicator is seen while selecting the sub-indicators. The various sub-indicators thus selected are given under each main indicator for drawing necessary conclusions for the purpose of the study.

Data Collection for Project Affected Mandals

4.08 The data collection for this report is done in two ways. The authentic and published data of the concerned departments in the district and the data from the Directorate of Economics and Statistics are used. Secondly, interactions with the concerned department through structured interview schedules are made to substantiate and corroborate the published data and as well as to collect additional information wherever required.

4.09 Since, the rehabilitation of displaced persons occurred in the same mandals affected through submergence. The study of both pre and post project situations is done for the same set of mandals. The observations derived from secondary data were supplemented with the results of a primary survey of the affected families selected on Random Sample basis. The primary data was collected through a pre-designed survey schedule and was used for triangulation with the secondary data.

4.10 The findings from various indicators of the project-affected mandals are also compared with the situation in the non-project mandals. The data for the non-project mandals is taken as the absolute difference between the aggregates of project mandals and the data obtained for the district as a whole.

Data Tabulation and Analysis

4.11 The data from the secondary source of information including the authentic published data from Directorate of Economics and Statistics is tabulated in the pre designed tables and the analysis is done using simple statistical tools such as mean, mean differences, averages and percentage variations to present the situation in project as well as non-project mandals.

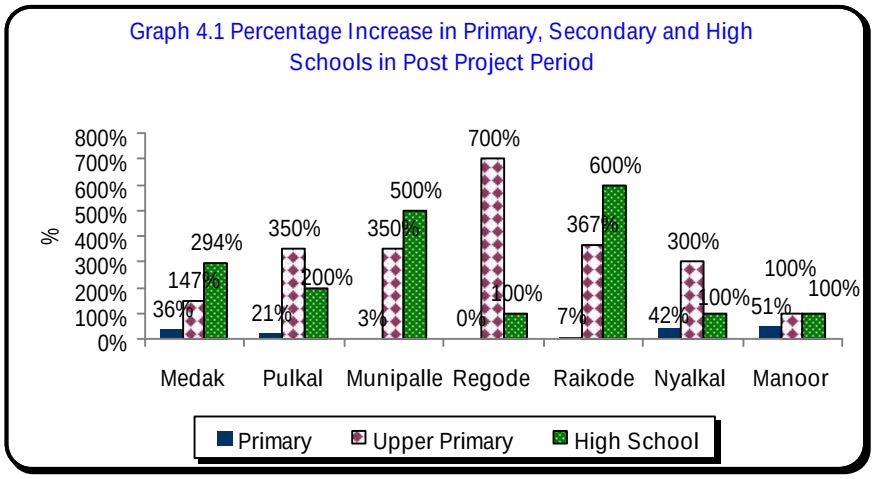
Details of Status of Schools / Teaching Staff / Student turn over

4.12 There is overall percentage increase in Medak District in respect of schools and teachers (Primary, Upper Primary and High school) as compared to Pre-project situation. However, in case of project mandals with regard to Primary schools it is observed that percentage increase was low as compared to Upper primary and High schools. The consolidated picture of the same is depicted in **Table 4.1 and Graph 4.1**. It is therefore, seen that appreciable efforts are made during post-project situation to improve literacy rate in the district. Even in the primary school sector though the increase in school is low as compared to other levels, there is increase in number of teachers, which indicate higher enrollment in primary schools.

Table 4.1
Status of Schools & Teachers in Post-Project Period

Sl. No	Particulars	Primary	Upper Primary	High School
1. Post-Project % increase in No. of Schools				
A	Medak District	36%	147%	294%
B	Pulkal Mandal	21%	350%	200%
C	Munipalle Mandal	3%	350%	500%
D	Regode Mandal	0%	700%	100%
E	Raikode Mandal	7%	367%	600%
F	Nyalkal Mandal	42%	300%	100%
G	Manoor Mandal	51%	100%	100%

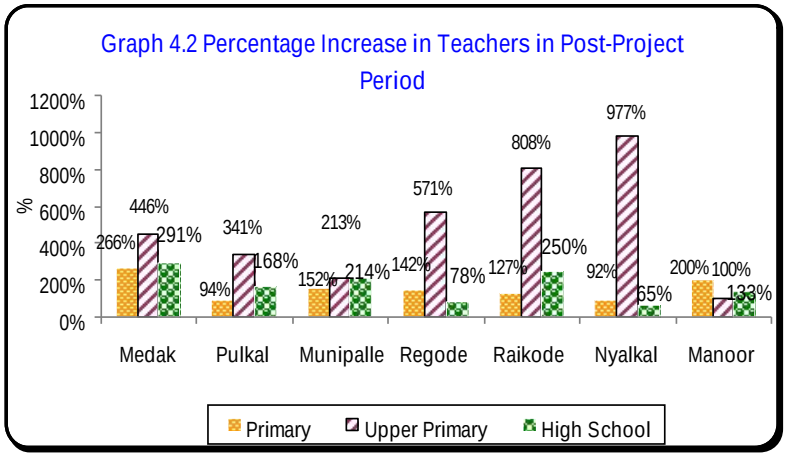
For details Refer Annexures-IV-1 to IV- 2



Increase in Number of Schools:

4.13 The district had registered an increase of 36%, 147% & 294 % in primary, upper primary and high schools respectively. The project-mandals have also shown significant increase in upper primary and high schools whereas it is seen in both district as well as affected mandals that the increase in primary schools is negligible. The increase in upper primary schools in Regode mandal is notably high.

Increase in Teachers:



4.14 The district had registered an increase of 266%, 466% and 291 per cent in primary / upper primary and high schools. Project mandals have also shown significant increase in number of teachers in all categories of schools. The increase in number of teachers at Nyalkal mandal in upper primary schools is notably high (977%).(**Graph 4.2** and **Table 4.2)**.

Table 4.2 Post Project % Increase in Teachers				
Sl. No	**District / Mandal**	**Primary School**	**Upper School**	**High School**
A	Medak District	266%	446%	291%
B	Pulkal Mandal	94%	341%	168%
C	Munipalle Mandal	152%	213%	214%
D	Regode Mandal	142%	571%	78%
E	Raikode Mandal	127%	808%	250%
F	Nyalkal Mandal	92%	977%	65%
G	Manoor Mandal	200%	100%	133%

4.15 When we compare the increase in teachers with that of increase in schools in respect of primary schools, it is observed that though the increase in number of primary schools is low there is increase in number of teachers. This may be due to increase in number of students in the primary schools though new schools have not come-up as in the case of upper primary and high schools.

Student Turn Over and Student Teacher Ratio

4.16 In post project situation it is seen that as many as 2.97 lakh students were enrolled in primary schools for district as a whole and the student teacher ratio stand at 30:1. Mandal wise breakup is not available.

4.17 In upper primary schools, 1.02 lakh students were enrolled for district as a whole and the teacher – student ratio is 15:1. Mandal wise break-up of this information is not available.

4.18 There is appreciable enrollment of students as well as employment of teachers in post-Project situation in all categories of schools. The details are given in **Annexure IV.1.**

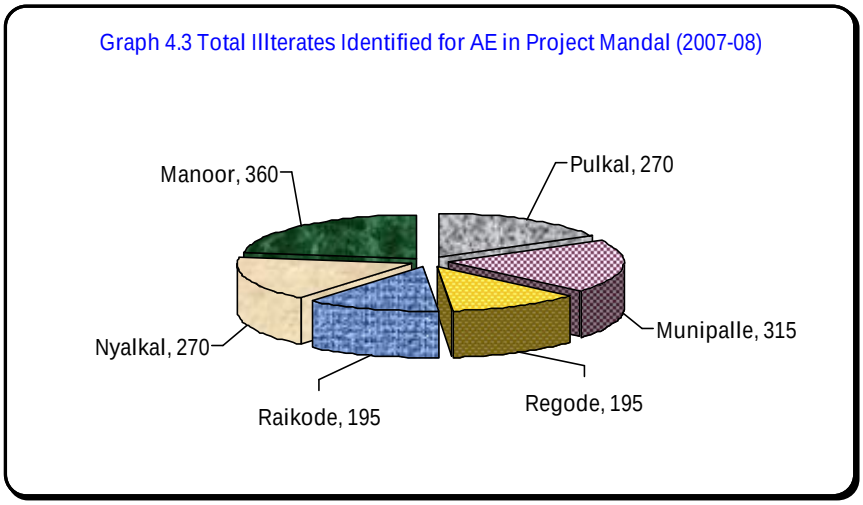
Adult Education (AE) Programs:

4.19 During the pre-project period, there were 900 AE centers in the district and these centers were spread over three divisions namely Sanga Reddy, Narayankhed and Siddepet. The enrollment under each project was 9000 and for all the projects combined, the enrollment was 27000. There were exclusive centers for SC & ST to improve their functional literacy levels. Similar exclusive centers were established to improve female literacy.

4.20 In the post-project situation, much emphasis was given for literacy and the project has been carried through national literacy programmes. There was a swift form limited project approach to that of a continuing literacy programme. It is seen that in each mandal new centers were opened in nook and corners of the Mandals. There are 1102 such National Literacy Mission (NLM) centers spread over all the 45 mandals. During 2007-08, as many as 16530 illiterates were identified and they are being given the basic educational skills. This programme is widely spread covering almost all the villages in

the mandals. The scenario in project mandals is given in **Table.4.3.** The graphical presentations of these details are given in **Graph 4. 3.**

Table 4.3 Illiterates identified in project mandal and Literacy Centers			
Sl. No	**Name of the Mandal**	**Total No of Illiterates identified 2007-08**	**No .of Literacy Centers Functioning**
1	Pulkal	270	18
2	Munipalle	315	21
3	Regode	195	13
4	Raikode	195	13
5	Nyalkal	270	18
6	Manoor	360	24
Source: Compiled from District Hand Book of Statistics			

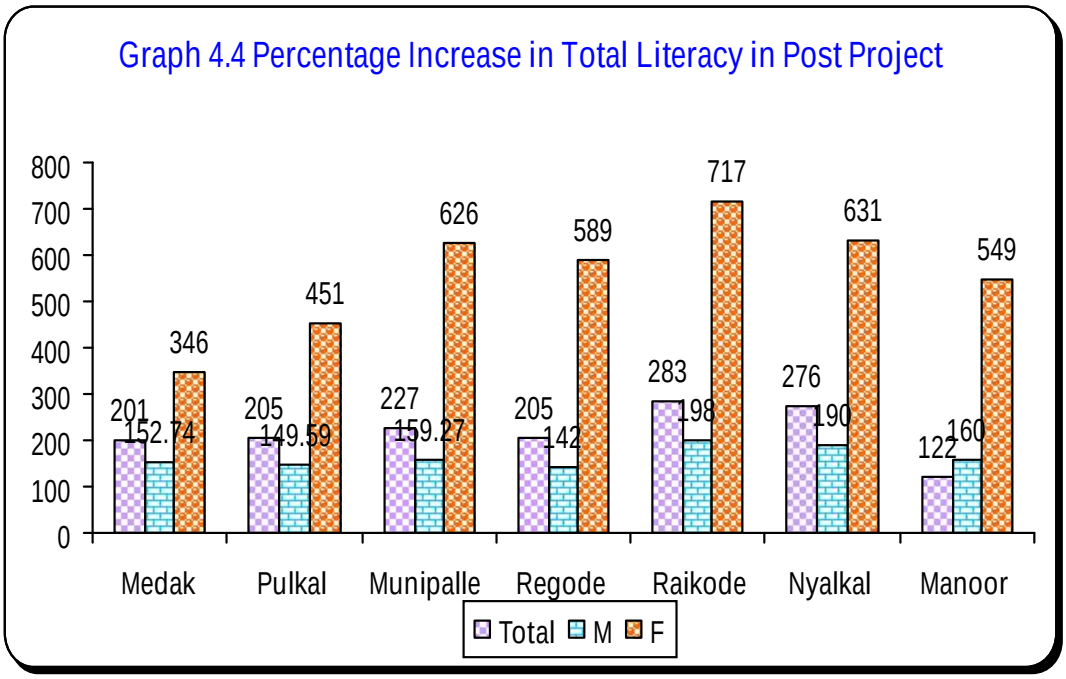


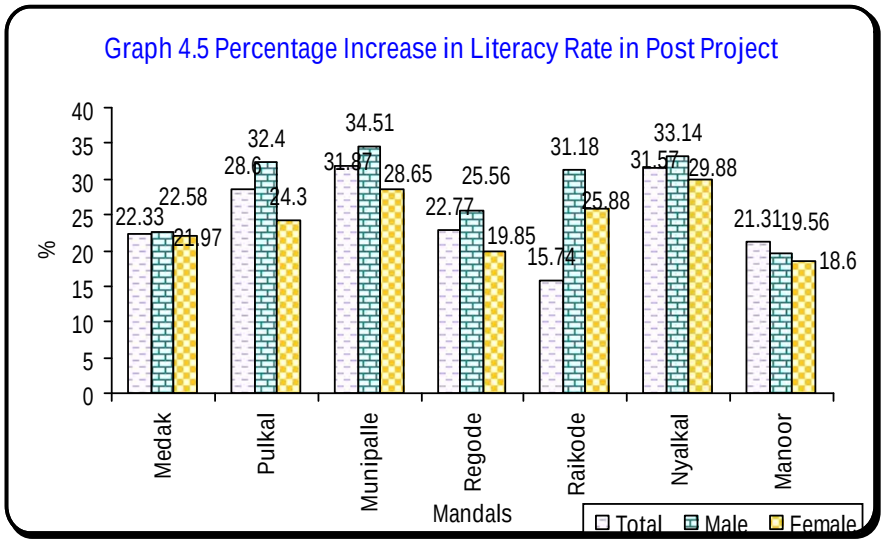
Percentage Increase in Total Literates and Literacy Rate

4.21 The total population of the district during post-project period stood at 26.7 lakh of which 11.71 lakh are literates. The Male literates are 7.38 lakh and Female literates are 4.33 lakh; these details are presented in **Table 4.4** and **Graph.4.4**. There is a tremendous growth of literates amongst women in post-project situation when compared to pre-project period. The percentage increase in literate women recorded 346 per cent where as the same for men it is 152 per cent at the district level. The graphical presentations of these details are given in **Graph 4.5.** The overall increase was 201 per cent. The higher rates of increase in women are due to number of women oriented programs particularly the Self Help Group (SHG) movement, which brought awareness amongst women. The percentage increase in literacy rate in district in post project situation is 22.33 per cent compared to pre project situation. The literacy rate was 21.52 per cent, which went upto 43.85 per cent. The male, female literacy rate was 32 per cent and 10.90 per cent in pre project, which grew up to 54.58 per cent and 32.87 per cent respectively **Graph 4.5). Annexure IV.3** gives further details in this regard.

Table 4.4
Percentage increase in Literacy rate from Pre-project situation Total Literates

Sl. No	District / Mandal	Total Population (in lakh)	Post Project Literate(Lakh)			% Increase in from Pre Project			Refer Annexure No. given below for details
			M	F	T	M	F	T	
1	Medak District	26.7	7.38	4.33	11.71	152.74	346	201	**IV.3**
2	Pulkal Mandal	0.48	0.12	0.07	0.18	149.59	451	205	**IV.4**
3	Munipalle Mandal	0.36	0.1	0.05	0.15	159.27	626	227	**IV.5**
4	Regode Mandal	0.33	0.07	0.03	0.1	142	589	205	**IV.6**
5	Raikode Mandal	0.37	0.08	0.05	0.13	198	717	283	**IV.7**
6	Nyalkal Mandal	0.53	0.13	0.08	0.21	190	631	276	**IV.8**
7	Manoor Mandal	0.52	0.10	0.05	0.15	160	549	122	**IV.9**





4.22 In Pulkal mandal out of 0.48 lakh 0.18 lakh are literates and the overall increase in percentage of literates stood at 205 per cent. Here again the increase in women literates is 150 per cent and that of men is 451 per cent. In Munipalle mandal out of 0.36 lakh of population, 0.15 lakh are literates and the overall increase in percentage of literates compared to pre-project is 232.55 per cent. The increase in women literates is 626 per cent and that of men is 159 per cent. The percentage increase in literacy rate in Pulkal mandal is 28.60 per cent. The increase in male literacy rate in post project is 32.40 per cent, whereas, in female literacy is 24.30 per cent **(Annexure IV.4)**. In Munipalle mandal the total literacy rate grew by 31.87 per cent while, that of male and female literacy grew by 34.51 per cent and 28.65 per cent respectively. **(Annexure IV.5)**.

4.23 In Regod mandal out of 0.33 lakh of population, 0.10 lakh are literates and the overall increase in literates stood at 205 per cent. The increase in women literates is 589 per cent whereas the increase is men literates are 142 per cent. The percentage increase in total literacy rate grew by 22.77 per cent and that of male and female by 25.56 per cent and 19.85 per cent respectively in Regode mandal **(Annexure IV.6)**.

4.24 The highest percentage increase of women literates is noted from Raikode mandal (717%) and men literates' percentage increase is 198 per cent. Similar trends are observed in Nyalkal and Manoor mandal also. The overall increase in literates in Raikode, Nyalkal and Manoor stood at 283, 276 and 122 respectively. In Raikode mandal, the percentage of increase in literacy rate for total grew by 15.74 per cent the male literacy by 31.18 per cent and female literacy by 25.88 per cent **(Annexure IV.7)**. The Nyalkal mandal registered a growth of 31.57 per cent in total literacy rate and 33.14 per cent and 29.88 per cent in male and female literacy rates respectively **(Annexure IV.8)**. In Manoor mandal, the total literacy rate in post project situation grew by 21.31 per cent and the male and female literacy rate grew by 19.56 per cent and 18.60 per cent respectively.

Comparison of Literacy Rates in Project and Non-Project Mandals

4.25 The increase in number of literates registered a growth of 235.64 per cent in project mandals during post project period in comparison to pre project situation. This growth in non-project mandals is assessed to be 198.34 per cent. The growth in number of female literates is found to be much higher as compared to the growth in number of male literates in both project and non-project mandals. Increase in rate of literacy among females in both project and non-project mandals was higher as compared to that of males **(Table 4.5).**

Table 4.5
Changes in Number of Literates and Rate of Literacy in Project and Non-Project Mandal during Post Project Period (1989-90 and 2008-09)

S. No	Mandal	% increase in number of Literates			Increase in Rate of Literacy (%)		
		M	F	T	M	F	T
1	Project Mandals	166.01	575.20	235.64	21.28	24.43	20.74
2	Non-Project Mandals	151.67	700.81	198.34	22.65	27.47	22.47

For details Refer Annexure-IV- 10

4.26 The percentage of increase to total population stood at 20.74 per cent for project mandals and 22.47 per cent for non-project mandals. Overall, the non-project mandals had shown marginal higher performance in absolute as well as to total population in literacy rates. There appears to be a need to enhance literacy programs in project mandals to bring them on par with the district averages.

Response to Education Provisions and Assessment of Constraints

4.27 Though the real situation on the response to the education provisions is discussed based on the primary survey, it appears in general from the analysis of literacy rate, the increased and imperative need for providing more opportunities in the project-affected mandals.

Population Growth

4.28 There is increase in population to an extent of 48 per cent in the district and in the affected mandals; the increase is from 26 per cent to 51 per cent. Manoor mandal had highest increase of 51 per cent. However, the sex ratio has declined in the district as well as affected mandals due to slower rate of increase in Female population. As per the field survey, the females per 1000 males during pre-project situation, which stood at 836, had improved to 886 in post project situation indicating enhanced awareness and health care for the girl child during post project situation. The density of population per Sq Kilometer has gone up by 47 per cent in the district and in the mandals; it is minimum of 27 per cent in Pulkal and maximum of 44 per cent in Nyalkal mandal, the presentation of these details are presented in **Table 4.6.**

Table 4.6
Population Growth in District and Project affected Mandals

Sl. No	Indicators	District	Pulkal	Munipalle	Regode	Raikode	Nyalkal	Manoor
1	% increase in Population	48	26	32	42	43	46	51
2	% increase in Male	48	28	34	42	46	46	53
3	% increase in Female	47	24	29	42	39	45	48
4	% increase in Sex Ratio	-1	-3.03	-4	-0.21	-4	-1	-3
5	% increase in Density per Sq. Km	45	27	32	42	5	44	43

For details Refer Annexure IV.11-IV.17

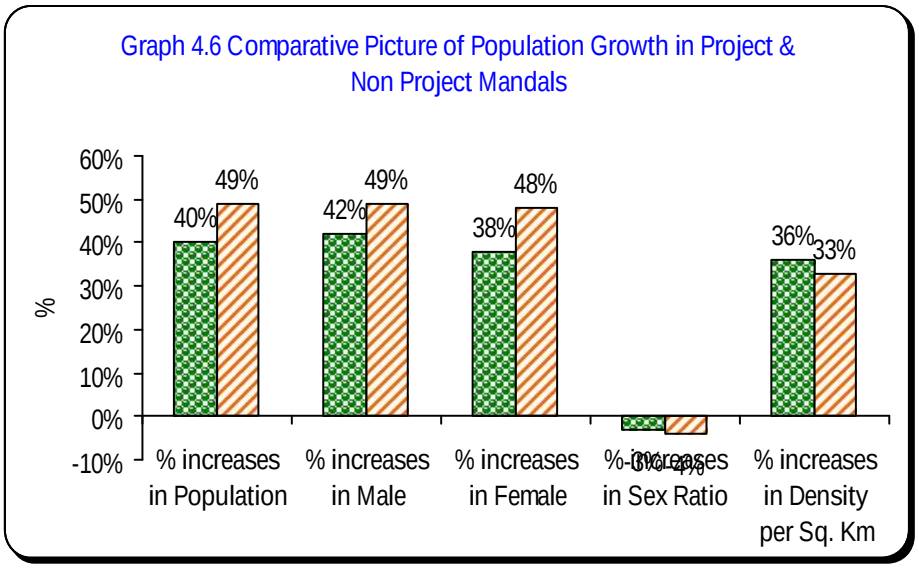
Comparison of Population Growth in Project & Non-Project Mandals

4.29 The percentage increase in population in total as well as male and female is higher in non-project mandals compared to project mandals. This may be mainly because some district in the state. The Sex Ratio, however, has declined more in project mandals than fo the project affected families migrated to other mandals in the district and to other non-project mandals. The density of population per Sq. Kilometer has gone up by 36 per cent in project mandals than in non-project mandals (33%). The details of these are presented in **Table 4.7** and **Graph 4.6**

Table 4.7
Growth of Population in Project and Non-Project Mandals

Sl. No	Indicators	Project Mandals	Non-Project Mandals
1	% increases in Population	40	49
2	% increases in Males	42	49
3	% increases in Females	38	48
4	% increases in Sex Ratio	-3	-4
5	% increases in Density per Sq. Km	36	33

For details Refer Annexure IV.18



Population Vs Workers

4.30 The percentage of total workers to total population has gone up after the project in the district as well as in the project affected mandals indicating opening of more avenues for employment. In the district, it has gone up by 4 per cent. In Manoor mandal, the increase is 6 per cent whereas in Pulkal mandal it is 8 per cent. In contrast, Munipalle mandal registered a decline of 1 per cent of workers to total population **(Table4.8)**.

Table 4.8
Increase / Decrease of workers to the total population before and after the project

Sl. No	District / Mandal	Total Population in Lakh		Total Workers in Lakh		Workers % to Population	
		Before	After	Before	After	Before	After
1	Medak District	18.74	26.19	8.09	12.92	44	48
2	Pulkal Mandal	0.38	0.48	0.17	0.25	44	52
3	Munipalle Mandal	0.27	0.36	0.13	0.17	48	47
4	Regode Mandal	0.23	0.33	0.11	0.16	47	48
5	Raikode Mandal	0.26	0.37	0.12	0.17	46	46
6	Nyalkal Mandal	0.36	0.53	0.17	0.26	47	49
7	Manoor Mandal	0.35	0.52	0.14	0.24	40	46

Pre & Post Project Occupational Details

4.31 The occupational categories and their changes in post project situation is studied to understand the nature of occupations as well as the occupational changes in different categories and the findings are presented in the following paragraphs.

4.32 The total workers have increased in both district as well as project affected mandals in a range of 35 per cent to 68 per cent, of which it is significantly seen that the female workers had increased substantially to that of male workers. The increase in

female workers ranged from 46 per cent to 142 per cent whereas the male workers increased from 22 per cent to 42 per cent. However, the cultivators especially the male cultivators have declined by 3 per cent to 17 per cent except in Raikode where 22 per cent increased is observed. There is growth in female cultivators by 17 per cent to 174 per cent, the highest being in Manoor mandal (174%). The growth of female cultivators is found to be more in Manoor, Raikode and Nyalkal mandals which ranged from 131 per cent to 174 per cent.

4.33 The agricultural labor has increased substantially both in the district as well as in project affected mandals by 48 per cent to 106 per cent. The male agricultural labors have increased more than female labors in Pulkal & Munipalle. Some of the cultivators appear to have become laborers. The increase in male workers in household industry as well as others is more than that of the females. The decline in cultivators during Post-Project period is noticeable and alarming, which needs special supportive measures to be given to the farming community to ensure sustainable farming. The details of district and mandals are presented in **Table 4.9.**

Table 4.9
Percentage Change occurred in occupation in district and project affected Mandals from Pre to Post Project Situation

Sl. No	% Changes in Nature of Workers	Medak %	Pulkal %	Munipalle %	Regode %	Raikode %	Nyalkal %	Manoor %
1	Total Workers	60	41	35	52	50	54	68
2	Total Male Workers	42	38	22	35	35	35	38
3	Total Female Workers	92	46	60	81	79	89	142
4	Total Cultivators	7.53	0	-0.08	-7	45.29	29	30
5	Male Cultivators	-4	-10	-13	-17	22	2	1
6	Female Cultivators	37	32	49	17	159	131	174
7	Agri Laborers	86	48	70	106	49	61	103
8	Male Labors	82	56	73	100	41	60	82
9	Female Labors	88	43	68	111	58	62	130
10	Workers in HH Industry	95	-8	1	4	22	77	8
11	Female workers in HH Industry	147	56	167	179	232	326	180
12	Other workers	154	62	63	150	66	91	77
13	Other Male workers	120	60	75	134	45	67	67
14	Other Female workers	352	71	14	253	107	307	149
Refer Annexure for detailed		**IV.19**	**IV.20**	**IV.21**	**IV.22**	**IV.23**	**IV.24**	**IV.25**

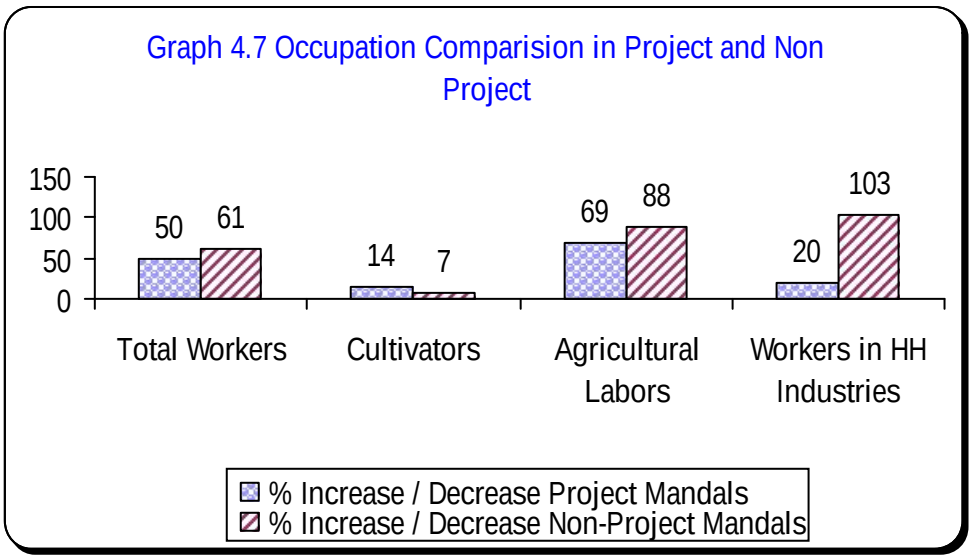
Occupation Comparison in Project and Non- Project Mandals

4.34 It is seen from **Table 4.10 and Graph 4.7** the percentage increase in total workers including male and female in project mandals is found to be lower when compared to non-project mandals, which indicates lack of wage employment opportunities. Further, it is observed that increase in total workers in household industry is 103 per cent in non-project mandals, whereas it is only 20 per cent in project mandals, which indicates lack of growth of household industry in project mandals.

Table 4.10
Percentage Increase/ Decrease with respect to occupation in project and non-project Mandals

Sl. No	Particulars	% Increase / Decrease	
		Project Mandals	Non-Project Mandals
1	Total Workers	50	61
	a) Male	34	43
	b) Female	79	97
2	Cultivators	14	7
	a) Male	-4	-4
	b) Female	77	34
3	Agricultural Labors	69	88
	a) Male	66	86
	b) Female	73	91
4	Workers in HH Industries	20	103
	a) Males	-24	53
	b) Female	202	145

For details Refer Annexure IV-26



Status of Educational, Recreational access and Banking facilities

4.35 The following paragraphs give the situation about the status of facilities for educational, recreational, and commercial banks in the project area:

Educational Institutions

4.36 It is seen from **Table.4.11** that the educational institutions including Jr. and Degree Colleges have gone up from 25 to 156 in the district primarily due to opening of

number of junior colleges. It is noted that the project-affected mandals have also seen growth of the junior colleges in Pulkal, Manipalle and Regode mandals in post – project situation.

4.37 The cinema houses have gone up in the district from 39 to 51, but the entire growth is in non-project mandals. The project-affected mandals had no cinema talkies either in pre project or in post project situation.

Table 4.11
Growth of Educational Institutions

Distrct/Mandal	Project (Pre/Post)	Primary School	Upper Primary School	High schools	Jr. College	Degree College	Total
Medak District	Pre	1415	217	173	19	6	1830
	Post	1933	537	484	116	40	3110
Pulkal Mandal	Pre	28	4	4	-		36
	Post	33	9	9	1		58
Munipalle Mandal	Pre	29	4	2	-		35
	Post	30	9	12	1		52
Regode Mandal	Pre	27	1	2	-		30
	Post	27	8	6	1		42
Raikode Mandal	Pre	30	3	3			36
	Post	32	14	6			52
Nyalkal Mandal	Pre	38	3	3			44
	Post	51	12	7			70
Manoor Mandal	Pre	43	2	3			48
	Post	65	14	6			85

Source: Compiled on the basis of Statistical Hand Book of Medak District

Commercial and Co-operative Banks

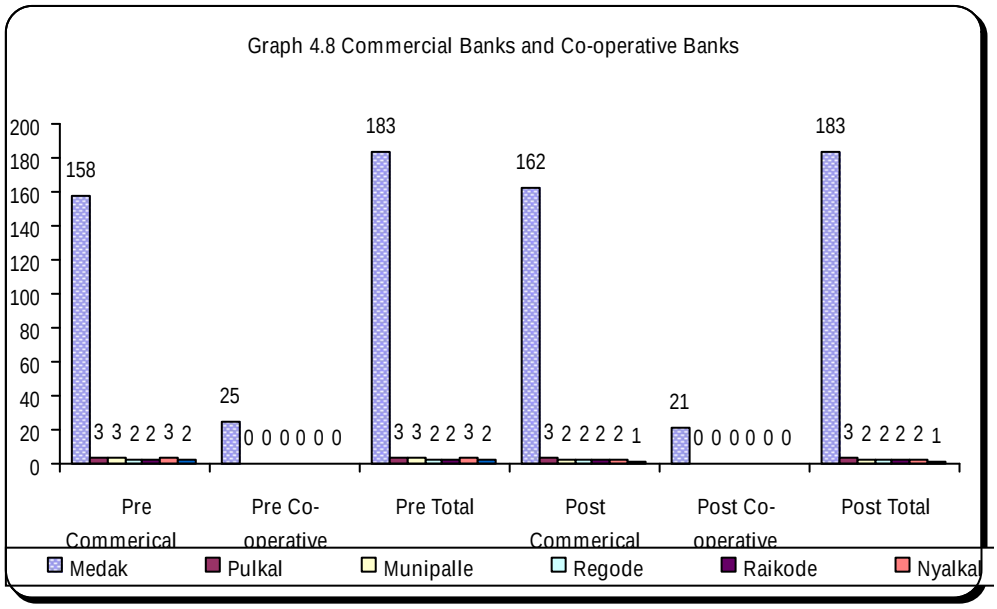
4.38 During pre-project period, there were 183 Banks in Medak District consisting of 158 commercial banks including Grameen Banks and 25 Co-Operative Banks. the graphical presentation of these details are presented in **Graph-4.8**. During the post project situation, it is seen that 4 Co-operative Banks are closed and 4 Commercial Banks are opened. The total numbers of Banks have however not changed (**Table 4.12**)

4.39 No Co-operative bank existed in project mandals either in pre-project or in post-project situations. Further, it is noted that in Munipalle, Nyalkal and Manoor mandals one Commercial bank in each of the said mandal was closed.

Table 4.12
Availability of Commercial and Co-operative Banks at District and Project Mandal level

Sl. No	Name of the District / Mandal	Pre-Project Nos			Post-Project Nos		
		Commercial Banks	Co-operative Banks	Total	Commercial Banks	Co-operative Banks	Total
1	Medak District	158	25	183	162	21	183
2	Pulkal Mandal	3	-	3	3	-	3
3	Munipalle Mandal	3	-	3	2	-	2
4	Regode Mandal	2	-	2	2	-	2
5	Raikode Mandal	2	-	2	2	-	2
6	Nyalkal Mandal	3	-	3	2	-	2
7	Manoor Mandal	2	-	2	1	-	1
8	Project Mandal Total	1.5	-	15	12	-	12

Source: Compiled on the basis of statistical Hand Book of Medak District



Incidence of Important Diseases in Pre and Post-Project Situations

4.40 The specific information on incidence of important diseases like TB, Malaria, Florosis, Cholera, HIV etc., is presented discussed at the later part of this report. However, the immunization programmes in pre and post project periods is studied and presented in the **Annexure IV.27**

4.41 It is seen that the number of persons immunized have gone up in the post project period in respect of Polio, DPT, BCG & Measles both in district as well as in the project

affected Mandals. The immunization for DPT has gone up from 29129 to 54845 at district level. Similarly, there is 3 to 5 fold increase in the mandals. Similar trend is observed in respect of other diseases both in the district as well as in mandals.

Health Care Infrastructure in Post and Pre-Project Situation

4.42 At the district level, the Government Hospitals are reduced by 9 per cent and there is increase of PHC's by 35 per cent. The actual number of medical facilitates existing at district and the project-affected mandals is given in the **Annexure-IV-28 to 34**. The number of patients treated under Allopathic, Homeopathy, Ayurvedic & Unani systems at district level stood at 21.83 lakh, 1.43 lakh, 3.8 lakh and 1.27 lakh respectively in post project situation. **(Table 4.13)** One Ayurvedic Institution in Pulkal has come up in the post-project situation.

Table 4.13
Percentage increase in Health care facilities from Pre-Project to Post Project Situation

S.No	District / Mandal	% increase in Institutes				
		Allopathic		Homeopathy	Ayurvedic	Unani
		Govt	PHC			
1	Medak District	-9	35	NA	NA	NA
2	Pulkal Mandal	Nil	Nil	Nil	100 (one institute)	Nil
3	Munipalle Mandal	Nil	Nil	Nil	Nil	Nil
4	Regode Mandal	Nil	Nil	Nil	Nil	Nil
5	Raikode Mandal	Nil	0	Nil	Nil	Nil
6	Nyalkal Mandal	Nil	0	Nil	Nil	Nil
7	Manoor Mandal	Nil	0	Nil	Nil	Nil

Source: Compiled on the basis of statistical Hand Book of Medak District

4.43. Pulkal Mandal: The numbers of beds are decreased from 6 to 2 at the P.H.C. The number of patients treated under Allopathic was 12850 and under Ayurvedic 13650. (Post project) **(Annexure IV.29)**

4.44 Munipalle Mandal: There is no change in the medical facilities except that one more-doctor is added. The number of patients treated was 8985 at the PHC. (Post project) **(Annexure IV.30)**

***4.45 Regod Mandal*:** There is no change in the medical facilities. The number of patients treated under Allopathic stood at 15605. (Post project) **(Annexure IV.31)**

***4.46 Raikode Mandal*:** In this mandal also there is no change in medical facilities. The number of patients treated under allopathic system stood at 12650 in post – project situation **(Annexure IV.32).**

4.47 Nyalkal Mandal: It is observed that there is no change with regard to PHCs at mandal level, However, there was a decline of 33 per cent of doctors and bed decreased from 8 to 2 in post – project situation. The number of patients treated was 13650 during post-project duration **(Annexure IV.33).**

4.48 Manoor Mandal: There is no change in medical facilities except the lone doctor posted earlier at PHC before project was withdrawn in post project situation. The number of patients treated after the project is 16260, **(Annexure IV.34).**

Family Welfare Programmes

4.49 In the post project situation the sterilization programmes have significantly increased both at district level and project affected mandals level. The increase in Manoor mandal is 195 per cent being the highest fallowed by Regode (1384%) mandal. In between two methods of sterilization, it is seen that vasectomies have come down drastically and tubectomies have grown tremendously. When we examine the work force category, the women workers had gone up than male workers. The men in rural areas need to be educated that vasectomy is the safest method and that it would be better for men to undergo the operation than subjecting the earning women to this process. Like wise, the IUDS have also increased which again target the women only. **(Table 4.14)**

Table 4.14
Percentage increase in VAS, TUB and IUD from Pre to Post Project situation

Sl. No	Indicator	Sterilization VAS, TUB	IUD	Refer Annexure No of details
1	% increase in Medak District	235	334	**IV.35**
2	% increase in Pulkal Mandal	90	206 (No)	**IV.36**
3	% increase in Munipalle Mandal	742	513	**IV.37**
4	% increase in Regode Mandal	1384	196 (No)	**IV.38**
5	% increase in Raikode Mandal	652	100	**IV.39**
6	% increase in Nyalkal Mandal	247	-36	**IV.40**
7	% increase in Manoor Mandal	1956	232	**IV.41**

4.50 When it is compared with project to non-project mandals, it is seen that the percentage increase was more in project-affected mandals (344%) as compared to non-project mandals (227%). However, IUD use percentage increase was more in non-project mandals over the project mandals (176%). **(Annexure IV.42).**

Human Development Index (HDI):

4.51 In order to compare the Human Development Index of the post project situation with pre-project, the available, data from the secondary source is used for this report.

***4.52 HDI (Pre & Post) at District Level*:** The density of population has increased at district level from 186 to 274 Sq. Km. The literacy rates of male have gone up from 32 per cent to 70.3 per cent. The birth and death rates per 1000 in post project situation stood at 23 and 8 respectively. The Human Development Index as far as literacy is concerned has improved. **(Table 4.15)**

Table 4.15
Human Development Index at District Level

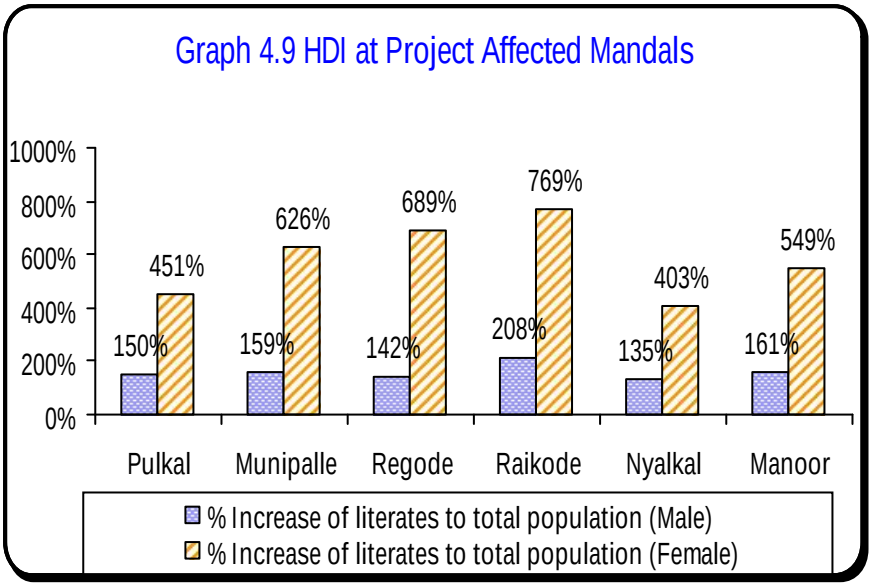
S.No	Indicator	Pre-Project	Post-Project
1	% Male Literates to Total Population	32%	70.30%
2	% Female Literates to Total Population	10.90%	50.40%
3	Birth Rate Per 1000	-	23
4	Death Rate Per 1000	-	8
5	Density of Population / Sq Km	186	274

Source: Compiled on the basis of Statistical Hand Book of Medak District

4.53 HDI at Project-Affected Mandal: The literacy indicator of HDI has improved in the project affected mandals for both males as well as females. However, the improvement of HDI for females is more than 5 times when compared to male population. Among the mandals, Regode Mandal registered higher (689%) percentage increase males of literacy rate, compared to other Mandals **(Table 4.16)**. The graphical presentation of the same is respect of depicted in **Graph-4.9.**

Table 4.16
Human Development Index at Project Affected Mandal Level

Sl. no	Indicator	Mandals					
		Pulkal	Munipalle	Regode	Raikode	Nyalkal	Manoor
1	% Increase of literates to total population (Male)	150	159	142	208	135	161
2	% Increase of literates to total population (Female)	451	626	689	769	403	549
Source: Compiled on the basis of Statistical Hand Book of Medak District							

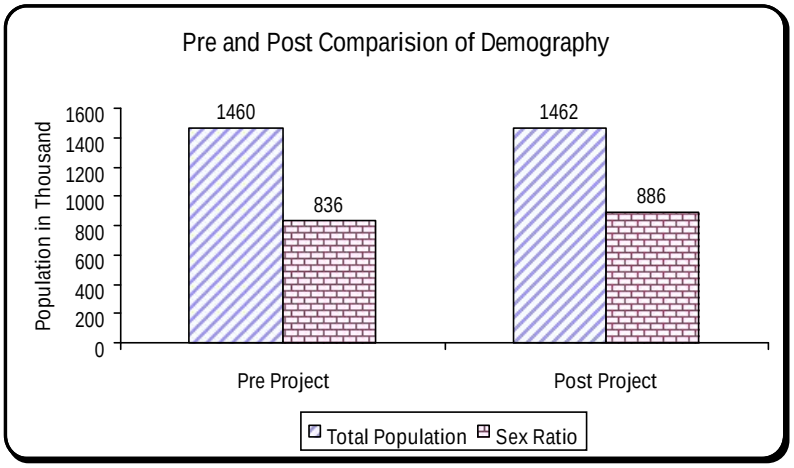


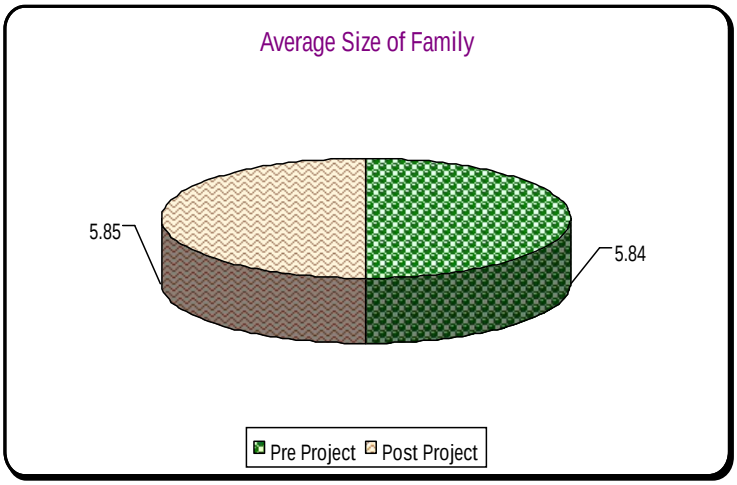
Findings of Field Survey for Fully Affected Area

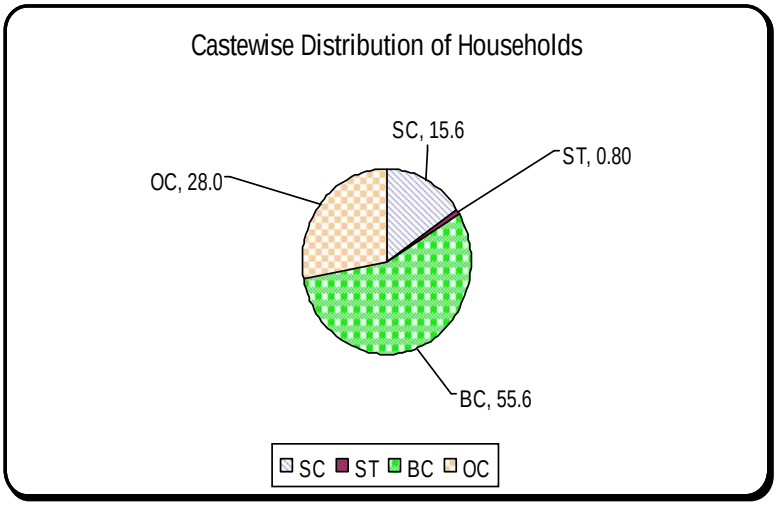
4.54 In the above paragraphs, the socio-economic environment aspects have been discussed and presented based on authentic secondary sources of information of project-affected mandals. In the following section of this chapter, findings of field data are presented which includes pre and post project scenario of fully affected sample households.

Demographic Profile and Sample Households

4.55 In all 250 households were selected for purpose of study form 10 Rehabilitation centers (Fully affected). The data analysis of sample households pertaining to their demography and population revealed that there is not much difference between pre project (1460) and post project (1462) situation relating to their family population as well as family size being 5.84 (pre) and 5.85 (post). In other words, it remained more or less same in both the situations. The sex ratio during pre-project period is observed to be 836 females per 1000 males while during post-project period it is 886 per 1000 males indicating improvement in post project period. It may be observed that the sex ratio improved in sample villages, while it decreased both in the district as well as in the project-affected mandals. The improvement in sex ratio among sample households from project-resettled villages during post project period may be mainly because of improved health care facilities particularly for women and children in these villages. Further, the primary health workers in these villagers have undertaken campaign against female infanticide and this improved sex ratio during post project period in these villages. The details of demography are presented in **Annexure IV.43**. Among the sample households majority (55.6%) belonged to Backward Caste followed by OC (28%), SC (15.6%) and SC (.8%) **(Annexure IV.44)**.







4.56 Occupation: Data analysis on this aspect revealed that majority of sample households are cultivators (59%) followed by Agricultural laboures (21%), land less (5.6%) and casual laboures (4.4%). Besides, this other occupations of the remaining

sample households noted to be rural artisans, services, business, and sheep rearing **(Annexure IV.45)**.

4.57 Literacy: The total literacy rate of pre-project period found to be 20 per cent which increased to 45 per cent during post project situation indicating an improvement of 25 per cent over to pre-project situation among the sample households. Within the sample villages the highest percentage change is noted in Nirjapa (50%) and the lowest in Pulkurthy and Doulathabad (19%). In the remaining 8 villages the percentage increase of literacy ranged between 20 and 35 per cent. The details of literacy are depicted in **Annexure IV.46**

4.58 Housing: During the pre-project duration about 31 per cent of sample respondents, possessed Kutcha houses, which has been reduced to about 9 per cent in post-project situation indicating the change of 23 per cent from Katcha to Semi Pacca. However, it is further observed that about 8 per cent of them are still dwelling in Katcha houses despite of extending financial assistance to them from project side for house construction in newly established Rehabilitation centers. In case of pacca houses, the number is just doubled in post-project situation (21%) over to pre-project (10). The details are given in **Annexure IV.47**.

4.59 Possession of Household Assets: The details of household asset possessed by the sampled respondents are presented in **Annexure IV.48**. The data revealed that there is a phenomenal change in possession of materialistic articles from pre to post project situations which has multiplied several times such as television (From 9 to 125 in nos.), mobiles from 0 to 101 nos., bicycle (from 49 to 89 nos.), two wheelers 6 to 25 nos., four wheelers which to 8 from zero nos., refrigerator from 0 to 3 nos., etc. This indicates that largely the oustees have spent their income (either from compensation or from other sources) in purchasing of these articles.

Income Pattern in Households in Rehabilitated Area

4.60 The highest annual income was derived from Agricultural by highest percentage of households in pre-project situation (94%) followed by income from wages (78%). In post project situation highest number of households (88%) depended on income from wages followed by income from agriculture (87%). The number of households depending on income from dairy remained more or less constant at above 20 per cent. The next prominent source of income during both pre and post project situating happed to be income from Artisan activities (44% of household).

4.61 The Average Annual Income per household during pre-post was ` 32491/- whereas the same after the project rose to ` 49403/-. However, the increase in absolute terms is insignificant when we take into consideration the inflation rate of 5-6 per cent. In fact, at this rate of inflation the income should have grown by 120 per cent particularly. The details are given in **Annexure IV.49**.

Expenditure pattern in Households in Rehabilitated Area

4.62 Highest expenditure was on food grains and food items followed by Religious functions in both pre and post project situations. This was followed by Health and education. Though the pattern of expenditure has not changed much, the absolute amounts spent in post-project situation for each purpose has gone very high. In fact, this reduced surplus in the hands of the farmers. For example the average income per household during pre-project was ` 32491/- and the average expenses were only ` 19125/- leaving a surplus of ` 13366/-. However, when we see the post-project situation the average income per household is ` 49403/- whereas the average expenditure per household is ` 46579/- leaving a meager surplus of Rs. 2824/- for other unaccounted expenditures. **Annexures IV. 49 and IV.50** give further details in this regard.

Sources of Borrowing in Sample Households

4.63 Out of total sample of 250 households, 321 of households (80) borrow from different source. About 13.20 per cent of these households borrowed from friends and relatives and 11.20 per cent from Banks. Borrowings from Money Lenders and Cooperative societies were by 4.80 per cent and 2.80 per cent of households respectively. The details are given in **Annexure IV.51**.

Indebtedness in Sample Households

4.64 The total volume of loans borrowed by 80 households from all the sources stand at ` 23.75 lakh and the average per household is ` 29688/-. The breakup of the sources indicate that the highest borrowing is from friends and relatives (36.5%) followed by Banks (34.2%) and Money Lender (19%) and Cooperative (10%). The details are given in **Annexure IV.52**.

Partially Affected Households

4.65 In the proceeding, Chapter 3 a detailed presentation has been presented of full and partially affected project household. The findings of partially affected households pertaining to socio economic situation is being presented here under

Demographic Profile

4.66 In all 60 partially affected households have been contacted to elicit relevant and needed information whish is concern to project. The demographic data of households is presented in **Annexure IV.53**. It is observed that there is not much difference with regard to sample household population between pre project (419) and post-project (405) situation, which has marginally come down, is post project situation. So is the situation pertaining to average family size also being 6.98 (Pre) and 6.75 (post). However, sex ratio indicated improvement in post-project situation i.e., 958 (Pre-project) and 1005 (Post Project) female per 1000 male respectively.

4.67 With regard to caste distribution **(Annexure IV.54)**, the data indicated that Backward Caste population constituted 62 per cent of the sample while Scheduled Caste represented 18 per cent followed by OC (17%) and ST (3%).

4.68 In case of literacy, it is noted that the literacy rate has gone up by 13 per cent from pre-project to Post-project situation indicating improvement among the sample households. Among the male and female literates during post-project situation are found to be equal (**Annexure IV.55).**

Income and Expenditure of Households in Partially Affected Areas

Income Pattern

4.69 The income trends from various sources indicated that the major source happened to be from agriculture in both the scenarios of pre (66.1%) and post (55.6%) situations of the sample households followed by wages in pre and post project situation being 15.2 per cent and 16.7 per cent respectively. Similarly, another major status of income noted to be from artisan activity during pre project situation, which was about 10 per cent, increased to 15 per cent during post project duration. So is the case the dairy farming increased to 3.8 per cent from 2.6 per cent of pre project duration.

4.70 The data on average income of sample households indicated that it has increased to three fold in post project situation over to pre project situation. The Average annual Income per household during pre project scenario it was ` 12, 446/- which in post project situation raised to ` 40,950. However, the increase in absolute terms is in significant, if we take the inflation rate of year into account, which has multiplied several times from the base year of 1989-90. If we consider this, it can be inferred that there is no change in income levels in positive direction from pre to post project situations **(Annexure.IV.56).**

Expenditure

4.71 The comparative data analysis of expenditure pattern of sample households of pre and post project situation revealed that there happened to be many changes. In pre-project situation, the sample household had spent more on food grains (39%), food items (14%), health (9%) which has reduced to 15, 7, 7 per cents respectively during post project situation. However, the data indicated that they have spent more on religions functions, education, loan payments, house improvement etc., during post project situation as compared to pre-project situation.

4.72 If we look at saving behavior of sample households, it indicates during pre project situation they were able to save ` 365.3 from this total income, which had some meaning to them. When we analyse the saving pattern during post-project situation, they could save ` 4236/- after meeting their regular expenditure annually. In absolute terms, if we take the difference between pre and post project situations, it comes to ` 583 of savings, which is very insignificant considering the inflation rates. The details of income and expenditure are presented in **Annexure IV.57**.

Indebtedness

4.73 The data analysis in this regard revealed that in all 70 per cent of sample households borrowed money from different sources. Out of these 40 per cent borrowed from bank followed by moneylenders (23%) and friends and relatives (7%).

4.74 Further analysis indicated that major amount of barrowing is from banks, (78%) followed by moneylenders (14%) and friends and relatives (8%). **(Annexure IV.58).**

Part – I

5
Effects on Agriculture

AFC, Hyderabad

5

EFFECTS ON AGRICULTURE

Introduction

5.01 Singur River Valley Project constructed on the tributary of Godavari submerged 72 villages situated in 6 mandals namely:

(I) Pulkal
(II) Munipalle
(III) Regode
(IV) Raikode
(V) Nyalkal
(VI) Manoor

5.02 Out of 72 villages, 33 villages got fully submerged by the year 1989 and only the land in the remaining 39 villages got submerged. The submergence of the land and villages had affected the agricultural scenario particularly the land use pattern and the consequent effect on crops and the output. This report based on primary data and secondary data is intended to capture the pre and post project agricultural situations in the affected mandals. The post project situation in regard to industries and business is also studied as per the terms of reference.

Methodology

5.03 The pre-project year selected for socio-economic study i.e., 1989-90 is taken for the study of agricultural and industrial scenario. The post-project situation is studied for the year 2007-08. The study for this report was focused on six affected mandals. The main indicators under "effects on agriculture" as given in TOR are as under:-

a) Improvement in production
b) Changes in cropping pattern and improvement in cropping intensity due to economic rehabilitation programs on agriculture / horticulture / animal husbandry
c) Improvement in quality of livestock and poultry
d) Assess agricultural co-operative and agricultural finance programs if initiated
e) Details of the steps taken to prevent contaminations of ground and surface water due to fertilizers pesticides, run-off etc.,
f) Development of industry in the command area
g) Over all development scenario in the command area

5.04 This chapter does not cover command area but only the situation analysis in affected Mandals. The status of command area is given as a separate chapter. The report covered not only production levels in the major crops in the study area but also the productivity per unit of area before and after the project. The cropping pattern in the district as well as in the affected mandals is studied before and after the project. Cropping intensity is arrived before and after by taking the gross cropped area (GCA)and net cropped area (NCA) and applying the standard formula i.e., by dividing the GCA with NCA and applying the percentage index. The livestock census before and after in respect of cattle, buffaloes, sheep, goat and poultry are compared for finding changes in the livestock population. The industrial and the overall development of the affected mandals is extracted from the secondary sources of information and presented.

Data collection, Tabulation & Analysis

5.05 The statistical reports of the Directorate of Economics and Statistics and the available information with the concerned departments like Agriculture, Animal Husbandry, Department of Industries etc are used for the collection of data, besides collection of primary data from rehabilitated settlement and affected sample households.

5.06 The data is tabulated in the well-designed and structured table incorporating all the necessary sub-indicators for pre and post-project comparison. The data is analyzed using the simple statistical tools such as mean, mean difference, averages and percentages and ratios as per the requirements of the data. The report is presented in the same order as given in the terms of reference. Graphs and pictorial support is used wherever necessary to make the report easily comprehendible.

Improvement in Production

5.07 Production levels may increase / decrease for specific crops in the area due to change in the land use pattern and the change in the cropping pattern. Therefore, the report studied the sub-indicators as above in order to understand their effect on the improvement in production.

Land Utilization

5.08 The land use pattern at the District and project affected mandals in pre and post project situation is given in the Annexures-V- 1 to V.8. The following **Table 5.1** indicates the variations in land use in post project situation compared to pre-project situation.

5.09 It is observed from the Table 5.1 that the forest area is decreased at district level as well as in Regod and Manoor Mandals by 7.67, 25.53 per cent and 28.57 per cent respectively. There is no change in Pulkal, Munipalle, Rakiode and Nyalkal mandals.

Table 5.1
Changes in Land Use Pattern

Sl. No	Land use	%Increase / Decrease (From Pre-project to Post Project)						
		District	Pulkal	Munipalle	Regode	Raikode	Nyalkal	Manoor
1	Geographical Area	0	0.00	0.00	2.01	0.00	0.00	0.00
2	Forest	-7.67	0.00	0.00	-25.53	0.00	0.00	-28.57
3	Barren & Uncultivated	-10.26	-55.61	0.00	-81.29	-27.45	115.66	34.28
4	Land put to Non-Agriculture Use	-9.34	238.00	35.80	94.18	-56.50	-71.05	-80.51
5	Permanent Pastures & Other grazing land	-35.5	0.00	0.00	627.91	27.32	-100.00	-100.00
6	Misc: Trees, Crops & Covers	-55.45	-94.00	0.00	0.00	-100.00	124.13	11.58
7	Culturable Waste	638.89	1655.00	-25.5	6675	-89.41	-100.0	-100.00
8	Current Fallow Land	2.77	71.00	2124.60	-34.21	-55.53	-30.22	4887.00
9	Other Fallow Land	88.13	-38.44	235.28	-30.32	1034.83	120.04	331.73
10	Net Area Sown (K)	-12.75	-42.24	-4.7	-4.71	-19.55	-2.80	-24.25
11	Net Area Sown (R)	3.92	43.25	317.60	316.50	284.65	75.29	147.76
12	Total Area Sown	-10.90	-30.54	-31.87	4.94	-1.50	3.82	-20.69

For details refer Annexure: - V- 1 to V. 8.

5.10 The Barren and uncultivated land has also decreased in the district and the project affected mandals except in Munipalle, Nyalkal and Manoor mandals. The decrease at district level is 10 per cent. Pulkal recorded decrease of 55 per cent, Regode 81 per cent and Raikode 27 per cent. Further, it is noticed that there is an increase in respect of Nyalkal (116%) and Manoor (34%) Mandals.

5.11 The land put to non-agricultural use has decreased at the district level. However, the project-affected mandals have shown increase in this category. Significant increase of 238 per cent is noted in Pulkal mandals. However, the decrease was also observed is post project situation in respect of Raikode (56%), Nyalkal (71%) and Manoor (80%) mandals.

5.12 There is decline in permanent pastures and other grazing land at district (35%) and Nyalkal and Mannor mandal levels to the extent of 100 per cent. No change is observed in Pulkal & Munipalle Mandals. Significant increase of 627 per cent is seen in Regode mandal in respect of permanent pastures and other grazing land. In addition to this, Raikode Mandals recorded an increase of 27 per cent.

5.13 The land under miscellaneous trees, crops & groves has decreased by 55 per cent at district level and 94 per cent to 100 per cent in Pulkal and Raikode mandals. However, there is significant increase in Nyalkal Mandal to an extent of 24 per cent and marginal increase of 11 per cent in Manoor Mandal. No change is seen in Munipalle and Regode mandals.

5.14 There is abnormal increase of Culturable waste land at district, Pulkal and Regode mandals in post-project scenario recording 638 pre cent, 1655 per cent and 6675 per cent respectively. However, decline was also observed in respect of Munipalle (25%), Raikode (89%), Nyalkal (100%), and Manoor (100%) mandals.

5.15 The current fallow lands have also increased at district (2.77%) as well as in respect of Munipalle (2124%), Pulkal (71%) and Manoor (4887%) whereas in Regode, Raikode and Nyalkal mandals which have shown a decrease of 34.21 per cent, 55.53 per cent and 30.22 per cent respectively. Similarly, other fallow land has also increased highest being 1034 per cent in Raikode followed by Munipalle (235%) and Nyalkal (120%) Mandals. However, in Pulkal and Regode mandals recorded a decrease of 38.4 pre cent and 30.2 per cent respectively.

5.16 The alarming situation in post-project is reduction of net area sown in kharif season at all levels. The decline at district level is 12.75 per cent. Highest decline in net-area sown in Kharif is observed in Pulkal mandal (-42.24%). This is due to late rains during the year under study.

5.17 The area sown under Rabi has slightly increased by 3.92 per cent at district level. However, an increase of 318 per cent is observed in Munipalle mandal more than compensating the loss in Kharif season. Sunflower and coriander crops are grown there in addition to the earlier rain crops. The total area sown has declined at all levels except in Regode and Nyalkal mandals.

5.18 The decrease of Forests, Barren and Uncultivated land, misctrees and groves, net area soun in Kharif, in post project situation is more in project affected mandals than in non-project mandals reflecting the impact of the project on these manals (please refer to V.8) for details.

Cropping Intensity

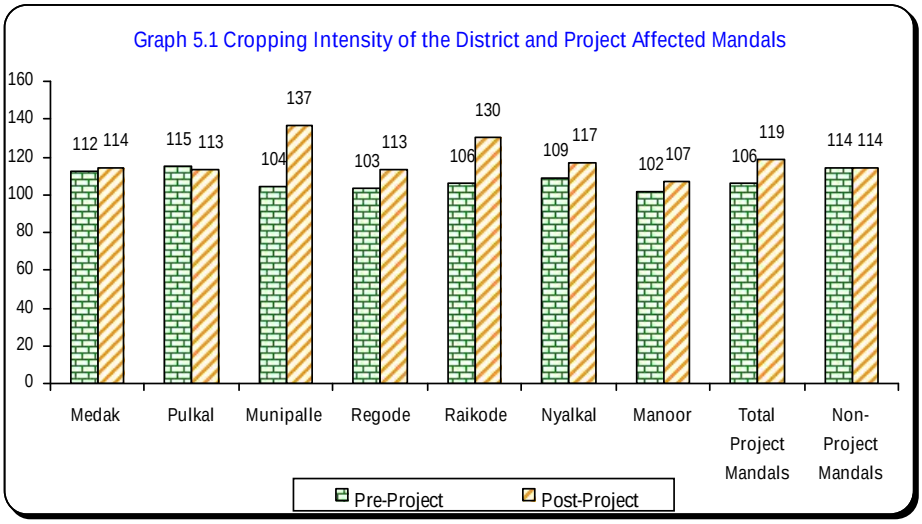
5.19 The cropping intensity is the number of times crop are grown on a unit of land in a year. The gross cropped area is divided by the net-cropped area and expressed as percentage. The following **Table 5.2** indicates the cropping intensity in the pre and post-project situations at district level as well as at the project affected mandal levels. The increase / decrease is also shown along side.

5.20 The cropping intensity has gone up at district level by 2 per cent. The Pulkal mandal has recorded a decline of 2 per cent in cropping intensity due to less area sown in Rabi comparatively. All other mandals have shown an increase of 5 per cent to 33 per cent. Cropping intensity of Pulkal mandal was declined in post- project period compared to pre-project period, but other mandal's cropping intensity was increased during post project period. **(Table 5.2 and Graph 5.1)**

Table 5.2
Cropping Intensity of the district and project affected mandals

Sl. No	District/ Mandal	Cropping Intensity percentage		
		Pre-Project	Post-Project	Increase / Decrease
1	Medak District	112	114	2
2	Pulkal Mandal	115	113	-2
3	Munipalle Mandal	104	137	33
4	Regode Mandal	103	113	10
5	Raikode	106	130	24
6	Nyalkal	109	117	8
7	Manoor	102	107	5
8	Total Project Mandals	106	119	13
9	Non-Project Mandals	114	114	0.00

For details refer Annexure V.1 to V.8



5.21 Further, it is seen that the increase is more in project affected mandals (13%) than in non-project mandals due to more thrust given to the project affected mandals through agricultural programmes.

Production of Major Crops

5.22 The increased / decrease production levels of major crops is studied in the pre-project as well as post-project situations and same is presented in **Table. 5.3.**

5.23 ***Rice:*** At district level production of rice increased by 28 per cent. Pulkal and Nyalkal mandal had declined 32 per cent and 43 per cent respectively in rice production. Production increased by 1341 tonnes in Manoor mandal (905%). Raikode turned out an increase of only 8% whereas in Regode mandal, the increase in absolute terms is 904 tonnes giving a percentage increase of 109%. **(Annexure V.9)**

5.24 ***Redgram:*** In case of Redgram it is observed that the production levels compared to pre-project situation have decline at both the levels i.e., district as well as mandals. At district level the decline was observed to be 37 per cent. At mandal level it was highest in Munepalle (80%) and lowest happened to be 8 per cent in Nyalkal mandal. **(Annexure V.10)**

5.25 ***Jowar:*** Jowar production also has decreased by 89% at district level. Similar trends are observed in all the project affected mandals except Pulkal Mandal where it has shown the positive trend of increase (100%). **(Annexure V.11)**

5.26 ***Maize:*** The data revealed that farmers had grown maize crop in large areas in post project scenario except Nyalkal and Manoor mandals where farmers had not grown this crop in pre and post project situations. The production levels of maize had increased from 100 per cent in each mandal to 227 per cent at district level. **(Annexure V.12)**

5.27 ***Green gram:*** It is observed that at the district level, the area under this crop has increased compared to pre-project situation. However, the production levels recorded negative by a decline of 23.20 per cent. In case of Mandals also production has decreased i.e., Pulkal (45.85%), Raikode (77%) and Manoor (44%) mandals. However, there is an increase of 32 per cent, 66 pre cent and 29 per cent of Production in Munipalle, Regod and Nyalkal mandals respectively. **(Annexure V.13)**

5.28 ***Sugarcane:*** Sugarcane appeared to be a much sought after crop in post-project situation. Production levels in absolute terms have increased from 80 per cent to 1584 per cent. Highest increase is seen in Regode mandal (1390%) and lowest at district level (80%). **(Annexure V.14)**

5.29 ***Groundnut:*** Production levels of groundnut had drastically come down at all levels i.e., district as well as Mandal level. The District level production has decreased by 92 per cent. The decrease at mandal levels ranged between 85 per cent and 100 per cent. **(Annexure V.15)**

5.30 ***Black gram:*** Farmers grew black gram also in large areas in post project situation. The production levels have increased both in absolute and percentage terms at all levels. The highest percentage increase of 1428 per cent is seen in Regode mandal. **(Annexure V.16)**

Table 5.3
Percentage Increase / Decrease in Production: Project affected District and Mandals

Sl. No	Name of the Crop	District		Pulkal		Munipalle		Regode		Raikode		Nyalkal		Manoor		Refer for details
		Tonnes	%	Tonnes	%	Tonnes	%	Tonnes	%	Tonnes	%	Tonnes	%	Tonnes	%	
1	Rice	61600	28	-1405	-32	460	273.04	904	109	45	7.81	-288	-42.78	1341	905.51	**V.9**
2	Jowar	-442975	-88.97	1946	100	-14507	-89.66	-15410	-89.88	-13135	-83.7	-19763	-85	-38868	-88.7	**V.11**
3	Maize	297973	228	305	100	141	100	177	100	154	100	0	0	0	0	**V.12**
4	Greengram	-13590	-23	663.66	-45.85	582.36	32.22	1164.28	65.78	-16277.8	-77	1077.56	29	-4251.93	-44	**V.13**
5	Sugarcane	1863368	80	400615	1584	53555	379	46405	1390	46859	106	122185	93	110884	1239	**V.14**
6	Groundnut	-50636	-92.41	-880.03	-82.96	-652	-100	-277.44	-85	-777	-87	-3607	-100	-1500	-100	**V.15**
7	Blackgram	121060	455	1807	151	3960	323	5164	1428	693	387	1434	348	2227	282	**V.16**
8	Redgram	-7021.5	-37	-534.18	-71.28	-1228.47	-80.06	-128	-30..93	-249	-39.7	-56	-8	-976	45.5	**V.10**

Note: As the production figures mandal wise are not available, the District averages taken for calculation and computation.

Changes in Cropping Pattern

5.31 Farmers usually adopt a particular pattern of cropping as passed on by their forefathers which is fixed on the type of land, soil condition and irrigation sources. However, changes in climate, rainfall and environment make an impact on the type of crops grown on their lands. At times late rains, during a year delay showing of paddy and due to which farmers may shift to irrigated dry crops. It is also possible that other problems like lack of remunerative prices, shortage of labor etc, may trigger a change in the cropping pattern. Some times the change is also brought about by commencement of processing units for a particular crop like sugarcane and groundnut.

5.32 The study that follows focus on such changes in pre and post project situations both at the district and project affected mandal levels. The following **Table 5.4** gives the crops in Kharif and Rabi seasons as per their extent of coverage in ha.

Table 5.4
District level changes in Cropping Pattern: Pre and Post Project Situation

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Paddy	Maize	Jowar	Bengalgram
2	Jowar	Paddy	Paddy	Paddy
3	Maize	Greengram	Sugarcane	Sugarcane
4	Greengram	Sugarcane	Bengalgram	Jowar
5	Sugarcane	Jowar	Chilies	Sunflower
6	Redgram	Redgram	Maize	Maize
7	Blackgram	Blackgram	Sunflower	Chilies

For details refer Annexure V.17

5.33 ***Kharif Season Cropping Pattern in Medak District:*** It is seen from the above table that in post-project situation the cropping pattern in Kharif has changed. Maize occupied first position and Jowar crop has come down to 5th position in the district. There is no change in the priority of Redgram and Blackgram.

5.34 ***Rabi Season Cropping Pattern in Medak District:*** It is observed that Jowar, which was occupying first position, has gone down to 4th position. Interestingly the first position is occupied by Bengalgram. There is no change in Rabi Paddy being the second most preferred crop in both pre and post project situations. Sunflower is pushed up in post-project situation replacing Chilies.

5.35 ***Cropping Pattern Changes at Mandal Level:*** A study of change in cropping pattern is made for the project affected Mandals and discussed mandal-wise.

Pulkal Mandal

5.36 ***Kharif:*** The shift is seen towards sugarcane in Pulkal mandal as large areas are grown under this crop. Paddy is pushed to the 3rd position. Jowar, which was topping during the pre-project, is pushed to 6h position.

5.37 ***Rabi:*** During Rabi season, also sugarcane occupied first position in post-project situation. Paddy is pushed to the 4th position.

Table 5.5
Changes in Cropping Pattern in Pulkal Mandal

Sl. No as per order of Priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Sugarcane	Jowar	Sugarcane
2	Paddy	Greengram	Paddy	Jowar
3	Greengram	Paddy	Sugarcane	Sunflower
4	Redgram	Blackgram	Groundnut	Paddy
5	Sugarcane	Redgram	Sunflower	Groundnut
6	Blackgram	Jowar		
7	Sunflower	Maize		

For details Refer Annexure V.18

Munipalle Mandal

5.38 It is seen that paddy is not preferred both in Kharif and Rabi seasons at Munipalle. Kharif Jowar is pushed to 4th position in post-project and Grams occupied first three positions. During Rabi, Jowar is the main crop followed by Sugarcane & Paddy.

Table 5.6
Cropping Pattern in Munipalle Mandal

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Greengram	Jowar	Jowar
2	Redgram	Blackgram	Sugarcane	Sugarcane
3	Greengram	Redgram	Paddy	Paddy
4	Blackgram	Jowar		
5	Sunflower	Sugarcane		
6	Paddy	Paddy		
7	Sugarcane	Maize		

For details Refer Annexure V.18

Regode Mandal

5.39 During Kharif season, grams occupied first three positions in post-project situation. Jowar & Sugarcane became prominent in Rabi season.

Table 5.7
Cropping Pattern in Regode Mandal

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Greengram	Jowar	Jowar
2	Greengram	Blackgram	Sugarcane	Sugarcane
3	Paddy	Redgram	Paddy	Paddy
4	Redgram	Paddy	-	Sunflower
5	Blackgram	Jowar		Groundnut
6	Sunflower	Sugarcane		
7	Groundnut	Sunflower		

For details Refer Annexure V.18

Raikode Mandal

5.40 It is seen that in Raikode mandal greengram pushed Jowar to 5th Position in post project situation in Kharif. Jowar, Sugarcane, Sunflower because prominent in Rabi season. Besides, groundnut is also taken up in post project Rabi season which was not grown in the pre-project situation. Paddy was at 4th place in pre project Rabi, which was pushed to 5th position post project period.

Table 5.8
Cropping Pattern in Raikode Mandal

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Greengram	Jowar	Jowar
2	Greengram	Jowar	Sugarcane	Sugarcane
3	Blackgram	Blackgram	Sunflower	Sunflower
4	Redgram	Redgram	Paddy	Groundnut
5	Sugarcane	Sugarcane		Paddy
6	Paddy	Paddy		
7	Sunflower	Maize		

For details Refer Annexure V.18

Nyalkal Mandal

5.41 The shift is seen towards green gram in Nyalkal mandal as large areas are grown under this crop in Kharif season. Jowar which was topping during the pre-project is pushed to 4th position during prost-project situation. During Rabi, Jowar was the main crop both in pre and post project period of the Nyalkal mandal. Sunflower's position was 3rd is pre-post situation was pushed up to 2nd position during post-project situation. Sugarcane and groundnut was grown in pre-project, were not taken up during post-project Rabi season at all.

Table 5.9
Cropping Pattern in Nyalkal Mandal

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Greengram	Jowar	Jowar
2	Greengram	Sugarcane	Sugarcane	Sunflower
3	Sugarcane	Blackgram	Sunflower	
4	Blackgram	Jowar	Groundnut	
5	Redgram	Redgram		
6	Paddy	Paddy		
7	Groundnut			

For details Refer Annexure V.18

Manoor Mandal

5.42 Jowar had occupied top position in Kharif season in Pre-project situation was pushed down to 3rd place in post project period. Further it was noted that in Kharif season Green gram and Black gram occupied the first and second position in post-project respectively. There is no change in Rabi as Jowar and sunflower being first and second most preferred crops in both pre and post project situation.

Table 5.10
Cropping Pattern in Manoor Mandal

Sl. No as per order of priority	Pre-Project Kharif	Post-Project Kharif	Pre-Project Rabi	Post-Project Rabi
1	Jowar	Greengram	Jowar	Jowar
2	Greengram	Blackgram	Sunflower	Sunflower
3	Blackgram	Jowar	Sugarcane	Sugarcane
4	Redgram	Redgram	Paddy	
5	Groundnut	Sugarcane		
6	Paddy	Paddy		
7	Sugarcane	Sunflower		

For details Refer Annexure V.18

Steps taken to prevent contamination of ground and surface water

Adequate steps are yet to be initiated in this regard. The farm development works need to be initiated to provide proper drainage system to the fields. The field channels from the main & sub distributaries also need to be constructed involving the command area farmers in order to prevent contamination of surface water and groundwater through pesticides and fertilizer run-off.

Improvement in Quality of Livestock & Poultry

5.43 The increase and decrease of livestock and poultry is presented in the **Annexures-V.19 to 25** both at district as well as mandal levels.

5.44 It may be seen that cattle is getting reduced and sheep and poultry are increasing in post-project situation. The data on cross bread and improved breed is not available at mandal levels and as such the same is being collected at field levels (selected sample villages) through field surveys and it is discussed separately under "Results of Field Survey". The population of cows has decreased due to change in the preference of farmers due to demand for Buffaloe milk rather than low milk. Secondly the small farms find it comfortable to manage a buffaloe which is rugged and rough requiring lesser health care than the cow which is delicate and requires closer than care.

5.45 At district level, in post project situation, the cattle population decreased by 29 per cent and Buffaloes has increased by 75 per cent. There is an addition of 402 per cent in sheep and 956 per cent in poultry. **(Annexure V.19).**

5.46 At Pulkal mandal, cattle increased hardly by 0.39 per cent. However, buffaloes increased by 58 per cent and sheep and Poultry by 118 per cent and 40 per cent respectively. **(Annexure V.20).** The Department of Animal Husbandry raised fodder crops in 657 acres. During 2007-08, a total of 48180 animals were treated for different diseases, De-worming was done for 54219 animals, vaccinations were given for 98540 animals; as a part of breed improvement programme Artificial insemination was conducted for 915 animals and new claves born are reported to be 350.

5.47 At Munipalle mandal, the decline in cattle population is 31 per cent buffaloes by 21 per cent. Sheep population is increased by 206 per cent. **(Annexure V.21).** At Munipalle mandal fodder crops were grown in 1020 acres. During health checkup 43378 cases were treated. De-worming was done for 42723 animals. Vaccinations for difference diseases were administered to 71713 animals. In Breed improvement programme 689, Artificial Inseminations were done resulting in the birth of 301 new calves.

5.48 At Regode mandal cattle decreased by 36 per cent and buffaloes by 10 pre cent. Sheep and poultry population have increased by 144 per cent and 212 per cent respectively. Goats decline by 0.58 per cent. **(Annexure V.22).** At Regode Mandal fodder crops were grown in 562 acres 37079 cases were treated. De-worming was done for 53452 animals. Vaccination for preventing diseases was done for 68846 animals. In all 993 Artifical inseminations were conducted resulting in the birth of 371 calves.

5.49 At Raikode mandal level also cattle population declined by 26%. However, in respect of sheep, poultry and goat, there was an increase of 131 per cent, 6 per cent and 75 per cent respectively **(Annexure V.23).** At Raikode mandal fodder crops were grown in 1442 acres, 42357 animals were treated for different aliments. De-worming was done for 29273 animals. Vaccinations were given for 50167 animals. As a part of Breed improvement 710 AIS were conducted resulting in the birth of 274 calves.

5.50 In Nyalkal mandal, it was observed that again cattle and buffaloes population was decreased by 35 per cent and 41 per cent respectively. There was a marginal increase in livestock population of sheep (11%), Poultry (13%) and goats (13%) in this mandal **(Annexure V.24)**. At Nyalkal mandal 63951 animals were treated for different aliments. De-worming was done for 37703 animals. Vaccinations were conducted for 57957 animals. As a part of breed improvement Artifical inseminations were conducted for 1191 cases resulting in the birth of 536 calves. Fodder crops were grown in 1521 acres.

5.51 At Manoor mandal also decrease of cattle population (5%) noted. However, it was worthy to note the increase of sheep population to the extent of 166 per cent. Similarly, there was an increase of 128 per cent poultry and 42 per cent goat population over pre-project situation **(Annexure V.25)**. At Manoor mandal fodder crops were grown in 1960 acres and it is the highest amongst project-affected mandals. About 85324 animals were treated for different diseases. De-worming was done for 80044 animals. Vaccinations were given to 120743 animals. As part of breed improvement 3409 Artificial inseminations were administered resulting in birth of 1513 calves. Manoor mandal has received highest volume of services from Animal Husbandry Department amongst project affected mandals. **(Annexure V.25 A)**

Agricultural Co-operative and Agriculture Finance Programs

5.52 The rural people in general and farming community in particular are economically not sound. Traditionally, this community had been practicing tradition old agricultural farming practices in their past where they were mostly depended on their won inputs and cost of cultivation happened to be low and farm produce yields remained quite low. For enhancing crop productivity, new improved agricultural farming practices were introduced in 1960s. With introduction of Improved Farming Practices, the cost of cultivation also gone up and majority of farming community could not bear the enhanced cost of cultivation. To reduce the financial burden of cultivators, the concept of

establishing Agricultural Cooperative societies at field levels came up and formation of these societies initiated in the country and Andhra Pradesh was no exception to this. Thus, farmers started taking financial help in the form of loan from these societies with membership in it. Banks also come forward in extending agricultural loans.

5.53 In this respect, it was observed that in Medak district in all 220 such societies were formed during the pre-project situation with the membership of 3.23 lakh farmers. The share capital was ` 388.18 lakh. Further, it is noted that during post-project situation the number of agricultural cooperative societies were reduced to 105 However, the membership in societies raised from 3.23 lakh to 4.78 lakh with share capital of ` 2585 lakhs. The details of these are given in **Table 5.11** presented below.

5.54 Project mandal wise data is not available for pre-project situation. Hence, it could not be compared with Post-project situation. However, district level data indicated that there was an increase in respect of membership and share capital while there was reduction in the number of Societies. The reduction in number of co-operative Societies was mainly because the policy of state government for amalgamatio0n of societies. The post project details i.e., District and Project Mandal are depicted in the above table indicate the functioning of these societies. The growth in the number of members and the share capital was mainly because of the increase quantum of loans extended by these institutions. The team members' interaction with the PAFs in rehabilitation centers also indicated similar trend regarding the number of cooperative societies and their share capital.

Cooperatives in the district Extend Crop Loans for Agriculture Development

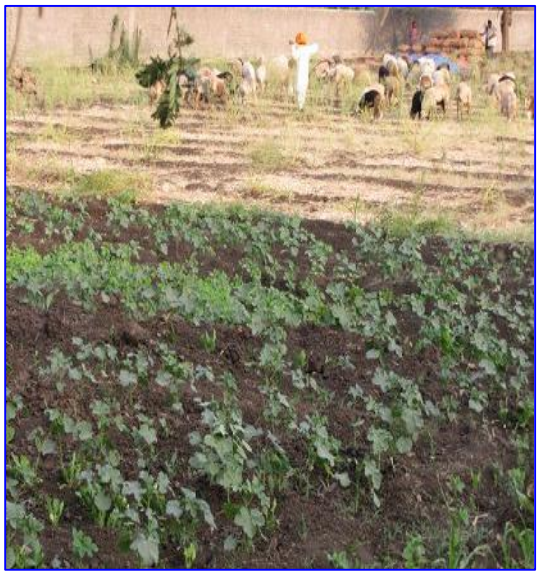


Table 5.11

Status of Primary Agricultural Credit Societies including Farmers Service Societies

District / Mandal	Pre-Post Project	No of Societies	Membership (in 1000)	Paid up capital (Share capital)	Deposits	Borrowings	Working capital	Loans		
								Advance	Received	Outstanding
Medak Dist	Pre	220	3.23 Lakh	388.18	NA	NA	NA	NA	NA	NA
	Post	105	478386.00	2585.00	14462.87	22375.81	17534.84	7200.73	5456.05	25720.16
Pulkal Mandal	Pre	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Post	4	10908	6426025.00	398578.00	74481811.00	8605890.00	51025284.00	24868043.00	71461156.00
Munipalle Mandal	Pre		NA	NA	NA	NA	NA	NA	NA	NA
	Post	1	5907	1897977.00	148445.00	30392131.00	32634354.00	9179040.00	4344424.00	181685588.00
Regode Mandal	Pre	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Post	1	4699	2805787.00	82362.00	59644242.00	626935357.00	15949983.00	15846502.00	38547209.00
Raikode Mandal	Pre	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Post	2	17026	896328.00	13729.00	7591973.00	15586293.00	7802299+	7802297.00	5152427.00
Nyalkal Mandal	Pre	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Post	2	10558	1460752.00	83157.00	27914259.00	30016420.00	18686935.00	15918961.00	20812209.00
Manoor Mandal	Pre	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Post	1	5345	1560103.00	281599.00	32712930.00	34646987.00	17692092.00	11598890.00	26568765.00

Source: Compiled from District level records

5.55 Besides Agricultural Cooperative Societies, the Medak District Cooperative Central Bank also extended short and long term Agricultural loan to the farming community. The district level data available for pre and post project period is presented in **Table 5.12.** The data indicated that there was an increase of 837 per cent from pre-project to post-project situation in respect of Short Term Loan. Similar Pre and increase percentage were also found with regard to Long Term loan i.e., (464%), there is overall percentage increase of 778 per cent putting together short and long term loans from pre-project and post project situation is observed in extending agricultural loan facility to farming community.

Table 5.12

Disbursement of Short Term and Long Term Agricultural Loan in Medak District by Cooperative Central Bank

Terms of Loan	Units	Pre-Project	Post-Project	% increase
Short Term	` in lakh	471.81	4423.55	837.57
Long Term	` in lakh	88.60	499.91	464.23
Total	**` in lakh**	**560.41**	**4923.46**	**778.54**

Development of Industry

5.56 During the pre-project situation, there were 146 units in Large Medium Industries (L & M I) in Medak district employing 37000 persons. In case of Small Scale Industry (SSI) it was noted that in the pre project period there were 3138 such units which were operating at the district. The data on engaging workers in SSIs was not available for the same.

5.57 During the post project situation tremendous growth of Large and Medium Size industries (L & MIs) is observed. The number of L&MIs increased from 51during pre project period to 2081 units during post project period in the district. These units employed 97610 persons during the post project period in the district. However, incase of SSIs, these have got reduced drastically from 3138 units during pre-project period to 223 during post-project period. These units employed only 6066 persons during post project period. The above analysis clearly indicated that the growth in L&MIs was at the cost of SSIs. It appears that there was paradigm shift from SSIs to L&MIs in the district. However, this growth in L&MIs can not be due to the project.

5.58 At the mandal levels (Project affected) the pre-project data on L&MIs & Rice Mill is not available. However, in post-project situation the establishment of L&MIs is observed in Pulkal, Munipalle, Regode and Nyalkal mandals. With regards to Rice Mills, it is observed that only Munipalle mandal is having 4 units employing 31 persons. Our discussions with sample framers indicated that all the four rice mills came up after the

mandal got the irrigation benefit due to project. This growth in rice mills can be attributed to the impact of the project. The details of L&MIs & SSIs are presented in **Table 5.13.**

Table 5.13
Development of Industry in Medak District

SL. No	District / Project Affected Mandals	Large & Medium Industries				Worker Factories				Rice Mill	
		Pre Project		Post Project		Pre Project		Post Project		Pre Project	Post Project
		No of Units	Person Employed	No of Units	Person Employed	No of Units	Person Employed	No of Units	Person Employed	No of Units	No of Units
I	Medak District	146	37000	NA	NA	51	NA	2081	97610	395	463
II	Project Affected Mandals										
1	Pulkal	NA	-	NA	NA	NA	NA	5	185	NA	-
2	Munipalle	NA	-	NA	NA	NA	NA	6	183	NA	4
3	Regode	NA	-	NA	NA	NA	NA	2	21	NA	-
4	Raikode	NA	-	NA	NA	NA	NA	0	-	NA	-
5	Nyalkal	NA	-	NA	NA	NA	NA	1	10	NA	-
6	Manoor	NA	-	NA	NA	NA	NA	0	-	NA	-

NA= Data Not Available

Source: Hand Book of Statistics Medak District

Overall Development

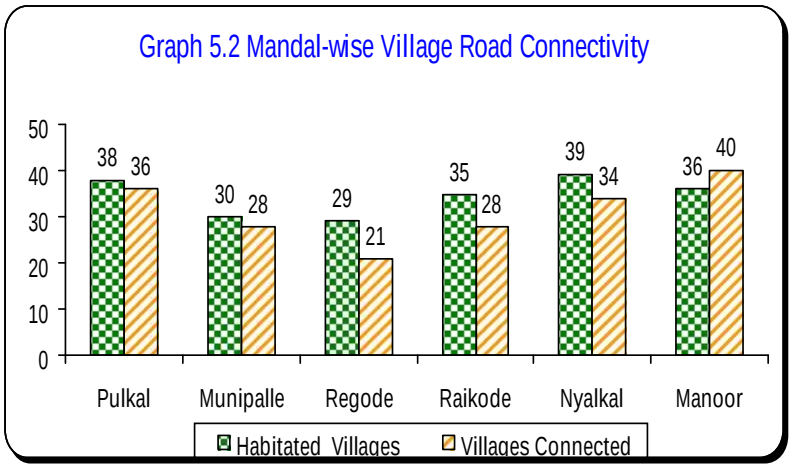
5.59 The pre and post-project scenario of development in respect of Roads, Road Transport & Communications are presented in the following paragraphs.

5.60 ***Road, Transport & Communications:*** The connectivity of the villages has improved substantially through laying of roads through Rajiv Gram Sadak Yojana, out of 1226 villages in the district more than 720 villages have been bought on the main road and other villages are also connected through Bi-Pass roads. Nine villages in 8 mandals in the district are provided with Railway stations. The mandal-wise road connectivity is presented in the following **Table 5.14.** It is seen that almost all the habitated villages are connected by roads.

Table 5.14
Road Connectivity: Mandals and No of Villages connected

S.No	Name of Affected Mandal	Habitated Villages	Villages Connected
1	Pulkal	38	36
2	Munipalle	30	28
3	Regode	29	21
4	Raikode	35	28
5	Nyalkal	39	34
6	Manoor	36	40
Source: Compiled from Hand Book of Statistics of Medak district			

5.60 Most of the habitated villages are having road connection, but Regode mandal villages are having less road connectivity compared to other mandals, the details are depicted in **Graph-5.2**.



5.61 ***Road Transport:*** The strength of APSRTC had increased from 330 in the pre-project situation to 538. Thirteen modern Bus Stations and 45 Bus Shelters are added to the infrastructure.

Facilities like Audio Visual amenities

5.62 The district as a whole had added TV sets both Color and Black & White after the project. There is growth of TV sets in the affected mandals also and as many as 14 TV sets are existing which were 7 before the project.

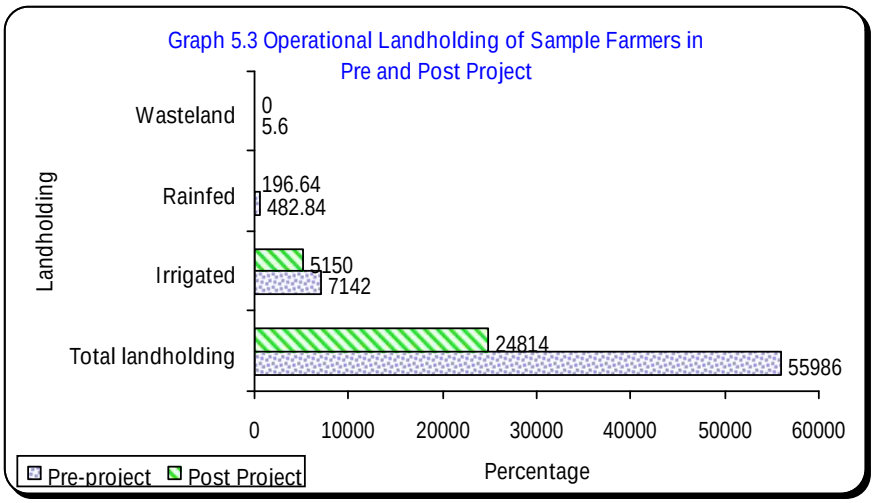
Table 5.15
Availability of Radio and TV Sets in the District and Project Mandals

Sl. No	District/Mandal	Pre-Project			Post-Project		
		Radio	Television		Radio	Television	
			Color	B.W		Color	B.W
1	Medak	788	NIL	129	790	67	118
2	Pulkal	29	NIL	7	29	1	NIL
3	Munipalle	22	NIL	NIL	22	2	NIL
4	Regode	13	NIL	NIL	13	1	6
5	Raikode	19	NIL	NIL	19	1	NIL
6	Nyalkal	17	NIL	NIL	17	1	1
7	Manoor	28	NIL	NIL	28	1	NIL
	Mandals Total	128	NIL	7	128	5	7

Source: Compiled from the District and Mandal level available records.

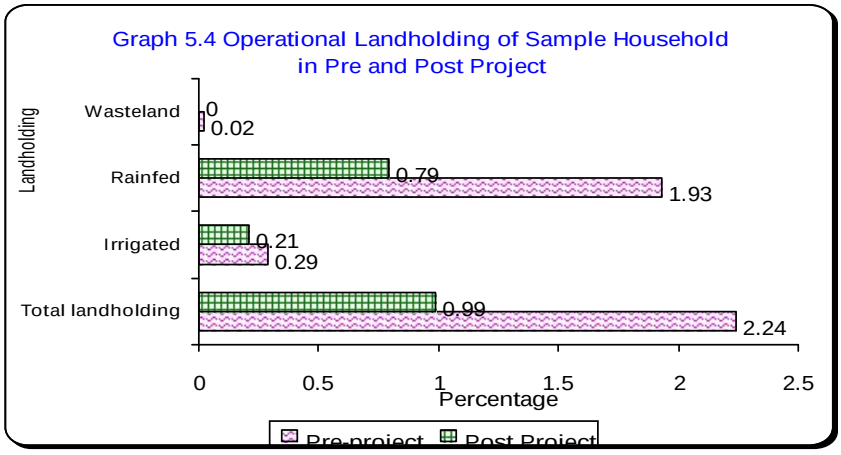
Findings of Field Survey

Operational Landholding of Sample Farmers



5.63 The household survey indicated that the total land holding of sample farmers came down from 559.86 ha to 248.14 ha during post-project. The decrease in rainfed area is steep from 482.84 ha to 196.64 hectares, whereas, the irrigated area decreased from 71.42 ha to 51.50 ha. The wasteland which was 5.60 ha became nil during post-project period. The percentage of total land holding decreased is 55.6 per cent. The village –wise and mandal-wise analysis is presented in **Annexure –V.26**.

Average Operational Landholding of Sample Household

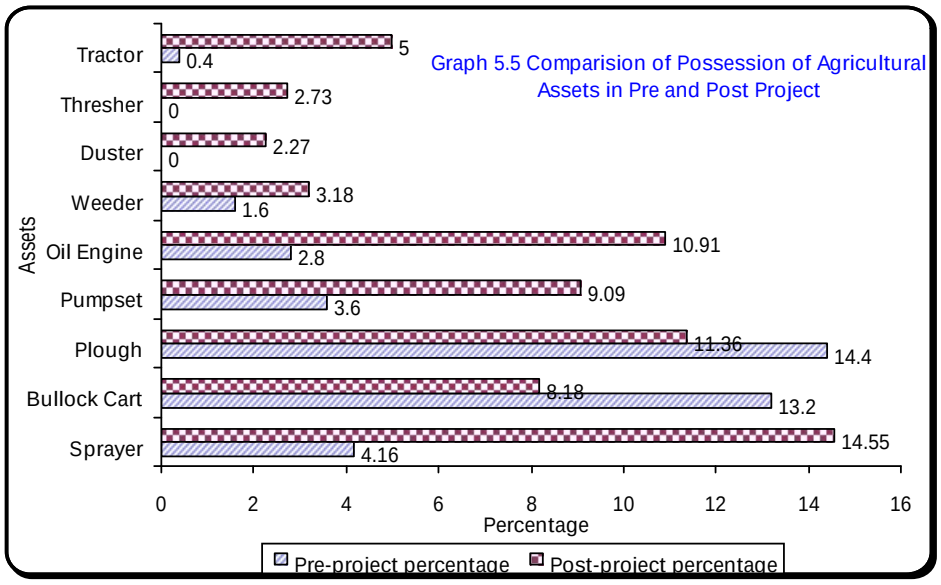


5.64 The average size of landholding during pre-project was 2.24 hectares which came down to 0.99 hectares. The irrigated land decrease from 0.29 h / household to 0.21 ha / household and rainfed land from 1.93 ha / HH to 0.79 / HH. None of the households during post-project hold waste land. The village-wise and mandal-wise analysis is presented in **Annexure V.27**.

Landholders to Landless

5.65 One significant finding from the field survey data is that 31out of 250 sample farmers became totally land less during post-project. During the pre-project the total land holding of these 31 households was 23.5 hectares which become zero in post project. These farmers could not purchase any land due to weak economic condition and remained as Agricultural labourers. The village-wise details are presented in **Annexure V.28**.

Possession of Agriculture Assets by Sample Household in Rehabilitated Area



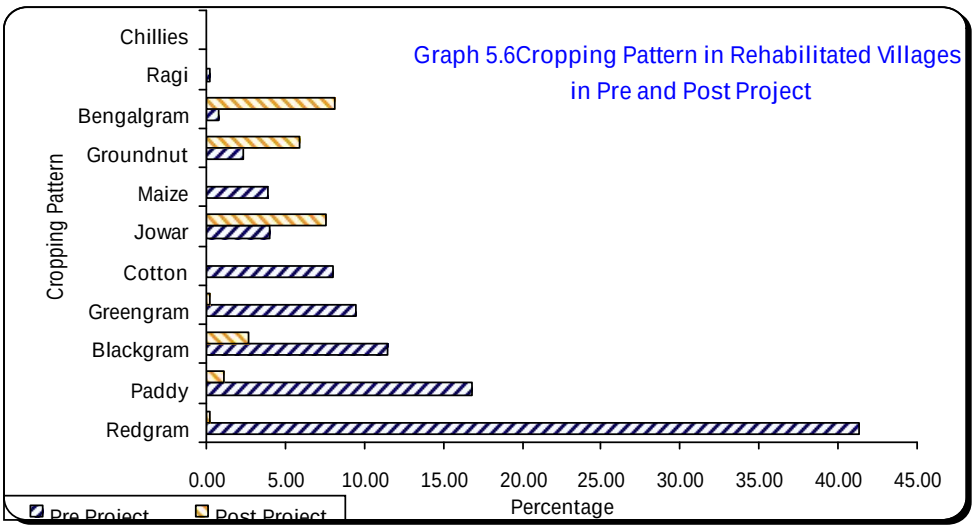
5.66 During pre-project tractors were possessed by only 0.40 per cent of sample household which rose to 5 per cent in post project. The household possessing ploughs decreased to 11.36 per cent whereas, oil engines and bullocks carts increased 10.9 per cent & 14.5 5 per cent post project. There is increase in assets also as revealed by above diagram. The percentage of household not holding any agricultural asset decreased to 30 per cent forms the earlier 48 per cent.

5.67 The increase in Agricultural assets despite decrease in land holding indicated that the assets are possessed for leasing out and earning income through rentals as the land

holding size decreased. The village and mandal-wise details are presented in **Annexure V.29**.

Cropping Pattern in Rehabilitated Villages

5.68 During Kharif season in the pre project scenario Red gram occupied 41.3% of area followed by Paddy (16.88%) and Black gram (11.5%), Green gram (9.5%). **(Annexure V.30).** The priority changed in post project situation.



Where green gram occupied 31.4 per cent area followed by paddy (22.8%), Red gram (21.1%), and Black gram (9.3%) **(Annexure V.31)**

Production and Productivity in Project Affected Mandals

5.69 There is increase in production in all the major crops when compared to pre-project scenario except in case of Bengal gram, Maize, Ragi and Red gram due to drastic reduction in the area of cultivation. The cultivated area in respect of all crops has gone down as the farmers could not acquire similar size of land after the project displacement. However, due to substantial increase in the average yield per hectare in respect of all crops the total volume of production more or less remained the same despite decrease in area.

5.68 The total area under Bengal gram came down from 218.66 hectares to a mere 23.09 hectares, Ragi from 0.79 ha to 0.29 ha, Maize from 15.35 hectares to 2.65 hectares, Red gram from 161.21 ha to 38.57 hectares and Paddy from 68.06 ha to 43.17 ha. However, the average yields per ha of respective crops as above have gone up to 10.69 quintals (4.40qtls), Black gram to 7.73 Q (2.62 qtls), green gram to 9.52 Q (2.83 Q), Groundnut to 28.81 Q (9.38 Q), Jowar to 13.18Q (4.57 Q), Maize to 47.26 Q (36.83) and

Paddy to 69.83 Q (3715 Q). The figures in brackets indicate baseline production levels prevailing in pre-project situation.

5.69 The trend in production indicated that despite decrease in land the production levels could be maintained due to improvement in technology. However, had the farmers retained the same size of land the total production would have been 3-4 times more than in the pre-project level. The status ene in production levels could be thus possible due to increase in average yield per hectare for all crops.

Cropping Intensity in Project Affected Mandals

5.70 The cropping intensity is the number of times crops are grown on an unit area of land. The gross cropped are in pre-project was 652.58 and the net cropped are is 559.86 hectares. The cropping intensity during pre-project therefore, worked out to 116%. The gross cropped area in post-project was 270.17 hectares and the net cropped area was 248.14 hectares. The cropping intensity after the project is 108%. The cropping intensity has comedown during post-project due to lack of enough irrigation facilities an the project affected mandals **(Annexures V. 30 & V.31 for details).**

5.71 **Possession of Livestock in Project Affected Mandals:** The study revealed the negative change in owning livestock from pre to post project situation. In other words the possession of livestock has drastically come down among the fully project affected sample households. The informal discussion held with respondents during data collection indicated that majority of the oustees had sold out their animals during the process of resettlement and rehabilitation for want of money or considering the extent of meager landholdings in new settlements. From the **Annexure V.33** it can be observed that 65 households sold out cows which they possessed during pre-project situation. Similarly 62 and 73 sampled households sold she-buffaloes and bullocks respectively during post-project period.

5.72 Further data analysis indicated that possession of cows came down from 294 (pre-project) to 56 nos. is in post-project situation. Similar is the case with she-buffaloes (from 396 to 180 nos.,) bullocks (From 223 to 63 nos.,) sheep (388 to 185 nos.,) goats (From 281 to 140 nos.). Details of livestock ownership are given in **(Annexure V.34)**

Agricultural Scenario is partially Affected Villages

5.73 Hither to the status of agriculture in pre and post project situations was given in the fully affected villages. In the following paragraphs the agriculture scenario in post project as compared to pre project is narrated.

Cropping Pattern

5.74 During pre-project in Kharif season green gram occupied major area (30.6%) followed by paddy (15.4%), Red gram (9.9%), Black gram (9.6%) and Sugarcane (9.5%).
5.75 During Post project in Kharif season the area under green gram remained same (30.6%) whereas, paddy occupied 24.2 per cent area followed by sugarcane (1.8%), Red gram (10%), Cotton (8.5%) and Jowar (8.4%). Cotton and Jowar are the new crops in the priority in the post-project scenario. **(Refer Annexures: V.35 and V.36).**

Production and Productivity

5.76 The total production during post project (11087 Q) of all the major crops had gone down under compared to pre-project level (12825 Q). The main reason for reduction in total production is decrease in the area of land held by the sample farmers in the partially affected villages. The farmers were holding in total 268.47 hectares in pre-project situation and after loosing the land due to project the overall holding of all the sample farmers come down to 127.22 ha. The analysis of individual crops revealed that the yield of paddy had almost doubled (981 Quintals to 1749 Quintals). Likewise the yield of groundnut had also gone up from 228 Quintals to 361 Quintals. Barring sugarcane the total production levels of other crops remained more or less same due to decrease in the area of cultivation.

5.77 In regard to productivity the average yields per hectares has gone up in respect of all the major crops due to improved cultivation practices during the post-project period. The average yield of paddy, increased from 37.27 Q/ha in pre-project period to 69.82 Q/ha during post project period. Similarly, it had gone up from 3.24 Q/ha to 8.99 Q/ha for green gram, from 9.19 Q/ha to 22.07 Q/ha for Groundnut and from 685 Quintals / ha to 910 Quintals / ha for Sugarcane. The average yields per hectare of other crops had also gone up. **(Annexure V.37 may be referred for details).**

5.78 Despite decrease in land during post-project in view of increase in average yields (productivity) due to improvement in technology the overall production status could be maintained barely. However, has the farmers maintained the same level of land even after the project the overall production levels could have gone up 3-4 times more than pre-project.

Cropping Intensity

5.79 As in fully affected villages, even in partially affected villages the cropping intensity during post project had come down. The cropping intensity during pre-project was 115.3 per cent which come down to 113.4 per cent during post-project. The reduction is attributed to lack of sufficient irrigation water after the project.

Status of Livestock

5.80 The population of livestock comprising of cows, Bullocks, Buffaloes, Sheep and goat had come down during post project situation. The percentage of households possessing loan had come down from 40 per cent to 10 per cent and that of bullocks from 45 per cent to 13.3 per cent. However, the decrease in respect of buffaloes is not that steep having a reduction of only 16 per cent of household. ***(Please refer Annexure V.38 for details).***

5.81 The average number of cows per household had come down from 1.68 to 0.27, bullocks from 1.48 to 0.27. In respect of buffaloes the average number per household had come down from 2.77 to 1.62 during post project while that of sheep from 3.05 to 2.08 per cent. The study also revealed that the population of sheep is more compared to other types of livestock. ***(Please refer Annexure V.39 for details).***

Part – I

6
Impact on Groundwater and Drainage

AFC, Hyderabad

6

IMPACT ON GROUNDWATER AND DRAINAGE

Introduction

6.01 It is but obvious that any development project is always proposed in the vicinity of or on the water source and it is more so in irrigation projects by formation of reservoirs at different locations by constructing barriers across the rivers. The main objective is irrigating large area for increasing productivity per unit area. Such projects, even though are beneficial for overall development of the area, will have both positive and negative impacts on groundwater scenario in the influence zone. The Singur River Valley Project was constructed about 25 years back and is catering to the needs of Agriculture Community in the command area of Ghanpur Anicut and Nizamsagar. It is also meeting the drinking water needs of twin cities of Hyderabad and Secundrabad to the extent of one third of the total population of these two cities. The evaluation in this chapter is focused on the impact of the project on groundwater in crop production, soil health in command area and on quality of groundwater. Hence, an attempt had been made in this chapter to assess the quantity and quality of surface water of Manjira River as well as that of groundwater in bore wells recharged due to the project.

Water Quality of Manjira

6.02 The suitability of water for irrigation and drinking will be determined by the quantity and kind of salts present, inaddition to the levels of pH and EC. With poor water quality various soil and cropping problems can be expected to develop. Among the soluble constituents, calcium, magnesium, sodium, chloride, sulphate and bicarbonate are of prime importance in determining the quality of surface water and its suitability for irrigation purposes. The other elements which are present in minor quantities usually do not affect the quality of irrigation water as far as the total salt concentration is concerned. Of the several factors influencing irrigation water quality, the generally accepted criteria for judging the quality are

- Total salt concentration as measured by electrical conductivity
- Relative proportions of cations as expressed by Sodium Absorption Ratio (SAR) and
- Bicarbonate and Boron contents.

6.03 Water quality ratings as proposed by Central Soil Salinity Research Institute, Karnal, giving emphasis on salinity and soil texture under specific situations is

reproduced in **Table 6.1**. The limits are subject to the condition that groundwater table in no time of the year rises within 1.5 m from the surface. If it is likely to rise up to root zone, the limits shall be reduced to half.

Table – 6.1
WATER QUALITY RATINGS

Sl. No	Nature of Soil	Crops grown	Safe Maximum limit of EC of irrigation water micro mhos/cm
1	Deep black soils and alluvial soils, having clay content of more that 30%, fairly to moderately well drained.	Semi tolerant Tolerant	1500 2000
2	Heavy textured soils having a clay content of 20-30 per cent, well drained internally and have good surface drainage system.	Semi tolerant Tolerant	2000 4000
3	Medium Textured soils having clay content of 10-20 percent, well drained internally and have a good surface drainage system.	Semi tolerant Tolerant	4000 6000
4	Light textured soils having clay content less than 10 percent and have excellent internal and surface drainage.	Semi tolerant Tolerant	6000 8000

Source: Central Soil Salinity Research Institute Karnal

6.04 The soils in the command area of Singur Irrigation Project fall under category II and III and the crops grown can be taken as semi tolerant. Thus irrigation water having EC less than 2000 micro mhos/cm will be quite suitable for growing all types of crops.

Water Sample Analysis

6.05 Surface water samples were collected at different locations from reservoir, and Manjira River during the hot weather period of 2009 and got analysed. The results of the analysis are furnished in **Table - 6.2.**

Table - 6.2
ANALYSIS OF WATER SAMPLES DURING HOT WEATHER PERIOD 2009

Sl. No	Parameter	Units	Sample I Reservoir (Singur)	Sample II Manjira River water at 1Km down stream of Singur	Sample III Manjira River Water about 7km down stream of Singur	Limits as per IS:10500 (1991) for Drinking Water
1	pH	..	7.68	7.57	8.34	6.5-8.5
2	EC	Micro mhos per cm	343	547	539	1500/2000
3	Dissolved Solids	Ppm	253.0	336.0	362	500 max
4	Total Suspended solids	Mg/l	20.0	22.0	26	-
5	Turbidity	NTU	0.24	0.35	0.61	5 max
6	Total Hardness as $CaCo_3$	Mg/l	142.0	246.0	214.5	300 max
7	Alkalinity to phenolphthalin as Co_3	Mg/l	BDL	BDL	BDL	200 max
8	Allkalinity to methyl orange as Ca Co3	Mg/l	20	50	60	200 max
9	Non carbonate hardness as CaCo3	Mg/l	08	09	12	-
10	Calcium as Ca	Mg/l	50.1	85.0	69.4	75 max
11	Magnesium as Mg	Mg/l	39.2	32.6	22.6	30 max
12	Sodium as Na	Mg/l	20.3	15.0	18.5	-
13	Potassium as K	Mg/l	4.5	1.8	2.1	-
14	Chlorides as Cl	Mg/l	22.0	7.0	31.6	250 max
15	Sulphates as So4	Mg/l	17.6	10.0	18.9	200 max
16	Nitrates as No3	Mg/l	0.66	0.77	0.66	45 max
17	Fluorides as F	Mg/l	0.31	0.60	0.49	1.50 max
18	Phosphorous as P	Mg/l	0.002	0.003	0.003	-
19	Manganese as Mn	Mg/l	0.003	0.004	0.009	0.05 max
20	Iron as Fe	Mg/l	0.24	0.20	0.16	0.3 max
21	Chromium as Cr	Mg/l	<0.001	<0.001	<0.001	0.1 max
22	Boron as B	Mg/l	<0.001	<0.001	<0.001	1.0 max
23	Zinc as Zn	Mg/l	0.26	0.08	0.21	5.0 max
24	Copper as Cu	Mg/l	<0.001	<0.001	<0.001	0.5 max
25	Lead as Pb	Mg/l	<0.001	<0.001	<0.001	0.1 max
26	BOD (5 day at 25°C)	Mg/l	9.0	6.0	8.5	30.0 max
27	SAR	-	3.64	1.96	2.73	-
28	Dissolved Oxygen Demand	Mg/l	NA	6.0	5.6	-
29	Total Coliform	MPN/100 ml	12	20	15	50
30	Faecal coliform (Escherichia coli)	MPN/100 ml	Absent	Absent	Absent	-

Source: Based on the Lab reports for the water samples collected from the project area

Note: BDL indicates Below Detectable Limits
NA indicates Not Available

6.06. The water quality standards for different uses, prepared by National Institute of Hydrology (NIH)[1] categorized water into five designated uses and classes. They are as follows:

Sl. No	Designated-Best-Use	Class	Criteria Water
1	Drinking Water Sources without conventional treatment but after Disinfection	A	1. Total Coli forms Organism MPN/100 ml shall be 50 or less 2. pH between 6.5 and 8. 3. Dissolved Oxygen 6 mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 2 mg/1 or less
2	Outdoor bathing (Organized)	B	1. Total Coli forms Organism MPN/100 ml shall be 50 or less 2. pH between 6.5 and 8. 3. Dissolved Oxygen 5 mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3 mg/1 or less
3	Drinking water source after conventional treatment and Disinfection	C	1. Total Coliforms Organism MPN/100 ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4 mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3 mg/l or less
4	Propagation of Wildlife and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4 mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
5	Irrigation, Industrial Cooling, controlled Waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25°C micro mhos/cm Max 2250 3. Sodium absorption Ratio Max.26 4. Boron Max. 2 mg/l
Source: Anonymous, "Water Quality Requirement for Different Uses" (Roorkey: National Institute of Hydrology), (April 2011)			

For each designated best use/class four main criterions were identified. As per this criterion the water of Manjira River is classified as Class-A and its designated best use is drinking water with out conventional treatment but after disinfection.

[1] http://www.nih.ernet.in/rbis/india_information/water%20quality%20standard.htm

The criteria for designated best use of irrigation, industrial cooling and controlled waste disposal consisted the following:

- pH : between 6.0 to 8.5
- Electrical conductivity at 25°C (micro mhos/cm) : Max 2250
- Sodium Absorption Ratio : Max 26
- Boron : Max 2 mg / l

The water quality analysis of Manjira River on the basis of the above four criterion and data presented in **Table 6.2** indicated that the same is quite suitable for irrigation purposes also.

Quality of Ground Water

6.07 The quality of ground water is obtained by representative sampling of various aquifers by the Andhra Pradesh State Ground Water Department. Standard analytical methods are being used to determine the chemical composition of these representative water samples of irrigation water.

6.08 The most abundant constituents are the two alkaline earths Ca and Mg. Potassium also occurs commonly but normally more than Na. The most common are from the two strong acids viz. sulphates and chlorides and two from weak acids viz., carbonates and bicarbonates. Sometimes small quantities of micro elements and nitrates are also present in water samples. An important characteristic of irrigation water in addition to the composition and content of dissolved salts is the reaction of water according to the pH scale. In a chemical analysis report, the reaction is reported as pH value and the chemical analysis shows concentration of constituents. The common terminology use mg/lit which is concentration of dissolved constituent in a litre of solution expressed in milligrams ppm is part by weight of a dissolved constituent in million parts by weight of a dissolved weight of solution.

6.09 The characteristics of irrigation water that appears to be most important in determining its quality of soluble salts, relative proportion of sodium to other concentrates, concentration of nitrates and under certain conditions the bi-carbonate concentrate as related to the concentration of calcium plus magnesium. The total concentration of soluble salts in irrigation water can be adequately expressed for purpose of diagnosis and classification in terms of Electrical Conductivity (EC). Nearly all irrigation waters could be successfully used for a considerable type having conductivity value less than 2250 micro mhos / cm at 25°C. In general, water with conductivity less than 750 micro mhos / cm are good from irrigation point of view in so far as salt concentration is concerned. Therefore, water in the range of 750 to 2250 micro mhos / cm at 25°C enables satisfactory crop growth only under good management.

6.10 Specific conductance of water is a measure of its capacity to conduct a current of electricity. It varies with concentration and degree of different minerals in solution and

the temperature of water. Specific conductance is expressed in micromhos / cm at 25°C. It is relatively easy to determine either in the field or in the lab.

6.11 Bi-carbonates and carbonates are common in ground water because of the abundance of carbonate minerals in nature and because of CO_2 that helps them to dissolve, are readily available. Bi-carbonate concentration range from 50 ppm in water from relatively insolvable rocks to as much as 400 ppm in water from limestone chlorides constitutes to the saltiness of the water supply and may cause the water to be corrosive if the water contains large amount of Ca and Mg. Irrigation return flows may greatly increase the chloride content above than that found in the natural water. Chloride concentrates up to 250 ppm are tolerable in drinking water. Fluoride is strongly soluble and is present in most irrigation waters in small quantities. Concentration greater than 1.5 ppm of fluoride is not permissible especially for drinking water.

6.12 Irrigation waters are divided into four classes with respect to Sodium Absorption Ratio (SAR) values. The dividing points for SAR being at less than10, 10-18, 18-26 and 26. Low sodium water (below 10) can be used in almost all soils with little danger of development of harmful levels of exchangeable sodium.

6.13 The analysis of the Groundwater samples collected at different parts in the project influence zone of Singur project is furnished in **Table - 6.3.** Only two samples of ground water were selected for analysis in the project influence zone, since the area of this zone is relatively small. Further, the Andhra Pradesh Ground Water Department is regularly analyzing the quality of ground water in the project influence area. These results available in their web site clearly indicated the quality of ground water in the area is good. Therefore, only two samples of ground water were selected for comparison with available data in this regard.

Table - 6.3
ANALYSIS OF GROUND WATER SAMPLES

Sl. No	Parameter	Unit	Sample I Groundwater at Peddireddipet (V)	Sample II Groundwater at Busireddipalli (V)	Limits as per IS:10500 (1991) for Drinking Water
1	pH	..	7.10	7.50	6.5-8.5
2	EC	Micro mhos/ cm	310	507	1500/2000
3	Dissolved Solids	Ppm	196	214	500 max
4	Total Suspended solids	Mg/l	4	3	-
5	Turbidity	NTU	8.0	10.0	5 max
6	Total Hardness as $CaCo_3$	Mg/l	180	140	300 max
7	Alkalinity to phenolphthalin as Co_3	Mg/l	Nil	Nil	200 max
8	Allkalinity to methyl orange as Ca Co3	Mg/l	120	180	200 max
9	Non carbonate hardness as CaCo3	Mg/l	20	40	-
10	Calcium as Ca	Mg/l	62	58	75 max

Table - 6.3
ANALYSIS OF GROUND WATER SAMPLES

Sl. No	Parameter	Unit	Sample I Groundwater at Peddireddipet (V)	Sample II Groundwater at Busireddipalli (V)	Limits as per IS:10500 (1991) for Drinking Water
11	Magnesium as Mg	Mg/l	26.70	48.9	30 max
12	Sodium as Na	Mg/l	15.20	20.0	-
13	Potassium as K	Mg/l	Nil	Nil	-
14	Chlorides as Cl	Mg/l	128.0	114.0	250 max
15	Sulphates as So4	Mg/l	165.0	170.0	200 max
16	Nitrates as No3	Mg/l	25.50	6.70	45 max
17	Fluorides as F	Mg/l	0.72	0.69	1.50 max
18	Phosphorous as P	Mg/l	0.005	0.007	-
19	Manganese as Mn	Mg/l	0.012	0.008	0.05 max
20	Iron as Fe	Mg/l	0.023	0.024	0.3 max
21	Chromium as Cr	Mg/l	<0.001	<0.001	0.1 max
22	Boron as B	Mg/l			1.0 max
23	Zinc as Zn	Mg/l	0.46	0.30	5.0 max
24	Copper as Cu	Mg/l	<0.001	<0.001	0.5 max
25	Lead as Pb	Mg/l	<0.001	<0.001	0.1 max
26	BOD (5 day at 25°C)	Mg/l	1.0	1.5	30.0 max
27	SAR	Mg/l	2.28	2.74	-
28	Dissolved Oxygen Demand	Mg/l	5.8	6.2	-
29	Total Coliform	Per 100 ml	4	7	50
30	Faecal coliform (Escherichia coli)	Per 100 ml	Absent	Absent	-

Source: Based on the Lab reports for the water samples collected from the project area

6.14 The ground water is most suited for irrigated agriculture and for drinking purposes also. This infers that there is no impact accrued due to Singur Irrigation Project on the quality of ground water. The water samples collected in different parts in the project influence zone analysis presented nil potassium levels. The sulphates (SO_4) are in the range of 165-170 mg/l which is below the standard level of 200 mg. The phosphorous content is negligible being 0.005-0.007. The chlorides are 114-128 mg/l which is below the standard level of 200 mg. From the above analysis, it is inferred that 'no contamination of groundwater and surface water due to fertilizers and manures is observed. Hence, no preventive steps are found necessary.

Groundwater Scenario in Andhra Pradesh vis-à-vis Medak District

6.15 Medak is one of the districts which receive scanty rainfall annually. The average rainfall of the state of Andhra Pradesh stands at 940 mm where as the normal rainfall of Medak has been only 873 mm on average. This is much below the state average. Moreover there are no surface water resources in the district on a large scale due to which the agriculture depends either on rainfall or groundwater resource. The rock types in the state of AP are 85 per cent hard rock and 15 per cent soft rock whereas in Medak district,

the hard rock is 99.8 per cent and soft rock is only 0.2 per cent. The total water resources combined from surface and groundwater in the state are 108.15 BCM (3820 TMC) of which 58 per cent i.e., 62.29 BCM (2200 TMC) is under current utilization. In Medak district the combined water resources from surface and groundwater is estimated at 91319 ha meters of which 87 per cent i.e., 70407 ha m is under current utilization. The area irrigated by surface water in the state is 3 million hectares out of total area of 6 million hectares and balance is irrigated by groundwater whereas, in Medak 1900 hectares out of total cultivable area of 5,25,000 hectares only 20000 ha are irrigated by surface water and an area of 1,01,000 hectares is irrigated by groundwater. The percentage of area irrigated by groundwater sources in the state stand at 50 per cent whereas in Medak district the percentage area irrigated by groundwater stands at 19.23 per cent and the balance area of 77.16 per cent rainfed which is scanty and erratic.

6.16 The groundwater sources in Medak comprise of open wells, bore wells and tube wells. There are 28604 dug wells and 87114 bore and shallow tube wells. The diameter of the domestic dug wells in Archean group of rocks range from 1.1 to 3 meters and is in circular shape. The irrigation wells measure 2.7 m x 4.5 m to 20 m x 10 m and the depth is around 20-45 meters. In Deccan trap basalt the depth ranges from 20 to 70 meters with a yield of 420 to 19800 lph. In alluvium aquifers where predominantly shallow dug wells and filter points exist, the depth ranges from 3.5 to 10 meters with yields ranging from 10000 to 20000 lph. Due to scanty rainfall most of the dug wells and dug-cum-bore wells in Archean group of rock soils had gone dry and maximum irrigation is done by bore wells.

6.17 A further analysis of average depth to water levels of Medak district in comparison to the average in the state also gives interesting facts as seen from Table 6.4

Table 6.4
Comparison of Average Depth of Water levels in Andhra Pradesh and Medak District

Month and Year	Average Depth (mbgl) to water level state	
	State	Medak District
Sep-08	7.01	11.85
May – 2009	10.64	17.64
August – 2009	11.17	18.47
Sep-09	10.04	16.15

6.18 The average depth to water levels (mbgl) in Medak in all the months are much higher as compared to the same for state as a whole. The water level fluctuations during May 2009, August 2009 and September 2008 in comparison to the water levels during September 2009 both in the State and Medak are presented in **Table 6.5.** The Water level fluctuations in Medak district were much higher as compared to these in state as a whole. This may be mainly because of rainfall variations in the state and Medak district.

Table 6.5
Fluctuations of Groundwater Table in Medak District

Month and Year	Fluctuation (in meters) between September 2009 and other stated months	
	State	Medak District
May – 2009	0.60 m	1.49 m
August – 2009	1.13 m	2.32 m
Sep-08	-3.02 m	-4.30 m

6.19 The classification of micro basins in the state as a whole reveal that 67 per cent of mandals are in safe zone, 15 per cent in semi critical zone, 8 per cent in critical zone and 10 per cent are in over -exploited zone. On the other hand, in Medak district only 22 per cent are in safe zone, 28 per cent are is semi-critical zone, 24 per cent in critical zone. The number of mandals in over exploited zone in Medak is 11 (24%). In view of this situation efficient groundwater management strategies are necessary in Medak district which shall advocate optimal utilization of groundwater resource. Drilling of bore wells need to be taken up with mandatory spacing norms as suggested by authorities without dilution of norms.

6.20 Keeping in view all the critical factors that govern the groundwater resources, this study is conducted to analyze the condition of and status of groundwater resources in the project affected and command area mandals under Singur project.

Topography and Drainage:

6.21 The groundwater influence zone of Singur project consists of six mandals. They are as follows:

- Manoor
- Regode
- Raikode
- Pulkal
- Munipalle
- Nyalkal

The groundwater scenario in these mandals is analysed in the following paragraphs

6.22 Topography plays a major role in the potential offered by an area for exploitation and recharge to groundwater. The lesser the relief the more the scope for recharge to ground water in a given area. The area has regional slope due east and south east and the local slope is due NW to SE. In general, the surface runoff and groundwater flow follow the topographic slope. However, in the case of groundwater, the hydraulic gradient facilitates the flow of groundwater in the directions wherever the aquifer is potential and has proper connectivity and accordingly, as per the data collected, the villages on the western flank have benefitted more on account of the potential acceptance of the recharge to ground water by the formation.

6.23 The drainage is a direct consequence of the type of a topography obtained in a given area and it decides the location for the construction of dams thereby plays important role in shaping the lives an of the local populace. The dam with its canal network and assured irrigation facility was to benefit the population down stream of the dam site.

The Pipeline Alignment from the project to Supply Drinking Water to city of Hyderabad

Hydrometeorology

6.24 The climate plays a major role in the need and the scope for recharge to groundwater. The prevailing semi arid climatic conditions necessitate substantial usage of groundwater. The erratic and deficit rainfall has resulted in reduced inflows into the reservoir and the contemplated irrigation could not be achieved. The normal rainfall of the District in mm and that of the six districts is given in **Table 6.6**.

Table 6.6
Normal Rainfall in Project Influence Zone Mandals

Sl. No	Mandal	Normal Rainfall in mm
1	Manoor	870
2	Pulkal	878
3	Regode	890
4	Munpally	909
5	Raikode	917
6	Nyalkal	878

6.25 The normal rainfall of the District is **873 mm**. The normal rainfall of six mandals in the groundwater influence zone of Singur project is presented in Table 6.6. The normal rainfall in five of the six mandals in the zone is higher than the normal rainfall of the district.

6.26 The district receives an average rainfall of 873 mm, which increases from South to North. The mean maximum and minimum temperature vary from 40° C to 26° C.

6.27 Andole mandal which is part of the contemplated command arrea has normal rainfall as 1031 mm. Analysis of the rainfall data for five years during 2001-2002 to 2005-06 as collected by the CGWB indicates to deficit in rainfall ranging from 20% to 40% during more than three years. Similarly, subsequent years also the rainfall was normal mostly ranging between + 10% to - 10%.

Soils

6.28 The area under investigation offers varied type of soils ranging from light Black cotton soil to mixed soils and at places red chalka. These types of soils are observed in Peddareddipet, Mantoor and other villages in the Catchment. In village Raikode, the soils are black cotton in nature with thick clay. Busireddipally village on the western flank also exhibits light BC soils to a considerable extent. However, village Allapur in Minipally mandal exhibits clayey soils.

Various types of soils in the study area

Mixed soils

Light Black Cotton Soils

Irrigation:

6.29 Manjira dam was supposed to change the lives of the local population by providing assured irrigation water to 16000 ha. Due to repeated failures of monsoons over the past 10-15 years, the project could not provide assured irrigation water to the fields in the contemplated command as envisaged. However, the project has succeeded in providing drinking water to quench the thirst of ever growing population of Hyderabad city, the State capital. Even though no irrigation could be created in envisaged command through the canal system, ground water irrigation increased due to the enhanced ground water potential created due to the recharge of the aquifer by the huge surface storage created by the dam.

Geology

6.30 The occurrence of type of geological formation in an area has immense control on the development of type of aquifer as well as the potential for recharge to groundwater. Besides the structural disturbances in the geological past, the mode of origin of the rock formation, the mineralogical composition and the climatic effects play a major role in deciding the type and thickness of the weathered zone which in turn affect the recharge.

6.31 The important rock types in the study area and in the immediate vicinity to it on the western side are Peninsular Gneissic complex, Dharwar super group associated with Younger intrusive of Achaean age separated un conformably with overlying Basaltic flows of late Cretaceous to early Eocene age with sub-Recent to Recent alluvium along the stream courses. The district of Medak has two types of rock types namely Granites and Deccan traps.

The granite mother rock exposed in different parts of the study area

Intrusive rock exposed downstream side of the masonry structure

6.32 The granites belong to Achaean age and the rock is grey and mixed granite. The texture is fine grained to medium grained. The granitic rock is covering more than 80 percent of the area. The other 20 percent of the area is covered by basaltic rock. The eastern, northern and southern parts of the district are covered by granite.

6.33 The western part of the district is covered by Deccan Trap which is of late Cretaceous to early Eocene age. The rock is in the form of thick layers of fine grained basalt which have been subjected to tectonic activity resulting in secondary porosity in the form of fractures and joints. Wherever such tectonic activity has happened, the aquifers are potential.

Hydrogeology

Weathering

6.34 In normal conditions, ground water occurs under phreatic conditions in the weathered portions of the rock and under semi confined conditions in the fractured parts of the formation. Weathered portions of the rock formation are the real contributors of the surface water to the subsurface aquifers. The more the weathered thickness, the more is the recharge to the groundwater. Weathering is two types: i) Physical weathering ii) Chemical weathering. Both the types of weathering lead to disintegration of the rock formation and help create potential shallow aquifers as well as a means to contribute to the deeper aquifers.

6.35 Joints, a genetic feature of the rock formation, help in faster disintegration of the underlying granite and basalt formations which leads to development of conduits for transport of water as well as storage locations in the subsurface. Besides weathering and jointing, the structural disturbances in the geological past leading to folds, faults would immensely aid in development of potential aquifers. The underlying fractures, below the weathered zone, carry the waters to the deeper horizon, storing it for posterity. This phenomenon is evident in the villages on the left flank of the reservoir.

6.36 The area under study can be divided into two parts, i) Eastern flank ii) Western flank. Eastern flank has area from three mandals namely i) Pulkal, ii) Regode and iii) Manoor, whereas the western flank has areas from i) Munipalle, ii) Raikode and iii) Nyalkal mandals.

Well Density

6.37 The well density is defined as the number of groundwater extraction structures per square kilometer of geographical area. It is observed that the density of bore wells in the western flank is 9, 7 and 8 structures per sq km and it is 3, 8 and 9 in the eastern flank **Table 6.7**. It is reported that the density of the bore wells was substantially low on the western flank than what it is now after the favorable recharge conditions due to impounding of water in the reservoir. The inventory of the field conditions also indicates similar situations. The existing conditions in the villages of Peddareddipet and Raikode, visited on the eastern flank, point to bore wells of moderate depth ranging from 50-60 m bgl with moderate to poor groundwater potential.

Table 6.7 Mandal-wise well Density in Project influence zone				
Sl. no	**Mandal name**	**Area (in sq.km)**	**No. of Ground water extraction structures**	**Density**
Western flank				
1	Nyalkal	219.74	1961	9
2	Munipally	212.0	883	7
3	Raikode	213.0	878	8
Eastern flank				
4	Manoor	296.66	1038	3.5
5	Regode	153.90	1255	8
6	Pulkal	227.78	2028	9
Source: Compiled on the basis of information obtained from Groundwater Department				

The Picture of the Singur Reservoir during November, 2010

6.38 The water spread area of the project has marked effect on the groundwater regime on the western flank of the river

6.39 This is corroborated by the number and density of the bore wells that is inventoried in the study area. Busireddipally and Allapally villages on the western flank have more than 30 to 40 bore wells in the villages and the yields range from 1000 to 1500 gph. However, the villages like Peddareddipet, Manthoor and Raikode, on the eastern flank have bore wells from 2-8 and the yield ranges are in the range of 300 gph to 600 gph only.

Water levels

6.40 The analysis of water levels in the area under study clearly elucidates the effect of rainfall and the storage of water in the reservoir on the groundwater regime. Regular

monitoring of the water levels at periodic interval will help to track the dynamic changes that keep happening in the aquifer.

6.41 The geological composition of the study area of Singur project comprises of hard rock formations (Archean and Deccan traps) on the western side. The western flank has area from three mandals and the eastern flank has areas from three mandals.

6.42 The groundwater occurs in joints, fractures and crevices of massive and jointed basalts. In vesicular basalts open vesicles pave the way for groundwater occurrence and movement. It is seen from the project site that the adjoining and peripheral hard-rock formations have no fractured zone or crevices due to which the top layer aquifers could not move to recharge the bore wells. However, the bottom layer aquifers around the reservoir could recharge the bore wells on the right flank. This is evident from the fact that though the water levels below ground level in the bore wells came down from 8 meters to 14 meters, the yield of the bore wells on the right flank remained satisfactory at around 16000 lph. Similar, situation is not obtained on the left flank as the bore wells could not be recharged and went more or less dry. The villages on the left flank have to suffer even for drinking water leave alone for irrigation purposes.

6.43 The second positive observation in regard to the impact on groundwater comes from the fact that in Medak district 22 per cent of mandals are in safe zone whereas all the six project influence zone mandals are in satisfactory position of groundwater availability inspite of higher density of wells as compared to the state as a whole.

6.44 The analysis of the pre and post monsoon water level data as collected from the Piezometers of the SGWD in the catchment area of the reservoir has indicated that they were considerably deep from 2001-02 to 2005-06 due to poor inflows into the reservoir on account of regular and continuous deficiency in rainfall.

6.45 Whereas, with improvement in storage levels in the reservoir due to good monsoon conditions beyond 2005-06, up to 2009-2010, the water levels exhibit marked rising trend indicating to the increased availability of groundwater in the areas which are hydro geologically favorable. The number of bores increased, yields improved and area of crops grown under groundwater irrigation also increased. This situation is exhibited in villages like Bhusareddipally, Allapally, and Mallikarjunapally **Table 6.8**.

Table 6.8
Trend in Groundwater levels in Sample Project influence zone during pre-monsoon and Post-monsoon season (2001-2009)

SL NO.	DISTRICT	VILLAGE	MANDAL	Pre monsoon Depth to water levels of the five mandals in the catchment								
				May -01	May -02	May -03	May -04	May -05	May -06	May -07	May -08	May -09
1	MEDAK	Hadnoor - s	Nyalkal	17.99	18.27	19.85	19.11	21.66	23.35	23.60	15.534	19.95
2	MEDAK	Manoor	Manoor	10.88	14.25	15.75	17.75	18.10	18.07	23.00	21.22	
3	MEDAK	Munigadapa	Jagdevpur	14.60	15.36	18.50	18.75	24.40	19.03	16.81	18.62	17.37
4	MEDAK	Raipole	Doulathabad	24.92	25.11	29.27	26.79	27.95	21.49	21.03	23.762	23.15
5	MEDAK	T.lingampally	Regode	16.01	16.11	12.60	9.28	6.81	4.94	6.71	5.91	9.41

SL NO.	DISTRICT	VILLAGE	MANDAL	Post monsoon Depth to water levels of the five mandals in the catchment								
				May -01	May -02	May -03	May -04	May -05	May -06	May -07	May -08	May -09
1	MEDAK	Hadnoor - s	Nyalkal	11.47	13.11	12.50	14.110	16.33	13.35	13.28	11.87	11.92
2	MEDAK	Manoor	Manoor	5.68	8.54	15.60	16.670	14.60	17.55	20.87		
3	MEDAK	Munigadapa	Jagdevpur	14.46	16.47	17.82	24.090	18.39	16.39	17.39	15.59	10.07
4	MEDAK	Raipole	Doulathabad	20.56	23.81	25.290	24.640	14.61	14.05	18.17	16.21	25.03
5	MEDAK	T.lingampally	Regode	4.56	6.50	2.090	2.770	2.12	3.34	2.6	2.66	1.76
Source:												

6.46 However, areas with poor hydro geological settings like fine grained granitic rock with shallow basement, poor jointing and fracturing could not benefit from the increased inflows. This situation could be observed in villages like Raikode, Mantoor and Peddareddipet which are located on the eastern flank of the reservoir. Despite the reservoir being full to the FRL, there is very little agricultural activity in the immediate vicinity of the above village.

6.47 The villages in the mandals of Pulkal and Andole, which form the command area, have been experiencing gradual improvement in the availability of more and more groundwater for the formers and they resorted to its extensive usage over the years thus resulting in substantial increase in the command.

Groundwater Development Status

6.48 The district as a whole is dependent mostly on groundwater for its irrigation requirements. As a result, many assessment units in the district are experiencing stress on groundwater. The exploitation of groundwater has been ranging from 90% and at places beyond 100% of the annual recharge to the dynamic groundwater resource and hence the Assessment Units (Aus) are categorized as Critical and Over Exploited.

6.49 However, the large tracts in the assessment units around the study areas have been offered more annual recharge due to the storage in the reservoir and hence the overall stress on groundwater utilization has been less than 70% and are hence are categorized as safe assessment units for groundwater exploitation **(Table 6.9).**

Table 6.9
Mandal Wise Groundwater Resource of the Project affected Mandals in Medak District, Andhra Pradesh-2007

S No.	Mandal	Ground water availability	Groundwater utilization	Groundwater balance	Stage of development	Category
		ha.m	ha.m	ha.m	%	
1	Manoor	1587	389	1198	25	Safe
2	Andole	2142	1209	932	56	Safe
3	Nyalkal	1428	777	650	54	Safe

Table 6.9
Mandal Wise Groundwater Resource of the Project affected Mandals in Medak District, Andhra Pradesh-2007

S No.	Mandal	Ground water availability	Groundwater utilization	Groundwater balance	Stage of development	Category
		ha.m	ha.m	ha.m	%	
4	Regode	1191	435	756	37	Safe
5	Pulkal	2773	1352	1421	49	Safe
6	Raikode	1185	315	870	27	Safe

Conjunctive use of Groundwater

6.50 The quality of groundwater is quite suitable for irrigation needs in all the project affected and command area mandals of Singur Project. The harnessing of groundwater in the command area mandals is assessed to be low. The possibility of development of salinity arises only when water is allowed to stagnate. The available data indicates that salinity is not present in the soils of the existing irrigated command area. The chemical analysis of the soils in the command area also indicates no salinity.

4.51 Conjunctive water use refers to simultaneous use of surface water and groundwater to meet crop demand. Number of farmers in the command area use surface water in conjunction with groundwater. They are doing so in an individual manner, uncontrolled by any scheme or basin level agency. The conjunctive management by contrast refers to efforts planned at the scheme and basin levels to optimize productivity, equity and environmental sustainability by simultaneously managing surface and groundwater resources. Conjunctive use of surface and groundwater has to be planned in the project command area preferably in the tail end reaches. The conjunctive use is suggested to achieve the following objectives.

a) To supply water during dry spells and even in Kharif so as to reduce the supplies of surface water and save in the reservoir.
b) Paddy nurseries can be raised in advance without canal waters.
c) During peak period of maturity groundwater may be used as supplementation.
d) During rabi, groundwater utilization is preferred to deplete the aquifers to a major extent and keep low water table levels so as to reduce water logging effects in Kharif. This will accommodate the recharge of the fresh water zone aquifers.

4.52 The use of groundwater is being practiced in the proposed command area Singur particularly in tail end areas. This is being done with the help of deep tube wells, filter point tube wells and medium depth tube wells. The level of utilization of groundwater in is over 45.25 per cent whereas the average utilization of groundwater resources in the state is only 18.31 per cent.

Groundwater Development

4.53 As observed from the groundwater depths, there is ample scope for the development of groundwater. The groundwater development shall be planned scientifically and cautiously.

4.54 There is possibility of development of groundwater through 900 tube wells. An amount of ` 270 lakh is required to provide filter points and tube wells where ever feasible for conjunctive use of groundwater along with surface water. The district administration can organize and develop groundwater development in private sector through institutional finances available and subsidies under normal programmes.

Implementation

4.55 Implementation of conjunctive use has to be done as follows:

1. Canal water supplies will be regulated by Govt. department
2. Groundwater will be developed by the farmers for which cost of well, pumpset, pipeline and accessories has to be financed fully to all types of farmers.
3. Tube wells/filter points will be constructed and maintained by Govt. Organization and the farmers will be levied water cess. Farmers will be given canal water only in Kharif.
4. Seed beds shall be developed with the help of groundwater. Paddling activities may also be carried out as per the feasibility with groundwater for optimum utilization.

Proposed Outlay for Conjunctive use

6.56 The proposed outlay for conjunctive use of groundwater under modified EMP is ` 270 lakh i.e., 900 tube wells @ ` 30000 per tube well.

Drainage Characteristics of Singur Command

6.57 Removal of excess water (free or gravitational / standing of stagnant water) from surface or below surface of the soil so as to create favorable soil conditions for plant growth is termed as soil drainage. The excess water leads to waterlogging and salt imbalance. This salt imbalance renders the land to be less productive and problematic.

6.58 Since most of the proposed command area of Singur project is level or gently slopping the flow of water may not be that rapid under sub-soil conditions. This type of terrain conditions may lead to water logging of the command area of the project. However, the soils in the proposed command area of the project are mostly sandy loamy soils. Even though the terrain conditions of command area may lead to water logging, the available soils in the command area will allow the stagnated water to percolate to deep in to the soil. Further, the groundwater table in most of the command area is over 10 mbgl during post-monsoon season. However, in some command area villages the groundwater

level during post-monsoon season of 2009 and 2010 is observed to be less than 1.5 mbgl. Such conditions with regard to groundwater table may lead to water logging. With the provision of irrigation facilities to these villages may lead to waterlogged condition. Therefore, the surface and sub-soil drainage conditions may need to be improved along with command area development. Since, the command area development is yet to start, the provision for on farm development and drainage improvement may need to be made in the EMP. The ill effects of poor drainage are enumerated in the following paragraphs.

Effects of Poor Drainage

a) Absence of air space in the soil for proper root growth where in availability of O_2 is limited.
b) Some of the toxic substances are produced including H_2S_1 (boric acid) in the presence of which even paddy crop is affected. This injury is similar to sulphide injury.
c) Natural vegetation like plantations and orchards will be effected due to water logging
d) Standing water for a long period all round will give rise to many soil health problems.
e) Fertilizers applied will percolate to lower zone or lost due to faster infiltration.

Factors Responsible for Poor Drainage

6.59 The factors responsible for poor drainage are enumerated in the following paragraphs.

a) **Soil Type:** In clayey and heavy soils the infiltration capacity is low and the soils are prone to waterlogged conditions and needs drainage.

b) **Slope:** In area with inadequate slope and flat areas, the movement of water is slow and results in poor drainage. The command area is mostly with gentle slopes but for the some village where the slope is almost level to gentle slope. Therefore, such villages warrant proper drainage in selected areas as per need.

c) **High Rainfall:** The excess rainfall received in the absence of proper drains will create waterlogged conditions. However, the command area of the project is in scanty rainfall area. Therefore, the rainfall pattern in the project area may not result in waterlogged conditions.

d) **High Groundwater Table:** In the absence of drains where ground water table is high due to lack of sub-soil drainage, water logged conditions or ill drained conditions are created. Such situations may prevail in some villages of the command in view of the minimum water table below ground varying from 1.50 to 2.00 m and is likely to drop further during monsoon. To overcome this problem, conjunctive use of surface and ground water and creating suitable sub-soil drainage has to be proposed.

Advantages of Drainage

6.60 Suitable drainage system has to be provided in the vulnerable areas under the project, since no drainage system was provided originally during project construction phase. The advantages of proper drainage are as follows.

- ✓ Drainage makes the command more productive
- ✓ Proper drainage makes the entire field more uniform in soil moisture (Elimination of wet patches) and result in more effective tillage and harvesting.
- ✓ Removal of surplus water from the field increases aerobic microbial activity by permitting air to replace water in more soil pore space. As a result the bio micro-organisms will increase which will decompose more organic matter and thus more potential plant nutrients are made available.
- ✓ Proper drainage decreases potential losses of nitrogen.
- ✓ Drainage reduces the building up of toxic substances in soil.
- ✓ Wide varieties of crops and more valuable crops can be raised in well drained soil.
- ✓ Drainage permits deeper penetration by plant roots thereby increasing the availability of
- ✓ Nutrient to growing plants resulting in higher crop yields. Deep roots make the plant more resistant.

Provision of Drainage in the Command

Surface Drainage

6.61 Surface drainage is the removal of excess water from rainfall or seepage or irrigation from the surface of lands. Command area whether localised for wet or ID crops, needs adequate surface drainage system. For designing surface drainage system the following factors are to be considered:

a) Intensity of `rainfall-1 day, 2 day, 3 day rainfall with certain frequencies (5 years, 10 years)
b) Infiltration rate of soil
c) Evaporation rate
d) Crops grown during rainy season or at times of heavy rainfall
e) Landscape
f) Gradient that can be given to the drainage channels
g) Outfall conditions

6.62 In the Singur Irrigation Project command there are natural drains/rivers existing at the boundaries. The rainfall precipitation or excess canal water can drain off into Manjira river.

6.63 All field drains will drain into subsidiary drains to be constructed at right angles to natural drains. The size of these drains should be sufficient to take the excess water of

the field drains dropped into it. The field boundaries can be made use of in digging these subsidiary drains.

Field Drains

6.64 These drains are to be constructed by the individual farmers with proper size so that the excess water from their fields is drained into intermediate drains. Field drains or ditches should be at least 30 cm deep with slide slopes ranging between 4:1 and 8:1 as per the site conditions. These should be constructed considering the low spots which collect water from adjoining higher areas. Ditches should be as straight as possible. The cross-section of the field drain should be trapezoidal shape. The cost of field drains has to be met by the farmers. However, if the farmers are not able to pay the amount for the modernization of the drainage system, the project management should undertake these works, after raising funds from other sources in a phased manner.

Part – I

7

Impact on Archeological Monuments, Minerals and Places of worship

AFC, Hyderabad

7

IMPACT ON ARCHEOLOGICAL MONUMENTS, MINERALS AND PLACES OF WORSHIP

Prelude

7.01 The river valley projects with the formation of reservoirs submerge large area of land, houses and other structures such as archeological monuments and places of worship. An attempt is made in this chapter to assess the impact of Singur project on Archeological Monuments, Minerals and Places of Worship. The main objectives of the study in this chapter, as provided in the ToR for the evaluation study, are as follows:

- Assess the significant impacts of Singur River Valley Project on archeological monuments, minerals and places of worship;
- Assess the mitigation measures implemented by the project proponents to mitigate negative impacts due to the construction of Singur project; and
- Identify practicable additional mitigation measures necessary for reducing the impact of the project on archeological monuments, minerals and places of worship

Impact on Archeological Monuments and Places of Worship

7.02 As per the definition of Archeological Survey of India (ASI), GoI, Archeological site or Ancient Monument means any structure, erection or monument or any tumulus or place of interment or any cave, rock-sculpture, inscription or monolith which is of historical, archeological or artistic interest and which has been in existence for not less than 100 years[1].

7.03 The ASI under the provisions of the Ancient Monuments and Archeological Sites and Remains (AMASR) Act, 1958 protects monuments, sites and remains of national importance by giving two-month's notice for inviting objections, if any in this regard. As per the estimates of ASI, at present there are more than 3650 monuments and archeological sites and remains of national importance. These monuments belong to different periods ranging from prehistoric period to colonial period and are located in different geographical settings. These monuments include temples, mosques, tombs, churches, cemeteries, forts, palaces, step wells, rock-cut caves and seculars architectures as well as ancient monuments and sites which represent the remains of ancient habitation.

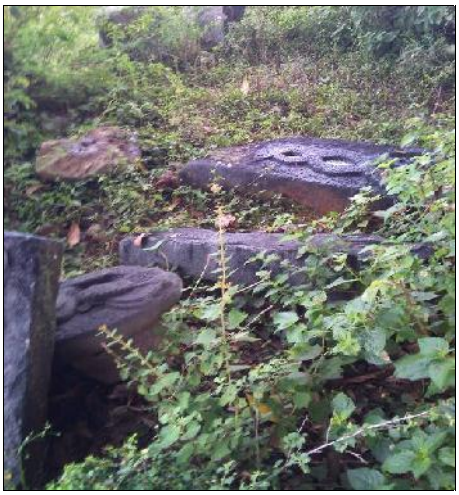
[1] http://asi.nic.in/asi_monuments.asp as on 18/12/2010

7.04 On the basis of discussions with the elderly people in the rehabilitation villages and officials of Irrigation and Command Area Development Department, GoAP it was found that no archeological sites or ancient monuments were submerged due to the formation of Singur Reservoir. However, one or two ancient temples were located in the submerged villages. The project proponents removed artifacts or sculptures from the temples of submerged villages and kept at the dam site. The Ministry of Environment and Forests (MoEF) insisted to keep the monuments under a roof. Further, it is also reported that an area of about 1.2 ha with a field shed was allotted to the Archeological Department in Singur camp for placing the sculptures under a roof. An amount of `.1.00 lakh was provided in the project estimates for this purpose. The Archeological Department has incurred and expenditure of `.0.60 lakh for shifting the stone sculptures from different submerged villages and transport them to a safe place in the camp area[2].

7.05 The field visits to the camp area and discussions with elderly persons in the project camp village indicated that the artifacts / sculptures were lying under a tree without any roof. Further, the villagers indicated that the dismantling of temples and the transportation of artifacts / sculptures was done without much care. As a results of this most of the sculptures got damaged. Further, it is noted that the interested oustees of rehabilitation centers, picked up the idols of their choice and placed them newly constructed temples. This clearly indicated the negligence on the part of concern officials. Some of the photographs of these sculptures and the place where they have been kept are indicated in **Figure 7.1.** List of Monuments is not available / provided by the Archeological department

Figure 7.1 Various Sculptures collected from Submergence Villages being kept under a tree without proper shelter

[2] Central Water Commission, Status Report on Environmental Aspects on Singur Project, (Hyderabad: Krishna & Godavari Basin Organisation-Monitoring and Appraisal Directorate), 1996 P.4



Impact on Minerals

7.06 The submergence area is not a source of any economically important minerals. Therefore, the Singur project did not have any adverse or negative impact on minerals. The project proponents, Department of Mines, and Geology, GoAP had confirmed this aspect.

7.07 There was no response from officials and villagers, as to how and why the oustees were allowed to take away the artifacts / sculptures while they were supposed to be kept in a secured place. It was also expected that the reconstruction of the temples and other places of worship in the resettlement colonies. However, no such activities were taken up either by the project proponents or by Archeological Department, GoAP.

Recreational Facilities Created

7.08 The project proposals did not contain any provision for recreation facilities near the dam site or in rehabilitation colonies. The lake formed across Manjeera River near Singur village in Medak district offer good scope for creation of recreational facilities and eco-tourism. Taking the advantage of available environment near the Singur reservoir, the Andhra Pradesh Tourism Development Corporation Limited initiated measures for beautification of Singur project area at a cost of `. 434 lakh. Initially it is planned to develop the waterfront of Singur reservoir with extensive landscaping, tourist amenities, conferencing facilities, cottages, children play area, illumination of project and fountains for a memorable trip to the tourists. The foundation stone for the project meant for beautification of Singur project area was laid by the Chief Minister of Andhra Pradesh[3] during 2006. These facilities will be available for tourists by 2011. Some of the Photographs indicating the locations of these facilities are presented in **Figure 7.2.**

[3] The Hindu, May 11, 2006 (http://hindu.com/2006/05/11/stories/200605118480300.htm)

Figure 7.2: Under Construction Tourist Resorts at Singur Project Area

Part – I

8

Impact on Forests, Flora and Fauna

AFC, Hyderabad

8

IMPACTS ON FORESTS, FLORA AND FAUNA

Introduction

8.01 The Convention on Biological Diversity (CBD), the Ramsar Convention, and the Convention on Migratory Species (CMS) recognize Environmental Impact Assessment (EIA) as an important decision making tool to help plan and implement development with biodiversity "in mind." The Conventions require Signatories ("Parties") to apply EIA to proposals with potential negative impacts on biodiversity to help meet their objectives, so that development proposals respect mechanisms for the conservation of biodiversity, result in sustainable use of biodiversity resources, and ensure fair and equitable sharing of the benefits arising from use of biodiversity. According to the International Association for Impact Assessment (IAIA), Impact Assessment provides opportunities to ensure that biodiversity values are recognized and taken into account in decision-making. Importantly, this involves a participatory approach with people who might be affected by a proposal.

8.02 The main aim of Conservation of Biodiversity is to ensure "No Net Loss" of any biological species whether big or small. The biodiversity-related Conventions are based on the premise that further loss of biodiversity is unacceptable. Biodiversity must be conserved to ensure it survives, continuing to provide services, values and benefits for current and future generations. The following approach has been chosen by the IAIA to help achieve '*no net loss*' of biodiversity:

1. Avoidance of irreversible loss of biodiversity.
2. Seeking alternative solutions to minimize biodiversity losses.
3. Use of mitigation to restore biodiversity resources.
4. Compensation for unavoidable loss by providing substitutes of at least similar biodiversity value.
5. Looking for opportunities for enhancement.

This approach can be called "positive planning for biodiversity." It helps achieve no net loss by ensuring the safety and survival of rare or endangered or endemic or threatened (REET) species.

8.03 The flora and fauna of any ecosystem are inseparably interrelated and interdependent. They show various responses and sensitivities to outside influences. Nature's stability depends upon its diversity. Therefore the need to assess the changes that have taken place in the plant and animal communities is a primary requirement even

in the case of water resources development project constructed decades back. Singur Project was constructed about three decades back. The Singur River basin forms part of Godavari River basin in the state of Andhra Pradesh. .

Objectives and scope of the work

8.04 The basic objectives of the study is to evaluate the status of the flora and fauna of the catchment and command areas of Singur Project with specific reference to the rare or endangered or endemic or threatened (REET) species. The study is also designed to evaluate whether the Singur Project has brought about any adverse changes and to suggest remedial / mitigation measures in accordance with the objectives as desired by the IAIA and the Ministry of Environment and Forests (MoEF), Government of India (GoI). With these objectives in mind, the following work was undertaken by a team of experienced professional:

i Documentation and evaluation of the status of the terrestrial flora of the core area and surrounding areas (buffer area).
ii Inventorization of the terrestrial flora of the core area and buffer area.
iii Assessment of the frequency, density, dominance, Importance Value Indices (IVI) and Shannon – Wiener Indices of diversity of structural species in the dominant plant communities.
iv Prediction of the impacts of the proposed activity on the REET species.
v Development of a management / mitigation plan to minimize the impacts of the proposed activity on the biotic environment so that there is no net loss of biodiversity.

Study Team

8.05 Singur Project located at Singur Village in Pulkal Mandal, Medak District is built on the River Manjira mainly to provide water to the State Capital city of Andhra Pradesh with a gross storage of 30 TMC. At full reservoir level, the total submergence is 14,056 Ha. A detailed survey of flora and fauna of the Singur Project and its environs covering the reservoir and the catchment as well as downstream up to 10 Km was carried out during July, August, September and October 2009 under the supervision and guidance of Prof.K.B.Reddy, Professor of Environmental Biology and a senior consultant for on flora, fauna and ecology for several major irrigation and hydroelectric projects and his team comprising the following:

1. Dr. S. Sai Chandra Sekhar, Zoologist,
2. Dr.J.Ahsa Kumari, Plant Ecologist,
3. Siva Rama Krishna, Wildlife expert,

Methodology for the study of Flora and Fauna

8.06 Flora and fauna studies were carried out during the post monsoon period during July, August, September and October 2009 to assess the list of terrestrial plant and animal species that occur in the core area and the buffer area up to 10 Km radius from proposed port site. Within the catchment area 20 locations and 10 in the command area of 100 m^2 each were chosen or phytosociological investigation using restricted random sampling techniques. For the purpose of calculation of Importance Value Indices (IVI) of the core area, quadrat method was used for estimation of frequency and density while the cover was estimated by modified line intercept method. Wherever feasible, sampling and phytosociological analysis of vegetation was done using samples of 100 m x 10 m belt transects for tree species, 10 m x 10 m quadrants for shrubs and 1 m x 1 m quadrants for herbs. A modified line intercept method was used for calculation of percent cover of each species. The canopy cover of each species that intercepted or over laid or under laid along a line transect of 100 m was determined based on the total distance intercepted. The average canopy cover was calculated as the percent cover based on five transects of 100 m each.

8.07 The Importance Value Indices (IVI), of each species was calculated based on canopy cover. For the determination of frequency and density of the herbaceous species, a nested quadrant of 1 m x 1 m subdivided in to 10x10 Cm is normally used for research purposes. But on account of low density and relatively large size of plants including the herbaceous species, a quadrant 1 x 1 m was used for determination of frequency and density of the herbaceous species while the cover was estimated by line intercept method. Density was calculated as the number of individuals per m^2 in case of herbaceous plants and as number per hectare in case of trees and tree like plants. However, for the determination of plant cover in case of both the herbaceous species as well as the trees including shrubs, modified line intercept method was adopted. The distance intercepted, overlaid or laid under by each species along a line transect of 100 m in case of herbaceous species and 500 m in case of trees were measured and calculated as the percentage cover based on the distance intercepted. Importance value indices (IVI) of different species were calculated as the sum of relative frequency, relative density and relative dominance (relative dominance was based on the percent cover). Relative values were calculated by dividing the value attained by a species by the total parametric value and multiplying with 100. Based on the IVI values, Shannon –Wiener Indices of Diversity, Simpson Index of dominance and Pielou's Evenness index were calculated by using a computer programme called "PAST".

8.08 Shannon – Wiener Indices of Diversity was calculated as the sum of **pi** value of each species multiplied by **ln** of **pi** using the following equation:

$$H^1 = \sum_{i=1}^{S} pi \ ln \ pi$$

Where, **pi** is calculated by dividing the IVI of a species by the total IVI of all species in the sampled community.

8.09 Shannon–Wiener Indices of Diversity vary depending upon the species richness (number of species present in a given unit area) and their dominance or evenness. As the species richness and evenness increase, Shannon–Wiener Indices of Diversity also increase correspondingly. On the other hand, when the species richness decreases and as dominance increases, diversity decreases. Communities with less number of species with high level of dominance or low level of uniformity will have lower diversity. Thus it is a statistical function based on the richness and evenness components. Evenness and dominance are inversely related.

Impact on Forests

Area under Forests

8.10 The area under forests comprises of open forest blank, forest plantation, scrub forest and tree clad area. At an aggregate level the area under forests got reduced by 6.39 sq km and this accounted for 17.69 per cent of total forest area in the catchments area of the project during 1989. The reduction in forest area was observed in case of forest blank, and scrub forest whereas the forest area was observed in case of forest blank, and scrub forest whereas the forest plantation registered an increase of 7.14 sq km (301.27%) during this period. Forest cover and the types of forests in the catchments area of the project are shown in **Table 8.1.**

Table 8.1
Forest Cover and the Types of Forests in Catchment Area of Singur Project in 1989 and 2008 and its changes during this period

Sl. No	Forests and forest cover	Area (Sq km) under stated category during			
		1989	2008	Absolute Change	% Change
1	Deciduous (Dry/Moist/Thron)-Open	3.34	3.34	0	0.00
2	Forest Blank	7.95	2.74	-5.21	-65.53
3	Forest Plantation	2.37	9.51	7.14	301.27
4	Scrub Forest	19.72	11.40	-8.32	-42.19
5	Tree Clad Area	2.74	2.74	0	0.00

Introduced species

8.11 *Senna uniflora* is has been introduced for biological control of *Parthenium hysterophorus* in Karnataka, Maharastra and Andhra Pradesh. About a dozen species of commercial fishes have been introduced by the fisheries department in most parts of the State of Andhra Pradesh.

Changes in Forest Based Livelihood

8.12 As the area under consideration does not have forests capable of providing Bamboo or Timber or Amla or beedi or tendu leaf (*Diospyros melanoxylon)* or other minor fruit, people in general were never dependent on forests. People residing close to forest areas have been dependent on forests for firewood and livestock grazing. As such there was no change in forest based livelihood.

REET Flora and Fauna of Project Area

8.13 Plant species found in the project areas are compared with the list of CITES plants in India (www.bsenvis.nic.in/citesplant.htm). None of the plants listed is included in Appendix II of CITES. There are no endemic or endangered plant species either in the catchment or in the reservoir area. The habitat of the area under consideration is so common and widespread that it does not support any REET flora. The REET fauna reported from the catchment areas include Python (*Python molurus*) and Cobra (*Naja naja*). Marsh or Mugger Crocodile (*Crocodylus palustris)* is an endangered species that has been spotted rarely by the fisherman in the reservoir. The conservation status of the birds has been verified with the Birdlife International's 2010 update of the IUCN Red List for birds from web sites www.birdlife.org *and www.iucnredlist.org*. None of the birds listed are placed in the red data of the IUCN.

Vegetation and flora of the catchment area:

8.14 Forest vegetation of the Catchment area of the Manjira River is now represented by open scrub jungles with thorny bushes. There are no thick forests in the catchment or command area of the project. There seems to be very little qualitative change in the flora and fauna of the Manjira River catchment but perceptible quantitative changes seem to have taken place on account of population explosion, urbanization, industrialization and decrease in land holdings. Large areas of wastelands have been brought under plough and the pressure on forests on grazing lands and forest for fodder and fuel wood may have altered the density and dominance of certain species. Similarly, the area under different types may have undergone a change. Closed scrub jungles may have become open scrub jungles. But there is no evidence to substantiate these changes at micro level. On account of severe biotic pressure some invasive species such as *the Prosopis juliflora, Parthenium hysterophorus, Senna uniflora, Hyptis suaveolens, Ipomoea carnea* etc have become more abundant in most areas of the catchment area. However, as far as the flora and fauna of the catchment area is concerned, there is no change.

Terrestrial Flora and Fauna

8.15 The terrestrial habitats include the area extending from the banks of the reservoir to the catchment in the upstream and up to 10 Km in the downstream of the Dam site. The aquatic habitat is represented by the reservoir, the Manjira River and a large number of small and medium irrigation tanks.

Terrestrial Vegetation and Flora of the Singur Project:

8.16 Except for a few isolated patches of open scrub forest type communities, there are no forests in the area under consideration. Croplands of Paddy, Cotton, Red gram, Castor, Sorghum, Sunflower, Vegetables, and Sugarcane represent the prominent man made vegetation. There are also agro forests of *Eucalyptus* and Subabul. Wastelands and open grazing lands were covered mainly by non-palatable annual and perennial weeds.

*Ipomea carnea (*local name "Besharam" means shameless) was most extensive all along the canals, road sides, and river sides and along the banks of the reservoir. *Cassia auriculata, Calotropis gigantea, Calotropis procera, Senna uniflora, Parthenium hysterophorus* and *Hyptis suaveolens* were most abundant, dominant and widespread in all wastelands. *Prosopis juliflora* was the most common thorny bush everywhere even along the banks of the reservoir. All common avenue trees and fruit trees of Andhra Pradesh represented by the following were found in the area under consideration:

Prosopis juliflora, Acacia auriculiformis, Mangifera indiaca, Peltophorum pterocarpum, Cassia siamea, Albizia lebbeck, Ficus religiosa, Ficus benghalensis, Acacia nilotica, Azadirachta indica, Syzygium cumini, Tamarindus indica, Pongamia pinnata, Millingtonia hortensis, Casuarina equisetifolia, Parkinsonia aculeata, Pithecellobium dulces, Dalbergia sissoo, Ailanthus excelsa, Ziziphus numularia etc. Besides the above, the following forest elements were also found: *Butea monosperma, Vitex negundo, Phyllanthus reticulatus, Diospyros melanoxylon, Acacia cesia, Acacia leucocephala, Acacia sundra, Ziziphus mauritiana, Ziziphus xylopyrus, Ziziphus rugosa, Capparis zeylanica, Capparis aphylla, Alhagi camelorum, Lantana camara, Wrightia tinctoria, Tabebuia argentea, Chloroxylon swietenia, Boswellia serrata, Cassia auriculata, Breynia vitis-ideae, Carissa spinarum, Calotropis procera, Calotropis gigantea, Waltheria indica, Tephrosia purpurea, Desmodium pulchellum , Grewia reticulata, Mimosa rubicaulis Flacourtia indica, Securinega virosa, Woodfordia fruiticosa, Clerodendrum serratum, Celastrus paniculatus, Buchanaia lanzen, Ichnocarpus frutescens* and *Anisomeles indica,*. A few other climbers like *Rhynchosia minima, Atylosia scarabaeoides, Ipomoea spp, Mukia maderaspatana, Daemia extensa, Wattakaka volubilis, Hemidesmus indicus, Cryptolepis buchananii* and *Pergularia daemia* were more common in bush lands, especially along field bunds. *Hyptis suaveolens, Parthenium hysterophorus, Alysicarpus monilifer, Tephrosia purpurea, Plectranthus mollis, Cassia tora, Pavetta tomentosa,* species of *Indigofera, Crotalaria, Leucas aspera, Borreria hispida, Borreria articularis, Tridax procumbens, species* of *Euphorbia, Ocimum* etc were more frequent in all areas. Within the study area, a few isolated individuals of both palatable and non palatable weeds represented by *Hyptis suaveolens, Parthenium hysterophorus, Celosia argentia, Sida acuta, Cassia occidentalis, Cassia tora, Cleome viscosa, Heliotropium indicum, Croton bonplandianum, Amaranthus spinosus* and *Cassia occidentalis*. *Cymbopogon coloratus, Heteropogon contortus, Erempogon foeveolatus, Dicanthium annulatus, Digera arvensis, Chloris barbata, Dactyloctenium aegyptium, Iseilema laxum, Andrographis echinoids* etc were common in association with trees and shrubs. Forest grasses of *Heteropogon contortus, Cymbopogon coloratus, Cymbopogon*

caesius, Aristida setacea, Aristida funiculatus, Chrysopogon fulvus, Chrysopogon verticillatus, Polycarpaea aurea, Polycarpaea corymbosa, Indigofera astragalina, Indigofera glabra, Cassia absus, Digitaria stricta, Dinebra retroflexus, Perotis indica etc were predominant in all wastelands and grazing lands.

8.17 A list of trees, shrubs including perennial climbers found in the area are given in **Annexure VIII.1**. Grasses and sedges (Together called Graminoids) and herbs found in the area are given in **Annexures VIII.2** and **VIII.3** respectively. Relative frequency, Relative density, Relative dominance and Importance Value Indices (IVI) of structural plant species present in the catchment area are given in **Annexure VIII.4**. Similarly, the Relative frequency, Relative density, Relative dominance and Importance Value Indices (IVI) of structural plant species present in the command area are given in **Annexure VIII.5**. In both the cases, *Prosopis juliflora* and *Ipomoea carnea* are found to be the most dominant species. The Shannon–Wiener Index of Diversity, Simpson's Index of Dominance, Pielou's Evenness index and the index of species similarity between the Catchment area and Command area are given in **Table 8.2**. It is evident from the data that the Shannon – Wiener Index of Diversity and Pielou's Evenness index of the catchment area were higher and Simpson's Index of Dominance was lower when compared with the command area. But the two areas are very closely similar as 81.6% species were common to both the areas.

Table 8.2
Shannon – Wiener Index of Diversity, Simpson's Index of Dominance, Pielou's Evenness index and the index of species similarity between the Catchment area and Command area

Indices	Catchment area	Command area
Shannon – Wiener Index of Diversity	3.874	3.013
Simpson's Index of Dominance	0.337	0.671
Pielou's Evenness index	0.763	0.317
Similarity index (%)		81.6

8.18 A survey of available literature (www.bsenvis.nic.in/citesplant.htm) as well as the present study indicates that there were no rare or endangered or endemic or threatened (REET) species either in the project area. On the other hand, most species were quite common and widely distributed in different areas of India.

Terrestrial Fauna of the Singur Project:

8.19 As there are no thick forests in the area under consideration, it is not an important habitat for any rare or endangered or endemic or threatened (REET) species. There are no Biosphere reserves or National Parks or Sanctuaries or other protected areas within or around the study area. Most mammals and birds listed were of widespread occurrence. Among the Mammals, only Squirrels, Mongoose, Rats, Bandicoots and Rabbits were

seen frequently during the survey. Monkeys were seen in only one locality. Among the resident birds, Crows, Parrots, Doves, Weaver birds, Swifts, Quails and Mynas were very common. Among the reptiles, Lizards, Garden lizards were very common. Rat snake and Monitor lizard were seen twice during the survey. Other reptiles were very rare. The amphibians were relatively more frequent but not abundant.

8.20 There are no thick forests, biosphere reserves, National parks, Wildlife Sanctuaries or other protected areas either in the catchments or around the reservoir within a radius of 10 Km. As such, it is not an important home for wildlife. But in the downstream, Pocharam bird habitat is located at a distance of about 16 Km. A list of vertebrate species other than birds, either spotted or known to occur in the area is given in **Annexure VIII.6**. Other than the Common Indian Monitor and Indian python there are no REET species in the study area.

8.21 Many birds from the Manjira Wildlife Sanctuary as well as **Pocharam** wildlife sanctuary are known to visit the reservoir and its surroundings for feeding in and around the Singur reservoir. A list of birds spotted by the survey team is presented in **Annexure VIII.7**. Some of them were found to breed on the islands within the reservoir.

8.22 A checklist of butterflies and moths either spotted or trapped during the period of survey is given in **Annexure VIII.8**. Though the area attracted a number of butterflies and moths, they were common to most areas in Andhra Pradesh. None of them belong to the REET category.

Impacts of Singur Project on the flora and fauna of the command area

8.23 The flora and vegetation of an area is influenced by a number of factors such as climatic, edaphic, hydrological and biotic variables. Changes in flora and fauna over a long period of time in any area could occur naturally in any changing environment. As the environment is dynamic, only those species which are capable of responding and adapting to the changes in environment have greater chances of survival. Long term observations on the natural communities by scientists revealed replacement of one community by another until a relatively stable community is evolved. In ecological parlance, it is known as ecological succession.

8.24 Anthropogenic and biotic pressure for food, fodder, fuel wood, fiber, timber etc., introduction of exotic species; intensive agriculture etc are capable of bringing about major changes in community composition, structure and function. Assuming that these disturbances are common in any human environment, creation of irrigation facilities brings about concurrent changes in cropping pattern. The effects of Singur project on Agriculture and cropping pattern has been outlined in Chapter V. It is abundantly clear from the report that Agriculture and cropping patterns are influenced by irrigation to a certain extent. But market forces seem to have greater influence on cropping pattern. When dry land is converted in to wetland water tolerant hydrophytes and semi aquatic plants become dominant and abundant. At the same time, the xerophytes and mesophytes

are either eliminated or reduced. Canal irrigation is also capable of influencing drainage and some areas may get waterlogged. Thus on account of irrigation, a shift in soil and hydrological environment occurs. Changes in crops and cropping patterns are capable of modifying the flora and fauna.

8.25 Base line data with regard to the flora and fauna of the command area has been collected and it is compared with the neighboring unirrigated areas as well as the catchment area in order to gain some insight in to the possible changes brought about by the canal irrigation. It may however be mentioned that the results could be suggestive but by no means conclusive or confirmatory.

8.26 As far as the floristic composition of the trees and shrubs are concerned, it is closely similar to that of the catchment area **(Annexure VIII.1)**. Grasses and sedges found in the command area are similar to that of the catchment area except that hydrophytes, sedges and the aquatic weeds like *Echinochloa colona, Echinochloa crus-galli* which are associated with Paddy have become more abundant while the drought tolerant perennial grasses have declined in wetland areas. Similar trend could be noticed in case of other herbaceous species also. Owing to stagnation of water in seasonal pools, ditches and tanks and also on account of Eutrophication, most wetland areas got completely choked with the "shameless plant" called Besharam *(Ipomoea carnea)* by the locals apart from *Eichhornia crassipes, Typha angustata, Nymphaea stellata, Nelumbo nucifera* and others. But the floristic composition is exactly similar to the list given in **Annexure VIII.7**. In waterlogged areas as well as in fallows *Prosopis juliflora* has become dominant. The Relative frequency, Relative density, Relative dominance and Importance Value Indices (IVI) of structural plant species present in the command area are given in **Annexure VIII.5**.

8.27 The wild terrestrial fauna of an area is influenced by a number of variables. The area under consideration is not a suitable habitat for any rare or endangered or endemic or threatened species of major wild animals. There are no forests or wildlife sanctuaries or national parks or biosphere reserves or other protected areas within the command area. There is no evidence of any significant increase in fisheries in the command area. The list of aquatic species of fauna reported from the command area is the same as that of the reservoir (Vide **Annexures VIII.9 to VIII.11**). Based on the study the following conclusions could be drawn:

1. Reservoir irrigation had very little impact on the flora and fauna of the command area mainly because of the following:
   a). Canal irrigated area is very small and scattered. Water from the Singur (Manjira) reservoir is mainly used to meet the domestic as well as the industrial needs of the twin cities (Hyderabad & Secunderabad).
   b). There is no significant change in the cultivation and cropping pattern.
   c). Owing to large variation in topography, soil and cultural practices in accordance with the crop, the impacts of the reservoir are limited mainly to low lying areas in the command of Singur project.

d). Similar habitats, topography, climate, soils and cultural practices exist in the catchment areas as well.

2. Only a slight shift in favour of aquatic or semi aquatic plants could be noticed in wetland areas.
3. Basically the flora and fauna of the upstream as well as the down stream area more or less same. If at all there is any difference, it is only with regard to relative dominance and abundance.
4. All wetlands in the upstream as well as the down stream are heavily colonized by the Besharam *(Ipomoea carnea).*
5. Mugger crocodiles spotted rarely by the fisherman in the reservoir were not spotted or reported from the command area.
6. But the entry of a Mugger crocodile in to a man made pond created for the construction of a Cellar in Nanakramguda, Hyderabad during November 2010 indicates that Crocodiles may venture out of the reservoir in to the nearby command area. It is only a possibility that may happen but no such incidence has been reported from the command area so far.

Aquatic Flora and Fauna

8.28 The aquatic ecosystems are represented by lotic and lentic ecosystems. There are no marine habitats in the area. Singur reservoir is the large perennial water body and Manjira River is a small seasonal River. There are a number of village and irrigation tanks within the study area. Besides, the above, drains and paddy fields also provide suitable aquatic habitats for aquatic species.

Aquatic Flora

8.29 The deep waters of the reservoir were devoid of any macrophytes. The reservoir water was clear and transparent up to 3 m. But along the border and around the islands, the shallow water was fully colonized by *Ipomea carnea (*local name "Besharam" means shameless), *Ipomoea aquatica, Typha angustata, Pistia stratiotes, Eichhornia crassipes, Nelumbo nucifera, Nymphaea nauchali, Nymphaea stellata, Nymphoides hydrophylla, Nymphoides indica, Ottelia alismoides etc.* A list of aquatic and semi aquatic macrophytes found in the area of study is given in **Annexure VIII.9**. Similarly, a list of algal species recoded from the area is given in **Annexure VIII.10**. Almost all aquatic species of plants and algae recorded from the study area and of common and widespread occurrence.

Aquatic Fauna

8.30 As already stated, the Singur reservoir and the Manjira River are potential habitats for aquatic life. In Singur village, a local fisherman society has been formed. The fish caught from the reservoir are supplied to nearby towns and also Hyderabad City. The fishes caught from the reservoir and river is listed in **Annexure VIII.11**.

8.31 The local fishermen reported the presence of large fish weighing about 10 to 12 Kg but they could not catch any fish weighing more than 7.5 Kg. They also reported that they have seen the Giant perch as well as a Crocodile. The Giant perch was neither caught nor seen. Marsh Crocodile was seen during floods a few years ago by many people. But during the last two years, the crocodile was not seen. The state fisheries department add fresh stocks of fish seedlings year every to maintain fish stocks at sustainable level. Hence, most of the fish found in the reservoir are edible.

8.32 A list of aquatic insects found in the water bodies around the reservoir is given in **Annexure VIII.12**. The insect populations were generally higher in shallow water bodies such as tanks and ponds but rare in the reservoir. A list of Annelids (Earth worms and Leeches) collected from the croplands, wetlands and water bodies is given in **Annexure VIII.13**. Similarly, a list of snails collected from different areas of the Singur project is given in **Annexure VIII.14.** Finally, a list of zooplankton collected from different areas of the Singur project is given in **Annexure VIII.15**.

Over all Impact of the Singur Project on local Flora and fauna

8.33 Temporal and spatial changes are natural phenomena. Man made changes such as the changes in land use and land cover pattern, cultivation, introduction of exotic species etc have the potential to bring about major changes in structure and composition of biotic communities. It is often difficult to isolate the changes brought about directly by the project and its indirect consequences especially in the absence of any reference for comparison. As the catchment and reservoir areas were not botanically and zoologically important from the point of biodiversity, there is no reliable pre-project data. As the consequences of the reservoir are generally limited to the reservoir and its vicinity, an attempt has been made to compare the flora and fauna of the project area with the surrounding areas. As far as the biological composition was concerned, there was no significant difference area under the impact of the project and surrounding areas. The major difference relate to dominance of certain species on account of the formation of the reservoir. Based on the above, it may be concluded that the reservoir has not contributed any undesirable changes in flora and fauna.

About Manjira Wildlife & Bird Sanctuary

8.34 It includes Pocharam wildlife sanctuary. The Manjira Wildlife & Bird Sanctuary in Andhra Pradesh is one of the most popular of the sanctuaries in the state because of being the habitat of a large number of resident as well as migratory birds. It is located near the Sangareddy in the district of Medak in Andhra Pradesh, along the River Manjira.

8.35 There are nine small islands which together form this small sanctuary between the Manjira and Singur barrages. There are different species of animals that are found in the Manjira Wildlife & Bird sanctuary, ranging from fishes, birds and other reptiles. The fishes here include are Catla, Rahu, Murrel, Karugu and Chidwa. Of the wide array of birds found in the sanctuary, the most common ones are Herons, Teals, Cormorants,

Pochards, Black and White Ibises, Spoon Bills and Open Billed Storks and Painted Storks. There are also a number of reptiles that one can se at the Manjira Wildlife & Bird sanctuary. These reptiles include Monitor Lizards, Fresh water Turtles, Cobra and marsh Crocodiles. The invertebrate species found at the Manjira Wildlife & Bird sanctuary include Prawns, Mollusks and Zooplanktons.

8.36 Water plants found in this wildlife asylum include *Pistia*, *Hydrilla*, *Eichornia* and *Vallisneria*. You can also see different species of fish including Catla, Rahu, Murrel, Ech Paten, Karugu and Chidwa. Manjira Bird Sanctuary also houses reptiles like Monitor Lizards, Fresh Water Turtles, Cobra and Marsh Crocodiles. The birds seen at Manjira Wildlife Sanctuary Painted comprise of Storks, Herons, Coots, Teals, Cormorants, Pochards, Black and White Ibises, Spoon Bills, Open Billed Storks, etc. The sanctuary also has museum, library and an auditorium in its Environmental Education Centre. The centre actually works to inform people about the benefits of nature conversation and protection of ecological balance. List of trees suggested for avenue, canal bank plantations and afforestation of the deforested catchment areas is given in **Annexure VIII.16**.

Impact of Pisiculture Development Programme

As part of EMP, Pisiculture Development programme was implemented in the reservoir area. A fish hatchery was developed in are one of the PAF villages, viz., Peddireddypeta was established. Hoverer the same is not functional for several years. Therefore, the socking of reservoir with fish fry and seedlings is under taken by Fish Former Co-operative Society, Peddireddypet by procuring the same from places like Rajahmundry which is about 500 km from the reservoir area. The Pisiculture Development programme in the reservoir area provided livelihood top about 150 fishermen, including in to those involved in fish trading in local villages. Most of these fishermen are from PAFs.

Part – I

9

Impact on Public Health, Drinking Water Supply and Communication

AFC, Hyderabad

9

IMPACT ON PUBLIC HEALTH AND DRINKING WATER

Introduction

9.01 The Singur River valley project affected 33 villages fully and 39 villages partially in Andhra Pradesh. All the affected villages are spread over six mandals, viz., Regod, Raikode, Nyalkal, Pulkal, Manoor and Munipalle of Medak district. The mandal wise distribution of the project-affected villages has already been discussed in the chapter entitled "Effects of Rehabilitation". The affected families from these villages were resettled in 29 resettlement and rehabilitation centers in Medak district. Various development works in the 29-resettlement centers have been taken up and completed. Now the time has come to evaluate the implementation of the EMP in the completed Resettlement and Rehabilitation Plan and to assess the level of Environmental Impact Assessment and to make suggestions for furthering the environmental improvement through modified EMP redesigned for the project. As a part of the study, this chapter includes the evaluation of public health hazards during pre and post project conditions covering health status, health services, and occurrences of diseases, drinking water supply and sanitation. The study also attempted to analyse the effects of construction of project on health status and health services provided in the project area and socio-economic changes including incidence of some important diseases in post and pre-project situations as the availability of health care infrastructure in the post and pre-project situations.

Health Care Infrastructure in Post and Pre Project Situation

9.02 The study indicated that at the district level the number of Government hospitals got reduced to 10 in post-project period from 11 in the pre-project period (Reduction is 9%). The PHC showed an increase by 35%. The number of PHCs during pre-project was 48 and in post project period it was 65 available data (2007-2008) indicated that during the post-project period 9 Community Health Centers (CHCs) have been opened in 9 resettlement villages out of the 29 villages. These 9 villages are Makthkyasaram, Kodur, Manthur, Khadirabad, Allapur, Siroor, Itikapalli, Pulkurthy and Belapur. Out of these 9 sub health centers, the centers at Manthur and Allpaur are non-functional due to shortage of Para-Medical staff. During the pre-project stage, there were no community Health centers. The details of village wise CHCs are given in **Table 9.1**

Table 9.1 Community Health Centers in the Resettlement Villages			
Sl. No	**Name of the Village**	**Community Health Centers (NO)**	
		Pre Project	**Post Project**
1	Busareddypally	Nil	Nil
2	Mallikarjunapally	Nil	Nil
3	Takkadapally	Nil	Nil
4	Garlapally	Nil	Nil
5	Makthkyasaram	Nil	1
6	Betoor Kakapally	Nil	Nil
7	Kodur	Nil	1
8	Peopalpally	Nil	Nil
9	Atmlyl	Nil	Nil
10	Mortga	Nil	Nil
11	Mamidipally	Nil	Nil
12	Bogulampally	Nil	Nil
13	Manthur	Nil	1 (not functioning)
14	Khadirabad	Nil	1
15	Osirikapally	Nil	Nil
16	Nirlipla	Nil	Nil
17	Paladugu	Nil	Nil
18	Allapur	Nil	1 (not functioning)
19	Siroor	Nil	1
20	Doulthabad	Nil	Nil
21	Raipally	Nil	Nil
22	Jangam Osirkapally	Nil	Nil
23	Indoor	Nil	Nil
24	Chkriyal	Nil	Nil
25	Itikapally	Nil	Nil
26	Lonikurd	Nil	1
27	Peddareddypet	Nil	Nil
28	Pulkurthy	Nil	1
29	Bellapur	Nil	1
Total		**Nil**	**9**

9.03 The actual number of medical facilities existing at the district and the project affected mandal is given in **Annexure IV.28 to 34**. The number of patients treated under Allopathic, Ayurvedic and Unani system at the district level stood at 21.83 lakh, 1.43 lakh, 3.8 lakh and 1.07 lakh respectively in the post project situation. The percentage increase in health care facilities from pre-project to post-project situation is presented in **Annexure IX.1**. it is seen from the available data except in Pulkal mandal where one Ayurvedic institute has come up in Post-project situation, in no other mandal there is growth in any type of medical institution.

9.04 The mandal-wise analysis of the medical facilities in the post and pre-project situations indicated the following position:

9.05 ***Pulkal Mandal***: The number of beds decreased from 6 to 2 at the P.H.C. The number of patients treated under the Allopathic was 12850 and Ayurvedic 13650 in the post-project period. The data of the number patients treated under allopathic is not available while no patients were treated under Ayurvedic system in the pre-project stage **(Annexure IV.29)**.

9.06 ***Munipalle Mandal:*** There is no change in the medical facilities in the post-project situation from the pre-project situation except that one more doctor is added. The number of patients treated was 8985 at the P.H.C (Post-project) **(Annexure IV.30)**.

9.07 ***Regod Mandal:*** There is no change in the availability of medical facilities in the post-project situation in comparison to the Pre-project situation. The number of patients treated during the post-project period under Allopathic system stood at 15605 **(Annexure IV.31)**.

9.08 ***Raikode Mandal:*** The number of patients in post-project situation is 12650. There is no other perceptible change in the medical services (Annexure IV.32)

9.09 ***Nyalkal Mandal:*** The number of Doctors in Primary Health Centres decreased from 3 to 2 and the number of beds from 8 to 2. The number of patients treated in post project stand at 13650 (Annexure IV.33)

9.10 ***Manoor Mandals***: There is no increase in either number of Doctors or in number of beds during post project situation. The number of patients stood at 16260. **(Annexure IV.34).**

Incidence of Important Diseases in Pre and Post Project Situations

9.11 The specific information on incidence of important diseases both during the pre and post project situation was not available with the District Medical and Health Office; as such, details are not furnished. It may, however be mentioned that field survey and PRA exercise indicated that the important diseases like Malaria, T.B., Typhoid, gastroenteritis that were prevalent in pre project situation are existing in the post-project situation as well but to a lesser extent. The PRA exercise highlighted that vector borne diseases like Chikengunya has cropped up in the post-project situation. The affected persons go for treatment to the P.H.Cs and Private medical practioners. An interesting observation made during the PRA was that the older generation of the affected villages prefers herbal and Ayurvedic medicines to the Allopathic treatment. This observation highlights that there is need for setting up a few Ayurvedic dispensaries in the re-habilitated villages.

Immunizations Programme

9.12 It is seen that the number of persons immunized have gone up in the post-project period is respect of diseases like Polio, DPT, BCG and Measles both in the district as well as Project Affected mandals. The immunization for DPT has gone up from 29129 and 54845 at district level. Similarly, there is 3 to 5 fold increase in the mandals. As far as immunization against polio is concerned, special immunization campaign are organized both at the district as well as in the Project Affected mandals. These campaigns have increased polio immunization by many folds in the post-project period. The details of immunization in the district and Project Affected Mandal are presented in **Annexure IV.27**.

Family Welfare Programmes

9.13 In the Post-project situation, the sterilization programmes have significantly increased both at the district level and project affected mandal level. The data presented in **Table 9.2** indicates that the increase in Regod mandal is as high as 1384%, which is the highest among the project-affected mandals. The lowest increase of 90% was recorded in Pulkal mandal whereas the increase in Munipalle mandal was 742% and in Andole mandal 469%. In between two methods of sterilization, it is also seen that vasectomies have come down drastically while tubectomies have increased tremendously. When we examine the work-force category, the women workers had shown increasing trends as compared to male workers. It is therefore, considered necessary that men in rural areas need to be educated that Vasectomy is the safest method and that it would be better for men to undergo the operation than subjecting the earning women to tubectomy. Similarly, use of IUDs has also increased which again target women only.

Table 9.2 Percentage increase in VAS, TUB and IUD from pre to post project situation

S. No	Indicator	Sterilization VAS, TUB	IUD	Refer Annexure no. for Details
1	% increase in Medak district	235	334	IV.35
2	% increase in Pulkal Mandal	90	206 (no)	IV.36
3	% increase in Munipalle mandal	742	513	IV.37
4	% increase in Regod Manal	1384	196 (no)	IV.38
5	% increase in Raikode Mandal	652	100	IV.39
6	% increase in Nyalkal Mandal	347	-36	IV.40
7	% increase in Manoor Mandal	195	-272	IV.41

ANM Facilities

9.14 During the post-project period, it is observed that the ANM team visits weekly, all the 29 rehabilitated villages. They mostly attend and counsel on mother child welfare, Aganwadi, related activities and pregnant women. The ANM team also attempts to meet the requirements of the general population as well.

Conclusions

9.15 In short, it is concluded that there has been marked improvement in the treatment of diseases and availability of medical facilities in the post project situation in comparison to that available in the pre-project situation.

Field Survey Results: Public Health

Incidents of diseases (Water born and Vector born)

9.16 Incidence of important diseases prevailing in pre and post project situations in the study area is studied and the findings of the same in being presented in the succeeding paragraphs. The common diseases studied are Malaria, Filaria, Gastroenteritis, Typhoid, Cholera, Jaundice, TB and Florosis.

9.17 The overall impressions drawn from data analysis indicated that the incidence of diseases have decreased in post project duration as compared to pre project situation in general. However, in some cases of water born diseases i.e., Malaria, Jaundice and Florosis have increased by 16, 12, and 2 per cent respectively among the sample household during post-project situation.

9.18 Further, data analysis revealed with in water born diseases such as Gastroenteritis, Cholera has brought under control marginally during post-project situation. Similarly occurrence of vector born diseases are also noted to be reduced i.e., Filaria (from 19.6 % to 15.6 %), Typhoid (From 48% to 45.6%) and TB (From 6.0% to 4.4%). These are the positive signs of controlling the spread of diseases in the rehabilitated centers, where a care has been taken by the concern authorities to minimize the occurrence of diseases. The details are presented in **Annexure IX.2**

Immunization Programme

9.19 A substantial positive change is observed in implementation of immunization program in the oustees rehabilitated areas (centers) from pre-project situation to post project situation. From the data analysis, it is seen that the number of persons (of sample households) immunized have gone up in the post project period as compared to pre-project situation in respect of polio (from 85 to 242), DPT (from 29 to 185), BCG (From 29 to 185), Measles (From 36 to 165). Details of these are presented in **Annexure IX.3**.

Family Welfare Programme

9.20 Under family welfare programme, sterilization (vasectomy and tubectomy) has also gone up among the sample household families during post project situation. However, high variation is observed between vasectomy and tubectomy cases attended. In vasectomy, there is an increase of 7 per cent from pre-project to post-project situation. In case of tubectomy, it was more than three fold increase (From 18.4% to 61.6%) during post project period.

9.21 Further, it is also noted that the use of condoms has increased several time during post project period among sample households. The use of condom during pre-project situation it was confined to one village i.e., Pulkal which as spread among all sample rehabilitated centers during post-project situation (**Annexure IX.4**)

Sanitation

9.22 Sanitation is the key to health of the rural population. If proper drainage and sanitation facilities are not available, it will lead to incidence of many diseases. Open defecation in the rural area is the root cause of many diseases. The project-affected populations of 33 villages have been rehabilitated in 29 villages. At time of building up facilities in the rehabilitation colonies in the 29 villages sufficient care has not been taken to ensure sanitation.

9.23 The field visit to the rehabilitation villages indicated that though drainage was provided it was only open drainage system. The drains provided are not only very shallow but also narrow. The shallow and narrow open drainage system always results in overflowing of drains and stagnation of dirty water. The stagnating water have become breeding grounds for mosquitoes which has resulted in high incidence of malaria and another mosquitoes borne diseases, chikengunya. There is, therefore, urgent need for construction of better and closed drainage system in the rehabilitated villages.

9.24 It was observed that total sanitation programme operating in Medak district has not reached the rehabilitated villages. It is observed that many of the villages still resort to open defecations due to the absence of proper latrines and community latrines in the villages. Steps, therefore, should be taken to extend total Sanitation Programme operating under the Rural Development Department to these 29 rehabilitated villages of the Project affected process.

Drinking Water Facility

9.25 All the 29 rehabilitated villages are covered by the drinking water supply. The Satya Sai Charitable trust had taken care of the drinking water supply in two or three villages in the left flank of the reservoir. It was observed and also confirmed in PRA that supply of drinking water is not regular and not adequate also. The service of supply of water is mostly ground water treated and supplied through pipes. In order to ensure regular and adequate quantity of protected drinking water there is need to tap more ground water sources.

Tree Plantation

9.26 To encourage a healthy environment and greenery in the rehabilitation centers, it was planned to take up the plantation. Accordingly plant seedling were distributed free of cost to the oustees. Although, tree plantation was taken up the survival rate is as low as 30 – 35 %. It was observed that after the seedlings were distributed there was no follow up action by the concerned Department to ensure the survival of the tress. It is suggested

that the concerned Department should take steps to see that after planting of the seedlings, watering is done in the initial stages for ensuring survival of the saplings.

Drinking Water

9.27 The primary objective of Singur projects is to provide additional drinking water requirements of the twin cities of Hyderabad and Secundrabad. The domestic water requirement of the twin cities by 2020 was estimated to be 3870 MLD when the population would grow to an estimated level of 136 lakh. The population at present stand at 80 lakh and the main supply sources before the project have been Osmansagar, Himayathsagr and Manjira reservoirs. As per UDPFI guidelines for large metropolitan cities, the domestic water requirement stand at 135 LPCD and the desirable norm is 150-200 LPCD. Even at the rate of 135 liters per capita per day the total requirement for all categories for a population of 80 lakh works out to 1080 MLD. The supply positions from the existing sources have been like below:

1	Osmansagar + Himayatsagar	208 mld
2	Manjeera Reservoir	232 mld
Total		**440 mld**

9.28 It is therefore, seen that there has been a huge gap between estimated demand and supply. In order to supplement the water requirements the Singur project aimed to provide 4 TMC of water per year to the twin cities of Hyderabad and Secundrabad.

9.23 The interaction with the General Manager of Hyderabad Metro Water Supply and Sewage Board indicated that 4 TMC of water was supplied to twin cities of Hyderabad and Secundrabad consistently every year ever since the completion of the project during 1989. Hence, the primary objective of the project to provide four TMC water per year to the twin cities is found to have been achieved fully.

9.29 The Singur project after completion has been supplying four TMCs per year of water for drinking purposes to the twin cities of Hyderabad and Secundrabad. During the past few years, the demand for drinking water increased due to population growth in twin cities, which necessitated finding alternate source of supply. The Government of Andhra Pradesh diverted water from the Krishna river to the twin cities for this purpose to meet the balance demand.

Part – I

10 Changes in Land Use Pattern

AFC, Hyderabad

10

CHANGES IN LANDUSE PATTERN

Background

10.1 Anthropogenic changes in land use and land cover are being increasingly recognized as critical factors influencing global change. Due to anthropogenic activities, the earth surface is being significantly altered and man's presence on the earth and his use of land has had a profound affect on the natural environment. Land use and land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Further, information on land use and land cover and possibilities of their optimal use is essential for the selection, planning and implementation of land use scheme to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. While, land use and land cover are often assumed to be identical, they are rather quite different. Land cover may be defined as the biophysical earth surface while; land use is often shaped by human, socio-economic and political influence on the land.

10.2 Remote Sensing (RS) integrated with Geographical Information System (GIS), provides an effective tool for analysis of land use and land cover changes at a regional level. The geospatial technology that combines the technology of RS and GIS holds the potential for timely and cost effective assessment of natural resources. The techniques have been used extensively in tropics for generating valuable information on forest cover, vegetation type and land use changes[1]. Therefore, we have used RS and GIS to study Land Use and Land Cover (LULC) changes in the catchments area of Singur project. Ssince the command area development of Singur project did not take place till date, the study of land use changes in the command area are not analyzed in this chapter.

Methodology

10.3 Satellite Imageries of 1989 (LANDST TM), and 2008 (IRS P6 LISS-III) were used for change detection in the catchment area. The 1:50,000 Survey of India (SoI) topographical sheets were utilized in the preliminary processing of satellite data. A False Color Composite (FCC) was generated using the different bands of satellite data. The satellite imagery was refined or geometrically corrected using ground control points obtained from SoI toposheets and ground control points collected from field. Points such as the intersections of roads, river junctions, etc., were identified on the toposheets as

[1] *Pranjit KR Sarma, at.el. "Land Use and Land Cover Change and Future Implication Analysis in Manas National Park, India Using Multi-Temporal Satellite Data", Current Science, Vol. 95 No.2, 25th July 2008.*

ground control points. Using polynomial equation the scene was geometrically corrected and geo-referenced into latitude / longitude coordinate system using polyconic system. The pixel were re-sampled using maximum likelihood algorithm and the free catchment area of Singur project was extracted from the scale using catchment boundary maps in ERDAS Imagine 9.0 software. Sub-pixel image to map registration accuracy was achieved through repeated attempts. Histogram matching was done to correct the radiometric differences, if any. Using ground control points, training sets were generated for different land cover and land use types and the image classified based on a combination of visual and digital classification schemes. The entire study areas i.e., free catchment of Singur project was classified and different land use and land cover types were obtained.

Ground Truthing

10.4 Before the preprocessing and classification of satellite imagery began, and extensive field survey was performed through out the Catchment area of Singur using Global Positioning System (GPS) equipment. The Global Positioning System has developed as an efficient GIS collection technology which allows users to compile their own data sets directly from the field as part of ground Truthing. Ground truth surveys are essential components for the determination of accuracy assessment for classified satellite imagery. This survey was performed in order to obtain accurate location point data for each land use and land cover classes included in classification scheme as well as for the creation of training sites and for signature generation.

Assessment of Changes in LULC

10.5 The total free catchment area of Singur project was classified and the following land use / land cover types were obtained.

- Crop Land-Single cropped area
- Crop Land-double cropped area
- Current Fallow land
- Agriculture Plantation
- Built Up Area
- Deciduous (Dry/Moist/Thorn)-Open
- Forest Blank
- Forest Plantation
- Scrub Forest
- Forest-Tree Clad Area
- Wastelands
- Water bodies-Reservoir/Tanks
- Water bodies-River/Stream

10.6 The above classification of LULC can be grouped into five main categories. They are as follows:

⇒ Crop land consisting of single crop land, double crop land current follows and agricultural plantations;

⇒ Forest land consisting of open forest, scrub forest, tree clad area, forest area and forest plantations;

⇒ Water bodies consisting of reservoirs, tanks, rivers and streams;
⇒ Built up land; and
⇒ Waste lands.

Changes in LULC of Catchment Area

10.7 The LULC of the catchment area of Singur project during 1989 and 2008 and the changes in LULC during this period as per above grouping of different land uses is presented in **Table 10.1**. The LULC maps of the catchment area of the project during 1989 and 2008 are presented in **Fig 10.1 and 10.2** respectively.

Changes in Crop Land

10.8 The Crop land comprises of single cropped area, double cropped area, agricultural plantations and current fallows. The area under this category is assessed to be 3718.12 sq km during 1989 and 3726.54 sq km during 2008. Thus, the crop land increased to the extent of 8.42 sq km during this period. The first impounding of water in Singur reservoir was during 1989, the crop land during this year did not account for crop land under submergence. The crop land under the submergence of reservoir during 1989 is assessed to be about 84.25 sq km. On the basis of this observation the total crop land during 1989 was corrected by adding this crop land under submergence to the observed crop land during 1989 with a view to obtain area of crop land in the catchment during pre-project situation. Thus, the crop land during pre-project period is assessed to be 3802.37 sq km. Therefore, the reduction in crop land during post-project period is estimated to be 75.83 sq km. Further, it is observed that the double crop area during 2008 reduced by 318.58 sq km (20.35%) as compared to the same during the pre-project period. The current fallows increased by 161.12 sq km (108.60%) during 2008. This was mainly because there was below normal rainfall in the entire catchment area of the project during 2006, 2007 and 2008 and above normal rainfall during 1989. Another significant change observed during the post-project period in the land use is the reduction in area under double crop. This again may be mainly due to low rainfall during 2008

Area under Forests

10.9 The area under forests comprises of open forest, forest blank, forest plantation, scrub forest and tree clad area. At all aggregate level the area under forests got reduced by 6.39 sq km and this accounted for 17.69 per cent of total forest area in the catchments during 1989. The reduction in forest area was observed in case of forest blank, and scrub forest whereas the forest plantation registered an increase of 7.14 sq km (301.27%) during this period. The reduction in forest area during this period was mainly because of encroachments and diversion of forest land for non-forest purposes. It also appears that a part of forest blank or open forest was afforested with the helps of various forest development programmers of Government.

Table 10.1 Land Use and Land Cover of Catchment Area of Singur Project in 1989 and 2008 and its changes during this period					
Sl. No	**Land Use / Land Cover**	**Area (Sq km) under stated category during**			
		1989	**2008**	**Absolute Change**	**% Change**
I	Crop Land				
	1) Single Cropped Area	2000.99	2166.82	165.83	8.29
	2) Double Cropped Area	1565.22	1246.64	-318.58	-20.35
	3) Agricultural Plantations	3.63	3.68	0.05	1.38
	4) Current Fallow	148.28	309.40	161.12	108.66
Sub Total		**3718.12**	**3726.54**	**8.42**	**0.23**
II	Forest Land				
	1) Deciduous (Dry/Moist/Thorn)-Open	3.34	3.34	0	0.00
	2) Forest Blank	7.95	2.74	-5.21	-65.53
	3) Forest Plantation	2.37	9.51	7.14	301.27
	4) Scrub Forest	19.72	11.40	-8.32	-42.19
	5 Tree Clad Area	2.74	2.74	0	0.00
Sub Total		**36.12**	**29.73**	**-6.39**	**-17.69**
III	Water Bodies				
	1) Reservoir / Tanks	138.35	144.89	6.54	4.73
	2) River / Stream	46.65	47.07	0.42	0.90
Sub Total		**185.00**	**191.96**	**6.96**	**3.76**
IV	Built up Area	48.02	50.49	2.47	5.14
V	Waste lands	251.99	240.53	-11.46	-4.55
Total		**4239.25**	**4239.25**		

Water Bodies

10.10 Water bodies in the catchment area of the project consisted of reservoir, tanks, rivers and streams. The total area under water bodies during post-project period can be assessed to be 191.96 sq km. The area under water bodies increased to the extent of 6.96 sq km between 1989 and area under 2008. A major part of this increase was due to increase in the area of reservoirs and tanks. This increase however, is without accounting for the area under submergence due to Singur project. The area under water bodies during pre-project period can be assessed as the sum of the area of water bodies in the year 1989 and Singur reservoir submergence during 1989, since the water impounding in the reservoir was done prior to1989. Therefore the area under water bodies during pre-project

period has been assessed to be 100.75 sq km. Thus, the area under water bodies between 1988 and 2008 increased by 91.05 sq km (90.93%).

10.11 The area under river and streams is assessed to be 46.65 sq km during 1989 and 47.07 sq km during 2008. The river banks devoid of any vegetation are mainly concentrated around the dried river bed of Manjira. The changes in course by Manjira along with excessive siltation during rainy season have resulted in the expansion of such areas.

Waste Lands

10.12 The area under wastelands registered a decrease of 11.466 sq km (4.55%) between 1989 and 2008. This reduction was mainly because; the marginal lands which are classified as waste lands were used for cultivation purposes. Further, part of the waste lands was converted in to built up land and this also contributed for reduction of waste lands between 1989 and 2008.

Built-up land

10.13 The area under built-up land in the catchment area of the project during 1989 is assessed to be 48.02 sq km and the same has increased to 50.49 sq km by 2008. This increase was mainly because the built-up land submerged under reservoir has been reconstructed on wastelands and crop lands. Further, the ever increasing demand for housing and infrastructure facilities such as roads have also contributed for increase in the area under built-up land during this period.

Map Overlay Analysis

10.14 Two main methods of data analysis for assessing changes in land use and land cover are adopted in the study. They are as follows:

- Calculation of the area is hectares of the resulting land use and land cover types for each study year and subsequently comparing the results; and

- Map overlay operation

10.15 A comparison of land use and land cover statistics assisted in identifying the percentage changes, trend and rate of change between 1989 and 2008. A map overlay operation identifies the actual location and magnitude of change. There are many Change Detection Algorithms that can be employed in change detection analysis. In this study "Image Differencing" has been used to carryout the analysis. Image differencing involves subtracting the image of one data from that of another. The subtracting results in changes that have taken place over the period of time. An important aspect of change detection is to determine what is actually changing to what i.e., which land use class in changing to other. This information will reveal both desirable and undesirable changes and classes

that are relatively stable over time. This information will also serve as a vital tool in management decisions. The process of map overlay involves a pixel to pixel comparison of the study year image through overlay. For the purpose of this analysis six main land use classes have been considered. They are as follows:

- Agricultural Land
- Forest Land
- Water Bodies – Reservoir / Tanks
- Water Bodies – Rivers / Streams
- Built-up Area, and
- Waste Lands

10.16 The changes in land use and land cover categories from 1989 to 2008 are presented in **Table10.2**. The built-up land has shown a steady increase over the period of 1989 to 2008. There is a slight increase in Agricultural land during this period. This may be mainly because the waste land has been converted to cultivable land through various watershed development programs implemented during this period particularly in the states of Karnataka and Maharashtra. The area under water bodies has also shown an increase during this period. The area under forest and waste lands has shown reduction in the period of 1989 to 2008 (**Fig 10.3**)

Table 10.2
Changes in Land Use Land Cover Categories in the Catchments Area of Singur River Valley Project (1989-2008)

Sl No	Change Particulars: Changes From To	Area in ha	Per cent in Total
1	Agriculture to Water bodies-Reservoirs/Tanks	699.21	13.11
2	Agriculture to Water bodies-River/Stream	40.67	0.76
3	Agriculture to Wastelands	169.57	3.18
4	Agriculture to Built-up Land	1046.53	19.62
5	Forests to Agriculture	983.12	18.43
6	Forests to Built-up Land	64.92	1.22
7	Water bodies-Reservoir/Tanks to Agriculture	26.5	0.50
8	Water bodies-Reservoir/Tanks to built-up Land	8.76	0.16
9	Water bodies-River/Stream to Agriculture	4.26	0.08
10	Wastelands to Agriculture	2178.43	40.84
11	Wastelands to Forest Plantation	20.22	0.38
12	Wastelands to Built-up Land	91.93	1.72
	Total	**5334.12**	**100.00**

Fig 10.1
Land Use and Land Cover of Free Catchment Area of Singur Project (1989)

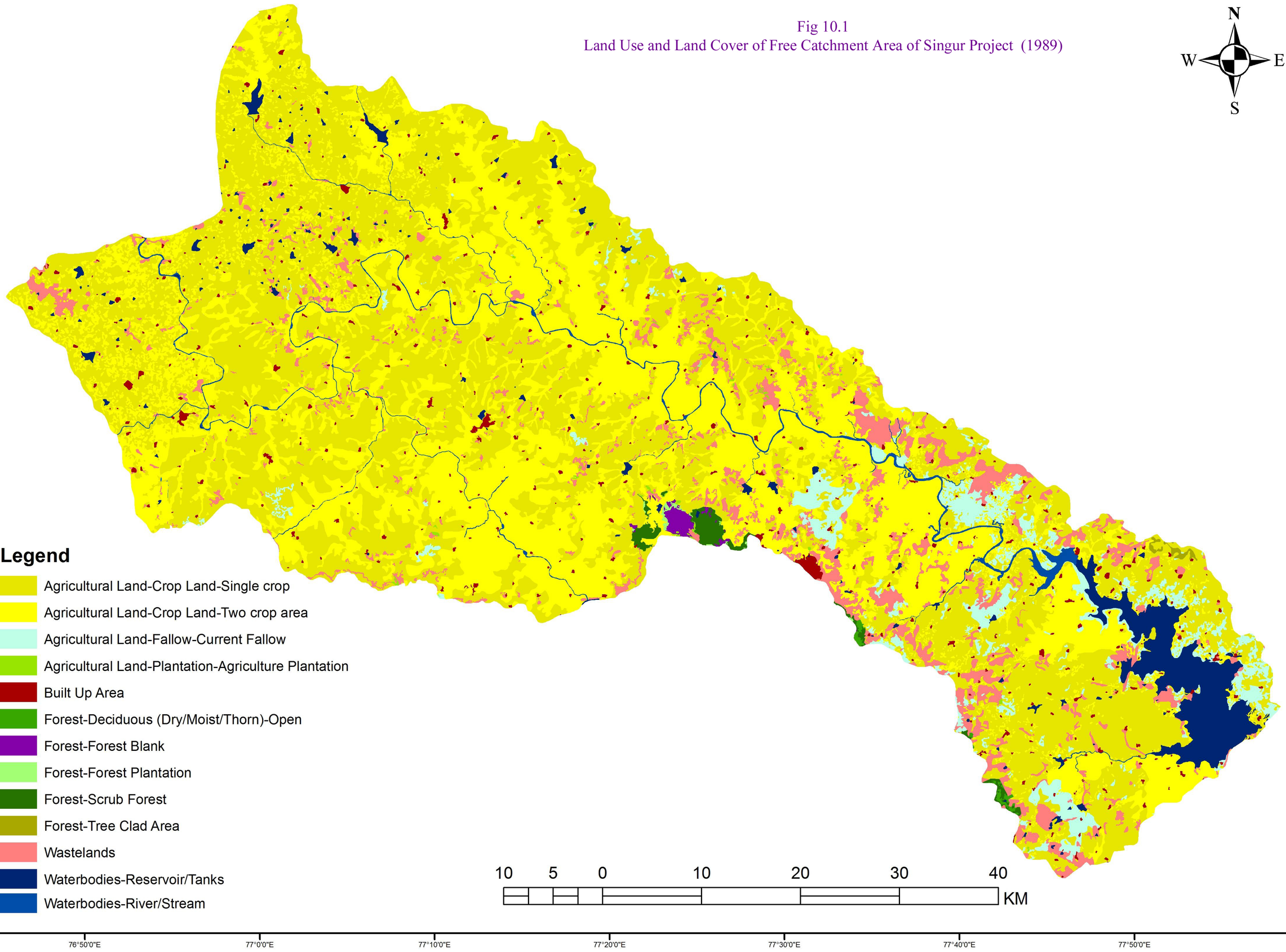


Fig 10.2
Land Use and Land Cover of Free Catchment Area of Singur Project (2008)

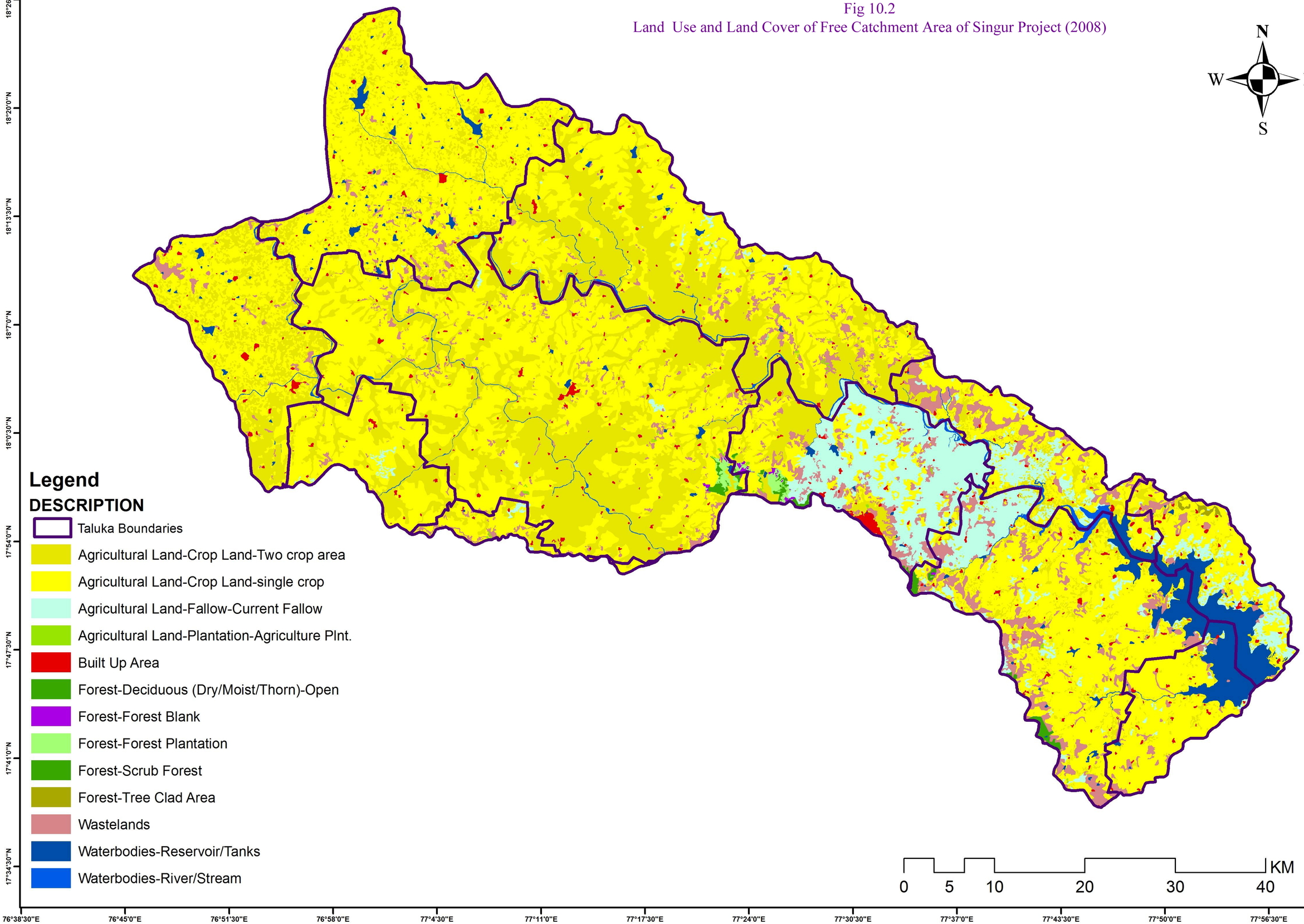
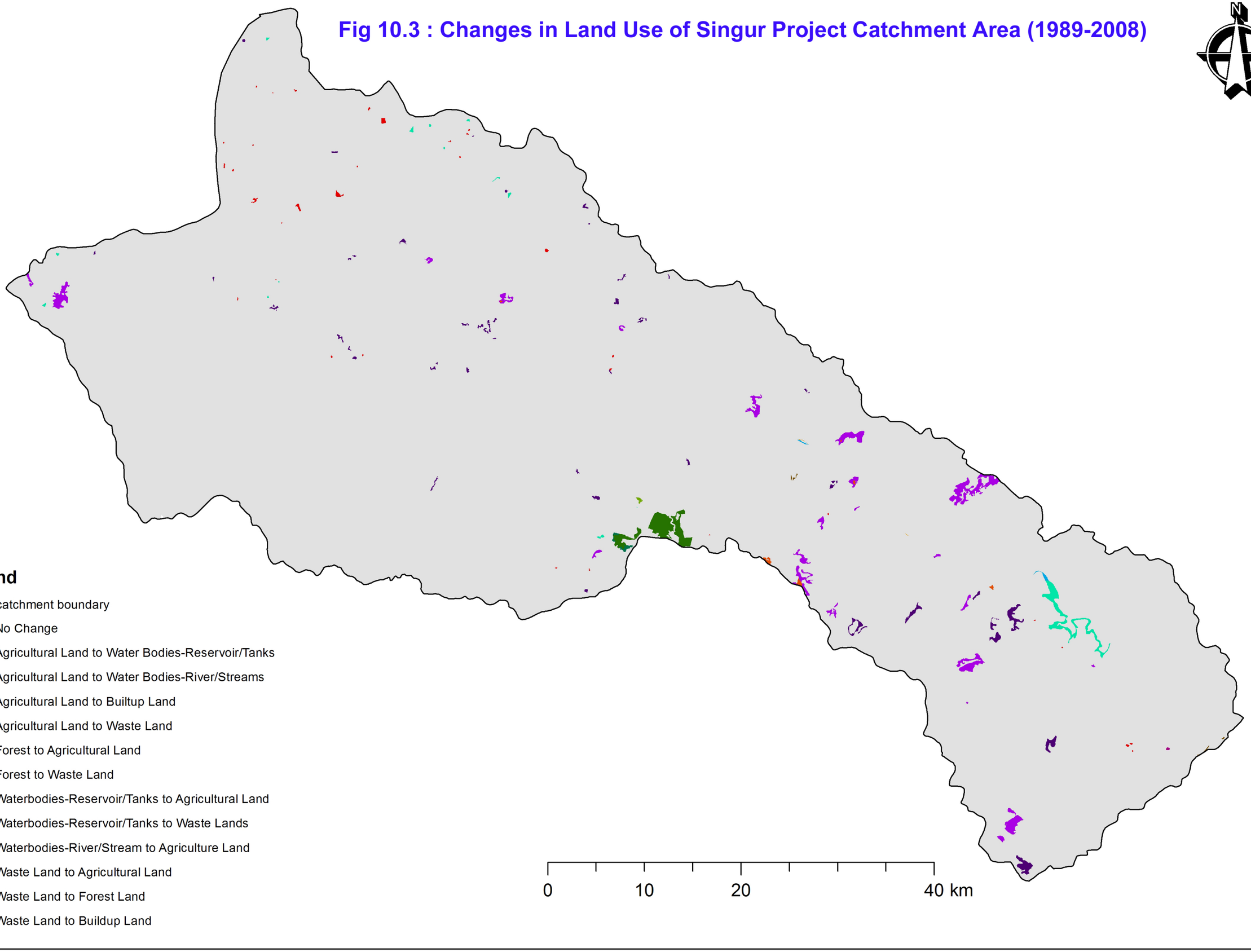


Fig 10.3 : Changes in Land Use of Singur Project Catchment Area (1989-2008)



Part – I

11
Status of Command Area

AFC, Hyderabad

11

STATUS OF COMMAND AREA

Prelude / Background

11.01 As stated earlier, the Singur project is a multipurpose project which was conceived to supply additional water requirements of the state capital of Andhra Pradesh i.e., the twin cities of Hyderabad and Secundrabad as well as to generate 15MW of power and arresting silt transportation through downstream of Manjira River to Nizamsagar Project, beside this it has also been envisaged to bring an area of 16000 ha under the project command. Under the project, a dam across Manjira River was constructed at Singur village in gorge area of the river between 1976 and 1982 with the provision of Left main canal and Right main canal to provide irrigation to the said demarcated command area.

11.02 As per the DPR, the proposed Left main canal length is 48 km which is designed to irrigate an area of 15000 ha with the discharge capacity of 25.40 m^3/s, while the Right main canal has the provision of 12 km length which is proposed to cover an ayacut of 1000 ha with the discharge capacity of 1.61 m^3/s. Thus, as mentioned earlier, it has been proposed to irrigate an area of 16000 ha under the project. The command area of the project is likely to cover about 54 villages list enclosed as **Annexure XI.1**. The command area lies on the North-East area (Left main canal) as well as on South-East area (Right Canal) of the Singur project. The mandals which are going to be covered under the project command are Tekmal, Andol, Pulkal Munipally, Sadasivpet and Sanga Reddy.

11.03 If the envisaged command area is developed, a large population residing in the command area villages will be economically benefited and help the beneficiary farmers in increasing their crop productivity by utilizing the newly developed irrigation facilities.

Present status of Command Area Development

11.04 In the process of developing the command area, as contemplated, the Government of Andhra Pradesh had accorded permission in G.O.Ms, No 455-Irrigation and Power (Irr.V) Department dt 03.10.1980 for utilizing 56.6 MCM (2TMC) of water under Singur project for irrigating 16000 ha irrigated dry crops in Kharif season only. The Government vide GOMS No. 136 dated 26.07.2005 had accorded Administrative Sanction for providing irrigation to an area of 16000 ha at a cost of ` 88.99 cores. Accordingly the estimates for works of “Earth Work Excavation”, forming Embankment and construction of CD & CM works including investigation, preparation and approval of Hydraulic particulars, designing and drawings and estimation of Left canal from 0.00 to 48.00 km and Right canal from 0.00 to 12.00 km distributory system and field channels to feed the

ayacut (16000 ha) for Kharif ID crops under the project was technically sanctioned. The sanctioned estimate for these works is ` . 84.45 Crore (communicated vide C.E.I.R. No 479/05-06 dt 27.2.2006/23.3.2006).

11.05 The Government of Andhra Pradesh vide GO (MS) No.93 dated 24.02.1990, had fixed minimum levels of water in the dam month-wise and issued interim operating rules prescribing that a minimum level of +518.50 meters shall be maintained during June and +518.25 m shall be maintained during July and August in order to ensure water supply to Manjira Phase III. The GO further stated that water for irrigation shall be released only when the water levels are higher than the minimum levels month-wise as indicated (GO enclosed)

11.06 The work was awarded to M/s Maha Laxmi Construction Corporation Limited., Pune vide AB No. 4/2006-07 dt 08.05.2006 for a contract value of ` 58,38,64,000/- with the stipulation to complete the work within a period of 24 months. The details of Left and Right main canals are presented in the following **Table 11.1**.

Table 11.1

Singur Project: Details of Proposed Left Main Canal and Right Main Canal

Particular	Left Canal	Right Canal
Length of canal proposed	48 km	12 km
Ayacut Proposed	37500 acres	2500 acres
Details of Sluice		
i) Sill Level	+520.00m	+520.00m
ii) Number and Size of vents	4 vents of 2.50 m x 2.00 m	vent of 150 m x 1.00 m
iii) Discharge Capacity	25.485 m^3 / sec	1.614 m^3 / sec

11.07 The total land requirement for canal system is estimated to be about 565 ha. The land acquisition proposals have already been submitted to special Dy. Collector, Sangareddy, Medak District which is under process as reported.

11.08 The investigation and surveys were completed in respect of 24.15 kms for left canal, 12.50 km for Right canal and the main branch canal to an extent of 24.1 kms work in relation to distributaries for Left and Right canal were completed and the distributaries work for main branch canal is in progress.

11.09 The ayacut under left main canal and main branch canal of LMC is 375 acres. The extent of land proposed for acquisition is 894.59 acres of which land including government land so far acquired stood at 800 acres leaving balance acquisition of 94.59 acres CD & CM works of LMC and MC is in progress. The land proposed to be acquired for Right main canal was 418 acres 15 guntas. The total land so far acquired is 377 acres leaving balance acquisition of 41.15 acres.

11.10 Thus, the total land to be acquired under this project stood at 1312.74 acres of which the balance acquisition reportedly remaining is 135.74 acres. An approximate amount of ` 500 lakh is required for acquiring balance land of 135 acres (94.59 +41.15).

Present Status of Command Area

11.11 As stated earlier, if the contemplated command area is developed, a large population residing in the command area villages will be economically benefited and the beneficiary farmers would be able to increase their crop productivity by utilizing the irrigation facility once it is developed. At present the canal laying process is held up due to land acquisition, as such, effect on agriculture, and its changes due to command area development could not be studied. However, an attempt is made to study the prevailing baseline scenario of the command area. This could be a benchmark data, as the actual command area development is yet to take off, which will be the base for comparison with the post-project (command area) situation and its impact for further studies.

Baseline Socio-Economic Environmental Status in the Command Area:

11.12 The command area lies on the North-East and South-East of the Singur Dam. The command area of the project is about 16000 ha covering about 54 villages **(Annexure XI.1 and Fig XI.1)**. The Gross Command Area of the project is assessed to 45, 847 ha.

Methodology

11.13 Following methodology followed for trapping the relevant information needed for the study. There are six components to be studied for the Command Area study viz.,

1. Socio-Economic Environment
2. Agriculture scenario
3. Land use pattern
4. Soils of the Area
5. Groundwater Status
6. Surface Drainage

11.14 The first two components i.e., Socio-Economic and Agriculture involved two approaches for Collection of data through secondary sources i.e., 1) authentic and published data of the concerned departments in district, 2) the data from Directorate of Economic and Statistics. Besides, interactions with concerned department officials through personal interview/checklist are made to substantiate and corroborate wherever required. ii) The primary data was collected through survey method with the pre-designed schedule at the village level. This primary data is collected using Random Sampling method. The sample comprised of selected Head of Household from the farming community only.

Sampling Design

11.15 Selection of Mandals: There are 7 mandals which come under the command area of the project, out of these seven mandals, five have been selected for survey purpose. The selected mandals are as follows: The other two mandals (viz) Sanga Reddy and Sadasivapet were dropped due to negligible coverage in command area.

1. Tekmal
2. Alladurg
3. Andol
4. Pulkal
5. Munipally

11.16 Selection of Villages: There are 54 villages which were brought under project command canal network. For the survey purpose 20% of the villages (11) are selected randomly for the household survey. The mandal wise selected sample villages are given in **Table 11.2**

Table 11.2
List of Selected Villages

Sl. no	Name of Mandal	Name of Village
1	Pulkal	1. Pulkal 2. Gongure 3. Gangojipet 4. Eskojipet
2	Munipalle	5. Mansanpally
3	Andol	6. Almaipet 7. Dakoor
4	Tekmal	8. Palvancha 9. Dhannaram
5	Alladurg	10. Yarraram 11. Nuredigunta

11.17 Selection of Farmers: It was assumed that on an average there would be 200 farming community households in each village. It is decided to select 10% of them for detailed household survey. It is made mandatory to select 20 farmers from each selected village, irrespective of farming community population in the sample village. Thus, the total of household sample stood at 220, for collection of primary data.

11.18 Pre-testing of Household Schedule: A pilot study was carried out for household schedule in three villages and based on the observation made during the field visits necessary modifications / deletions / additions are carried out in the data collection tools. Thus, the schedule is finalized after its pre-testing through the household survey.

11.19 Data Collection: Research team along with field investigators visited the selected sample villages and contacted the farmers selected for random for collection of primary data.

11.20 Besides primary survey, the observation made during the data collection are also used in supplementing the quantitative data. In additions to above, field photographs, focus group discussions and PRA Methods were used for understanding the existing situation in the study area. Observations emerging from these tools were also utilized in preparing the study report.

11.21 For the data on land use pattern, soils of the area and surface drainage of the study area, Remote Sensory Imageries (RSI) are used for its interpretation, discussion and presentation. The Groundwater data of the study area is procured from Groundwater Department of Government of Andhra Pradesh.

Data Tabulation and Analysis

11.22 The data from primary and secondary sources of information is tabulated in pre-designed formats and analysis is done using simple statistical tools such as mean, averages and percentages to present the situation of the study area. Graphs and pictorial support is used wherever necessary to make the report easily comprehendible.

Socio-Economic Environment of the Study Area

11.23 The baseline socio-economic study is conducted keeping in view the scenario as indicated in the introductory narration. It is to be mentioned here that the command area study is confined to the present situation (2007-08) of the area with reference to socio-economic situation existed during the conduct of the study. In other words, it is a benchmark (baseline) data, as the actual command area project is yet to take off, which will be the basis for comparison with post project (command area) situation and its impact for future studies as mentioned earlier..

11.24 The present study is confined to the command area mandals viz., Pulkal, Munipalle, Andol, Tekmal, Alladurg, Sadasivapet and Sangareddy. The demographic particulars of Medak district have already been presented. However, the district figures are also depicted in the tables wherever it is found necessary for references.

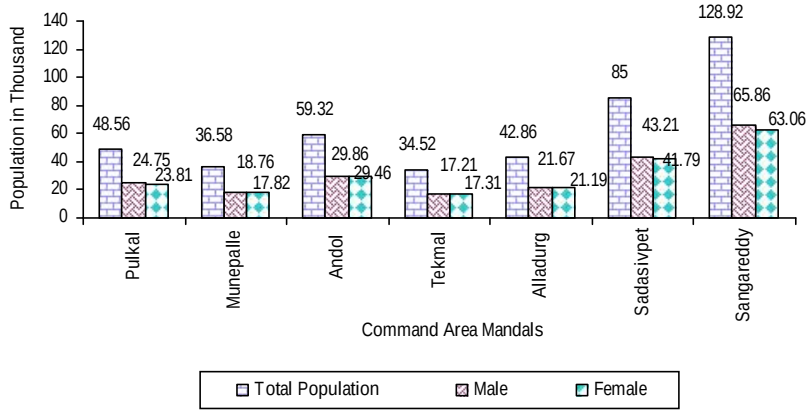
11.25 Population and Sex Ratio: Among command area mandals, Sangareddy is found to be thickly populated (1.29 lakh) followed by Sadasivapet (85000) and Andol (59000) as compared to other remaining mandals **(Annexure XI.2)** which ranged between 35000 to 49000. Similar trends were noted with regard to rural population of the mandals. The male and female population is not evenly distributed except Tekmal mandal where female population is slightly more (0.5%) than male population. However, it is observed that female population has closely followed male population. Sex ratio data indicated that

for 1000 males, females are ranged from 949 to 1000.5. Further, it is noted that on an average males – female sex ratio is 1000:970.

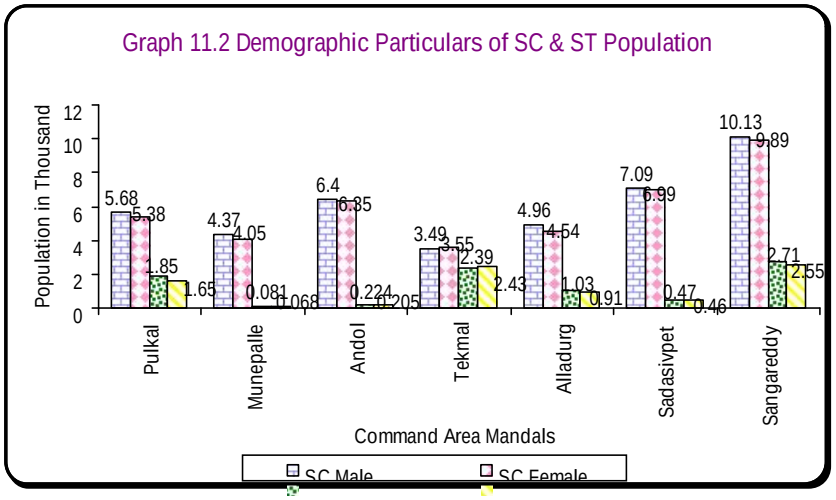
11.26 With regard to SC and ST Population, it is observed that on an average SC population constituted 25 per cent of total rural population. The Sangareddy mandal has more SC population (34.4%) compared to other mandals which ranged between 21 and 30 per cent. In case of ST population it is noted that on an average, it constituted 5.4 per cent to the total rural population. The Munipalle and Andol mandals have less than one per cent of S.T population. Further, the data revealed that the Tekmal and Sangareddy mandals have more ST population as compared to other mandals i.e., 14.0 per cent and 9.0 per cent respectively.

11.27 The data on Density of population (per sq km) indicated that among all mandals Sangareddy is on top (581) and Munipalle is on bottom (181). Please refer to Annexure XI.1 for details. The graphical representation is given in **Graph 11.1 and 11.2**

Graph 11.1 Demographic Particulars of Command Area Mandals



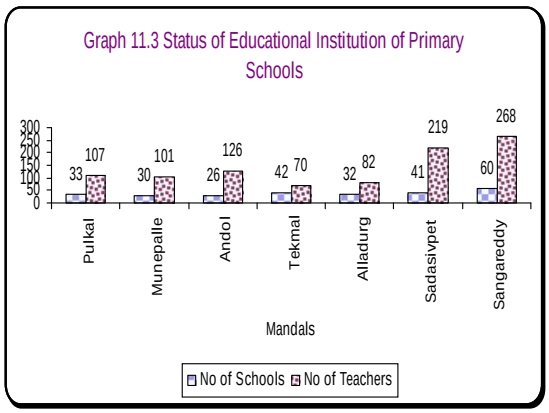
Graph 11.2 Demographic Particulars of SC & ST Population

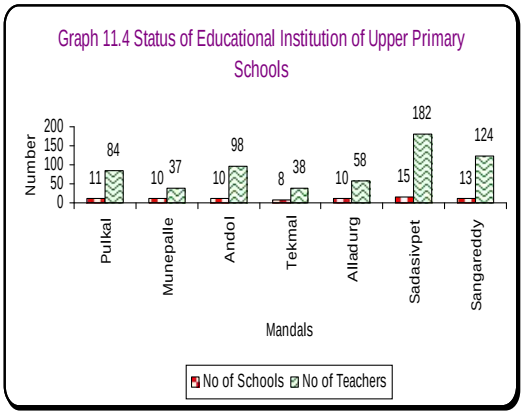


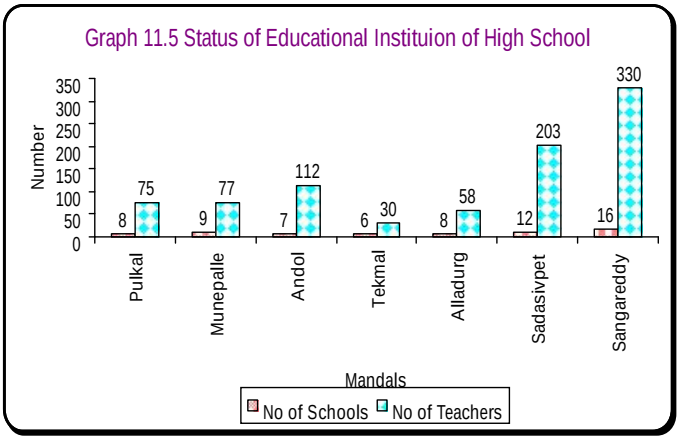
Details of Status of Schools, Teaching Staff and Students Turnover

11.28 The data on mandal-wise students turn over is not available. However, at district level (2007-08) data is available (Annexure IV.1) which has been presented in the Chapter IV. The authentic published data which is available with reference to type of Schools (Primary, Upper Primary and High schools) and teachers working in these educational institutions for the year 2006-07 is presented in **(Annexure XI.3)**. From the table it is observed that at the primary school level on an average 4 teachers are available per school. The average number of teachers per school at upper primary school showed improvement in posting of teachers as compared to primary school, minimum being 4 (Munipalle mandal) and maximum 12 (Sadasivpet) per school.

11.29 With regard to High school, it is noted that Sangareddy mandal got the preference in getting posted good number of teachers (on an average 21 teachers / school) followed by Sadasivapet (17) and Andol mandal (16). The lowest (5) number of teachers per school is noted in Tekmal mandal. Graph 11.3, 11.4 and 11.5 reveal the status







Male-Female Literacy and Adult Education Programme

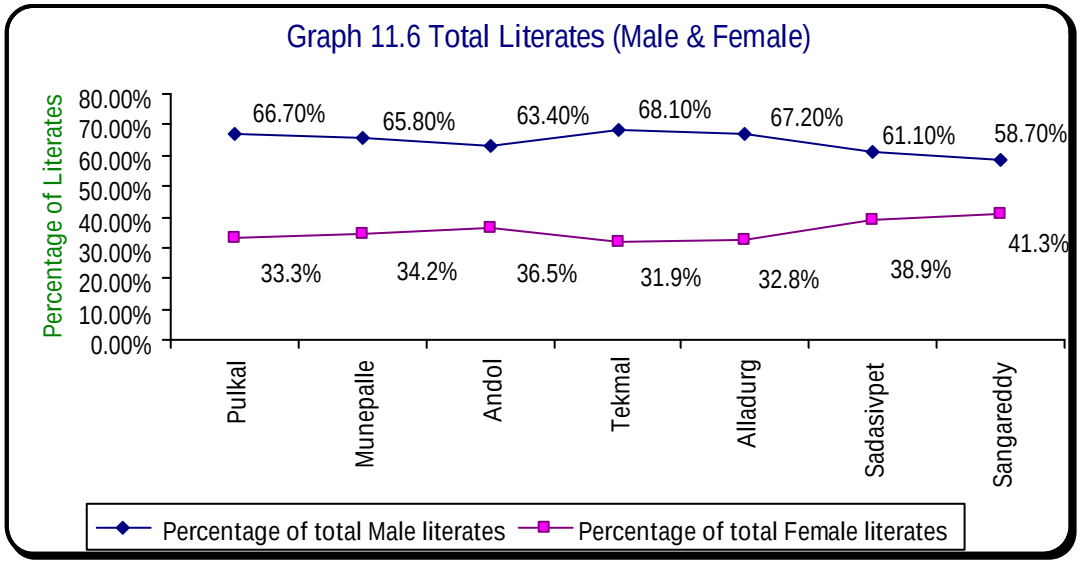
11.30 It is reported that the Adult Education Programme is being carried out through National Literacy Programme. At the mandal level, it is observed that a number of literacy centers are being run under the literacy programme to educate the illiterate masses. Details of illiterates identified and number of literacy centers functioning in the respective mandals during 2007-08 is depicted in **(Table 11.3)**. The literacy programme is widely spread covering almost all the village of mandals. Through this programme attempts are being made to provide basic educational skills among the illiterates which is taking care of male as wells as female members of the illiterate community at the respective village literacy centers.

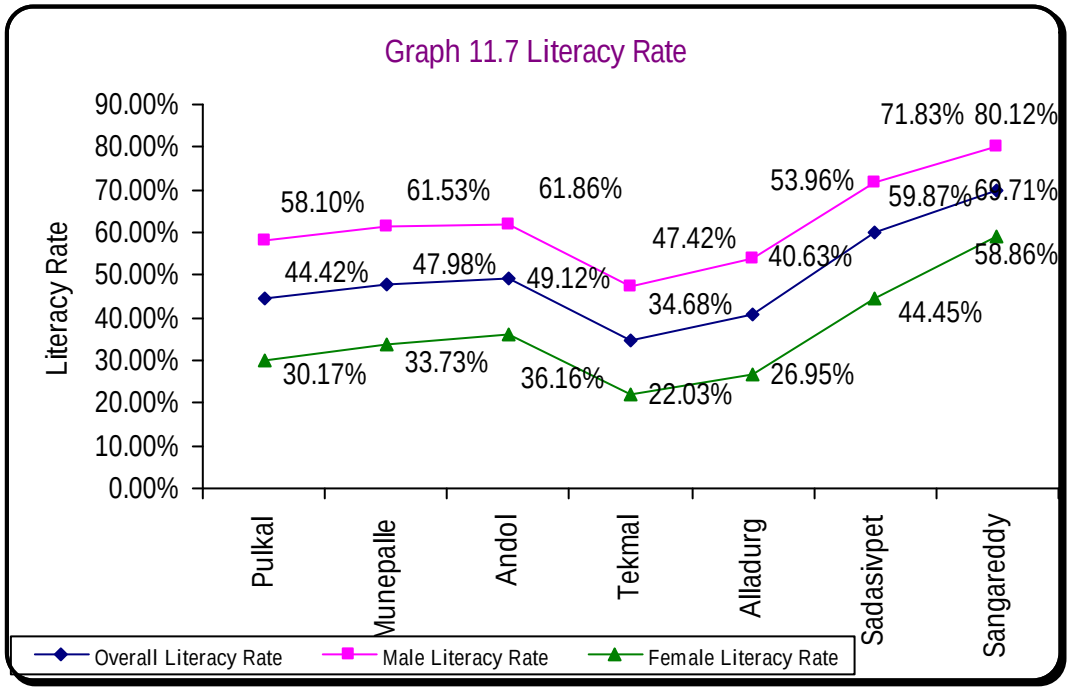
Table 11.3
Illiterates identified in Project Command Area mandals and Number of literacy centers (2007-08)

Sl. No	Name of the Mandal	Total number of illiterates identified	No. of literacy centers Functioning
1	Pulkal	270	18
2	Munipalle	319	21
3	Andol	255	15
4	Tekmal	630	42
5	Alladurg	420	28
6	Sadasivapet	480	32
7	Sangareddy	240	16
Total Command Area mandals		**2614**	**172**
Medak District Total		**16,530**	**1102**
Source: Complied on the basis of Statistical Hand Book of Medak Dist			

Literacy Rate

11.31 The total population of project command area mandals (7) during 2007-08 stands at 4.36 lakh of which 2.03 lakh are literates; out of which 1.27 lakh are males and females are 0.77 lakh. In terms of percentage of male and female literate, it is found to be 62 and 38 per cent respectively. The details of mandal-wise literacy rate with respect to its total population is presented in **Annexure XI.4**. The average literacy rate in the command area mandals stood at 49.5% to its total population. The lowest literacy rate is noted in Tekmal mandal (35%) and highest is in Sangareddy mandal (69%). The Mandal-wise breakup of male literacy rate indicates that the lowest male literacy rate is found at Tekmal (47%) and the highest male literacy rate is found in Sangareddy (80%). The female literacy rate indicates the lowest at Tekmal (22%) and highest at Sangareddy (59%).

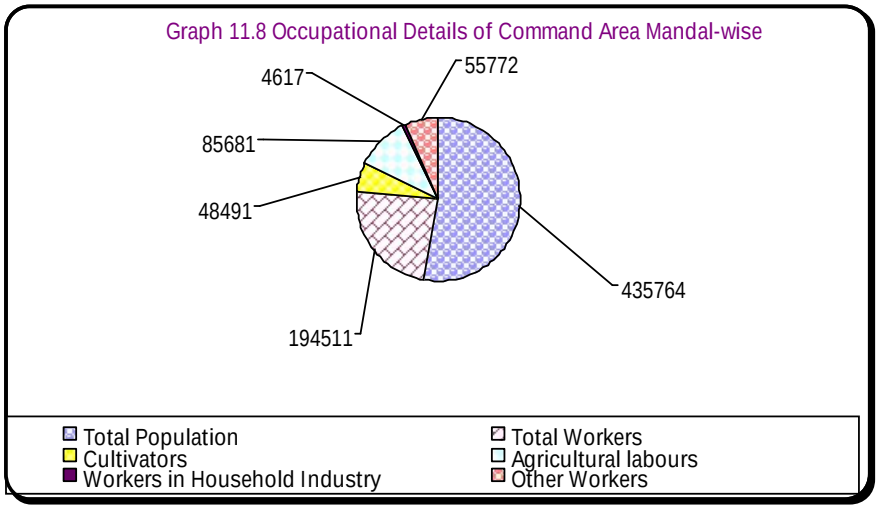


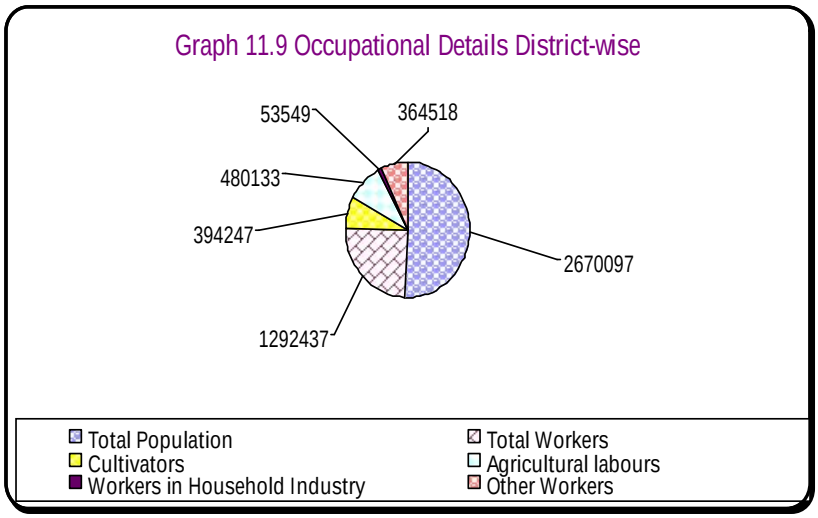


Occupational details of Command Area Mandals

11.32 The total population of command area mandals (7) stood at 4.36 lakh of which total workers i.e., Cultivators, Agricultural labourers, workers in House Hold Industry (HHI) and other workers are 194511. These workers work force constituted 44.6 per cent of the total command area mandals population. Among the total command area workers, 25 per cent are cultivators, 44.0 per cent constituted Agricultural labourers and 2.4 per cent found to be engaged in Household Industry. The remaining 28.6 per cent of

workforce is engaged in miscellaneous type of works. The mandal-wise details of these are give in **Annexure XI.5**.





Status of Educational Institutions (Colleges), Recreational and Commercial Institutions

11.33 Educational Institution: With reference to this, it is observed that in all project command area mandals at least one Junior college existed during the year 2007-08. Sangareddy mandal is exceptional where 10 Junior colleges are functioning followed by Andol mandal (3). With regard to Degree colleges, it is observed that these Institutions are existing in Sangareddy (2) and Sadasivapet (6). Besides degree colleges, Sangareddy is also having one Post-Graduate college **(Table 11.4)**.

11.34 Recreational Facilities: The cinema theaters are located only in Andol (2), Sadasivapet (4) and Sangareddy (5) mandals. Electronic community sets viz., Radio &

TV are found in all project command mandals. The details are presented in the following **Table 11.4**.

Table 11.4
Availability of Educational and Recreational Facilities in Project Command Area

Sl. No	Name of Mandal	Jr. Colleges	Degree colleges	PG college	Recreational		
					Cinema theaters	Community sets	
						Radio	TV
1	Pulkal	1	-	-	-	29	1
2	Munipalle	1	-	-	-	22	2
3	Andol	3	-	-	2	19	1
4	Tekmal	1	-	-	-	13	4
5	Alladurg	1	-	-	-	6	7
6	Sadasivapet	1	6	-	4	20	7
7	Sangareddy	10	2	1	5	20	14

Source: Compiled on the basis of Statistical Hand Book of Medak Dist

11.35 Commercial and Cooperative Banks: Banking institutions are found to be working in all command area mandals during the year 2007-08. The number of commercial bank braches ranged between 2 and 10 in each mandal. More number of commercial banks is noted in Sangareddy (10) and Sadasivapet (6). However, the cooperative banks are found to be established only in Andol (1), Sadasivapet (1) and Sangareddy (5) mandals. In all there are 37 banking institutions operating in the project command mandals. The details of these are given in **Table -11.5**.

Table 11.5
Availability of Commercial and Cooperative Banks in Project Command Area (2007-08)

Sl. No	Name of the project	Commercial banks	Cooperative Banks	Total
1	Pulkal	3	-	3
2	Munipalle	2	-	2
3	Andol	3	1	4
4	Tekmal	2	-	2
5	Alladurg	4	-	4
6	Sadasivapet	6	1	7
7	Sangareddy	10	5	15
Total		**30**	**7**	**37**

Source: Complied on the basis of Statistical Hand Book of Medak District

Availability of Medical Facilities

11.36 The medical infrastructural facilities are found to be established in each of the mandals, mostly at the Mandal Headquarter. Further it is noted that Government Public Health Centers (PHC) are located in each of the mandals. The Govt, Homeopathy dispensaries have been established only in Sadasivapet and Sangareddy mandals whereas Govt. Auryvedic dispensaries are functioning in 5 mandals (Pulkal, Andol, Tekmal, Alladurg and Sangareddy). The Govt. Unani dispensary is located at Sangareddy, which

is also a District Headquarters. The details of availability of doctors, number of beds and patients treated are presented in **Table 11.6** below**.**

Table 11.6
Availability of Medical Facilities in Medak District and Command Mandals (2007 - 08)

Sl. no	Particulars	Units	Medak Dist	Pulkal	Munepalle	Andol	Tekmal	Alladurg	Sadasiv pet	Sanga reddy
1	Allopathy (Govt Hospitals & PHCs)	No's	75	1	1	1	1	2	1	2
	a. Doctors	No's	216	1	2	7	1	1	5	29
	b. Beds	No's	1466	2	2	30	6	2	30	250
	c. Patients treated	No's	2188359	12850	8985	130587	10250	13650	98784	417183
2	Homeopathy - Govt Dispensaries	No's	11	0	0	0	0	0	1	1
	a. Doctors	No's	11	NA	NA	NA	NA	NA	1	1
	b. Patients treated	No's	143383	NA	NA	NA	NA	NA	16800	20768
3	Ayurvedic - Govt Dispensaries	No's	25	1	0	1	1	1	0	1
	a. Doctors	No's	25	1	NA	1	1	1	NA	1
	b. Patients treated	No's	381245	13560	NA	12000	16296	12100	NA	15110
4	Unani - Govt Dispensaries	No's	9	0	0	0	0	0	0	1
	a. Doctors	No's	5	NA	NA	NA	NA	NA	NA	2
	b. Patients treated	No's	127348	NA	NA	NA	NA	NA	NA	15853

Source: Complied from Handbook of Statistics Medak Dist, 2008

Family Welfare Programme

11.37 Under the Family Welfare Programme, Sterilization Programme is found to be regular one in the district and is true with the command area mandals also. The details of VAS/TUB and IUD which are carried during the year 2007-08 in terms of number of persons Sterilized mandal-wise is depicted in **Table 11.7** for reference. From the table it can be noted that with respect to VAS / TUB stabilization Sangareddy stands first (1374 cases) followed by Sadasivapet (1114). The lowest among the mandals is in Alladurg mandal (229).

Table 11.7
Sterilizations carried out in Medak District and Command Area Mandals (2007 - 08)

Sl.no	Particulars	Units	Medak Dist	Pulkal	Munepalle	Andol	Tekmal	Alladurg	Sadasiv pet	Sanga reddy
1	VAS / TUV	No's	31247	601	564	398	410	229	1114	1374
2	IUD	No's	14100	206	196	239	400	137	442	978

Source: Complied from Handbook of Statistics Medak Dist

Immunization Programme

11.38 Immunization Programme is also a regular activity in the command area mandals by the Health Department under which Polio, DPT, BCG and Measles are being covered. The number of Children immunized during the year 2007-08 is given mandal-wise in the **Table 11.8**. The highest Polio drops are administered in Sangareddy mandal (3021) followed by Sadasivapet (1752), Andol (1036) and Pulkal (1038 more or less similar trends are observed in respect of DPT, BCG and Measles.

Table 11.8
Immunisation Programmer (No. of Children Immunized) : District and Mandal Wise (2007 - 08)

Sl. no	Particulars	Units	Medak Dist	Pulkal	Munepalle	Andol	Tekmal	Alladurg	Sadasiv pet	Sanga reddy
1	Polio	No's	54845	1038	672	1036	678	862	1752	3021
2	DPT	No's	54845	1038	672	1036	678	862	1752	3021
3	BCG	No's	57186	1072	721	1089	648	891	1629	4342
4	Measles	No's	54186	936	848	932	661	802	1891	2825

Source: Complied from Handbook of Statistics Medak Dist

Baseline Environmental Status of Command Area

Land Use Pattern

11.39 The land use pattern of the command area is given in **Table 11.9** and **Fig XI.2**. It is observed from the table that 710 ha of the area is covered by Barren Rocky / Stony waste / Sheet Rock are, while about 1250 ha is occupied by Degraded Forest, and the fallow lands of the area accounted for about 425 ha.

11.40 Land under cultivation is found to be more than 33,065 ha. Further it is noted that single crop area of the command area is 19,865 ha while the double crop area is to 13,200 ha. The double cropped area is being irrigated by the available minor irrigation tanks and a barrage downstream of Singur Reservoir. An area of 1700 ha is occupied by dry tanks. The land under the other uses has been indicated in the table for reference.

Table 11.9
Land Use and Land Cover of GCA of Singur Project

Sl. No	Particulars	Area Covered (ha)
1	Barren Rocky / stony waste / sheet Rock area	71.08
2	Degraded Forest	1252.58
3	Double crop	13200.75
4	Dry River	961.81
5	Dry Tank	1788.63
6	Fallow lands	425.63
7	Land without Scrub	201.33
8	Land with scrub	581.00
9	Major Settlements	842.81
10	Mining areas	107.98
11	Plantations	93.86
12	River Island	5.90

Table 11.9 Land Use and Land Cover of GCA of Singur Project		
Sl. No	**Particulars**	**Area Covered (ha)**
13	River with water	1305.62
14	Scrub Forest	52.87
15	Single crop	19865.02
16	Tank with water	4451.53
Total		**45,847.38**

Soils in Command Area

11.41 The soil taxonomy of the command area is presented in **Figure XI.3**. There are only 5 types of soils namely Chromic Haplusterts, Entic Haplusterts, Rhodic Paleustalfs, Rock outcrops and Typic Ustorthents.

11.42 The entic Haplusterts occupy about 64 per cent of command area. The typic ustrothents occupy 15 per cent of the command area. In about 10 per cent of the area chormic haplusters are found while Rhodic Palestalfs also occupied only 10 per cent of the area. However, the Rock outcrops occupied a negligible 1 per cent of the area.

11.43 Mostly the soils in the command are heavy and medium tuned soils having clay content of 20-30 per cent. They are well drained, internally having good surface drainage system.

Soil Erosion in Command Area

11.44 The soil erosion status of the command area is presented in **Fig XI.4.** The soil erosion depends upon the extent of slope of land in a particular area. It is distinctly seen from the map that the command area is subjected to three levels of soil erosion ranging from moderate to very severe. Large tracks of command area fall under “Severe” soil erosion zone. This is followed by “Very Severe” zone of soil erosion in about 12 to 15 percentage of area. The area is command subjected to “Moderate” soil erosion is less (about 10 % to <12%) compared to very severe and severe soil erosion area.

Irrigated Area:

11.45 The total area irrigated during the year 2007-08 is found to be 30.895 thousand hectares ha in the command area mandals which includes both the crop seasons i.e., Kharif and Rabi. The area which is irrigated more than once is accounted for 8693 ha during the said period. The details of these are depicted in the **Table 11.10**. Among the mandals Andol has more area under irrigation (7314 ha) followed by Pulkal (7005) and Sangareddy (4319 ha) in both seasons put together. Similarly, in Rabi Season, Pulkal mandal has more area under irrigation (2904) followed by Andol and Sangareddy compared to other mandals.

COMMAND AREA

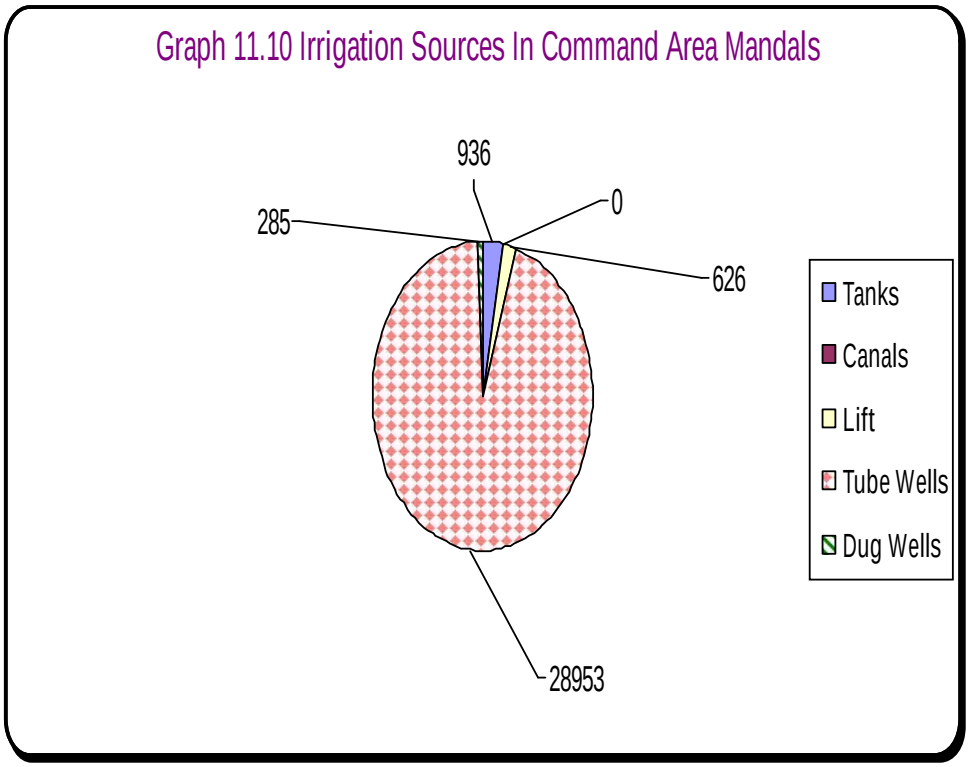
Table 11.10 : Area Irrigated : District and Mandal Wise (2007 - 08)

Sl no	Particulars	Medak dist Area in ha		Pulkal Area in ha		Munepalle Area in ha		Andol Area in ha		Tekmal Area in ha		Alladurg Area in ha		Sadasivpet Area in ha		Sangareddy Area in ha		Total of All Mandals Kharif	Total of All Mandals Rabi	Total of All Mandals Kharif and Rabi
		Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi			
1	Total Irrigated Area	102157	99636	3682	3323	908	396	2809	4505	2348	1243	2062	2068	2281	951	2710	1609	16800	14095	**30895**
2	Area Irrigated More than once	0	49097	0	2904	0	209	0	2025	0	898	0	837	0	362	0	1458	0	8693	**8693**

Source: Complied from Handbook of Statistics Medak Dist

Source of Irrigation

11.46 In this regard it is noted that Tube wells are the main source of irrigation in the command area followed by Tanks and Lift irrigation. The tank irrigation is found in Andol, Tekmal and Alladurg mandals whereas irrigation through lift is noted in Pulkal, Andol and Tekmal. Area under dug well irrigation is confined to Munnipalle and Sadasivapet mandals only. The details of season-wise mandal-wise sources, of irrigation and area covered are presented in **Annexure XI.6** for reference.



Crop Production

11.47 The principal crops raised in the command area of Singur Project are paddy, Jowar, Sugarcane, Green gram, Bengal gram, Black gram, Red gram, Cotton, Maize and Groundnut. Further, it is observed that maize and groundnut are raised in less area as compared to other crops. It is to be mentioned here that mandal-wise crop productivity details are not available, as such, to calculate the production levels (at mandal level), the district average of crop productivity figures are taken into consideration. The details of crop area and crop production are presented in **Table 11.11**.

COMMAND AREA

Table 11.11 : Area Production and Productivity of Major Crops : District and Mandal Wise (2007 - 08)

Sl. no	Crops	Medak dist			Pulkal		Munepalle		Andol		Tekmal		Alladurg		Sadasivpet		Sangareddy	
		Area in ha	Production (Tones)	Productivity Q/ha	Area in ha	Production (Tones)	Area in ha	Production (Tones)	Area in ha	Production (Tones)	Area in ha	Production (Tones)	Area in ha	Production (Tones)	Area in ha	Production (Tones)	Area in ha	Production (Tones)
1	Rice	92809	281490	30.33	986	2991	207	628	1554	4713	2039	6184	1335	4049	931	2823	1426	4325
2	Redgram	23716	11953	5.04	427	215	607	306	645	325	568	286	948	478	448	226	629	317
3	Jower	44722	54919	12.28	1585	1946	1362	1673	3318	4075	1639	2013	1870	2296	1216	1493	1222	1501
4	Maize	1E+05	428947	32.75	93	304.57	43	741	165	540	569	1863	76	249	350	1146	929	3042
5	Greengram	52817	45000	8.5	920	784	2805	2390	1288	1097	1472	1254	2494	2125	934	796	283	241
6	Sugarcane	52099	4173129	801	5317	425892	845	67685	4283	343068	1115	89311	1808	144821	1816	145462	1708	136811
7	Groundnut	2208	4158	18.83	96	180.8	0	0	370	697	165	311	204	384	8	15	39	73
8	Blackgram	21216	14766	6.96	432	301	745	519	667	464	511	356	1051	731	306	213	214	149

Source: Camplied from Handbook of Statistics Medak Dist

Cropping Intensity

11.48 The cropping intensity is the number of times crops are grown on a unit area of land. The gross cropped area is divided by the net-cropped area and expressed as percentage. Following this method, the cropping intensity of each of the command area mandals has been calculated. The overall command area cropping intensity is 128. Among the mandals, highest cropping intensity is noted in Sadasivapet mandal (141%) followed by Pulkal (139%) and Munipalle (137%). In the remaining mandals it is ranged between 116% and 127%. (Source: Hand Book of Statistics 2007-08)

Cropping Pattern in Command Area

11.49 As stated earlier, farmers of the area adopt a particular pattern of cropping as passed on by their forefathers which is fixed based on a type of land, soil conditions and irrigation sources. However, changes in climate, rainfall and environment make an impact on the type of corps grown on their lands. At times late rains, during a year delay sowing of paddy and due to which farmers may shift to irrigated dry corps. It is also possible that other problems like lack of remunerative prices, shortage of labour etc., may trigger a change in cropping pattern. Sometimes the change is also brought about by commencement of processing units for a particular crop like sugarcane and groundnut. Besides crop rotation is also one of the factors in changing cropping pattern.

11.50 Based on analysis of the published secondary data, the crops grown during Kharif and Rabi Season during the year 2007-08 in the project command mandals the following cropping patterns are observed and is presented mandal-wise. Further, it is to be mentioned here that cropping pattern has been prioritized based on the extent of area covered in a particular season by a particular crop in descending order. The details are presented in **Annexure XI.7** and **XI.8**.

11.51 In command area mandals, overall, cropping pattern is presented in the following **Table 11.12** which indicated that the green gram crop of Kharif season is followed by Bengal gram in Rabi season. Sugarcane continued in Rabi season and placed at 3rd position. Cotton of Kharif season is replaced by Jowar in Rabi season positioning at second place. Paddy was at 4th position in Kharif remained at 4th position in Rabi season also. Similarly maize crop was at 8th position (lowest) in Kharif season remained at lowest position in Rabi (5th position) season also.

Table 11.12 Over All Cropping Pattern in Project Command Area		
Sl. No as per order of priority	**Kharif Season**	**Rabi Season**
1	Greengram	Bengalgram
2	Sugarcane	Jowar
3	Cotton	Sugarcane
4	Paddy	Paddy
5	Redgram	Maize
6	Blackgram	
7	Jowar	
8	Maize	

The **Annexure XI.8** gives the cropping patterns of the command area mandals.

11.52 In principle following cropping patterns are observed in Command Area (Viz)

1. Paddy - Paddy
2. Paddy - Jowar
3. Greengram - Paddy
4. Paddy - Maize
5. Cottion - Bengalgram
6. Jowar - Bengalgram

From the foregoing discussions and the cropping patterns adopted in the command area mandals, as presented in the above table, it is clear that the cropping patterns of the respective command area mandals are characterized by its local physical and environmental conditions as well as availability of water during the season. For example sugarcane crop is taken up in all the mandals, however, extent of area coverage depended on availability of irrigation sources. Similarly Green gram and Bengal gram, which are irrigated dry crops has been adopted in all the mandals during the Kharif season depending upon the irrigation potentiality the farmers had. In the same way Jowar crop in Rabi season has been adopted by farming community whose position mostly remained at 2^{nd} / 3^{rd} which is mostly a dry crop.

Livestock Population in the Command Area (2007-08)

11.53 The livestock population among the command area mandals is more or less evenly distributed with few exceptions. The details of livestock population are given in **Table 11.13**. The cattle population is found to be more in Pulkal mandal (11380) as compared to other mandals which ranged between 6000 and 8600. More number of Buffaloes are noted in Sangareddy (8782), Sadasivapet (7681) and Pulkal (6321) mandals. In other mandals its population is found to be almost half as compred to said mandals. However, Munipalle mandal is having lowest Buffaloes population (2407) among all mandals. With regard to sheep population, it is found that Andol and Tekmal dominated as compared to other mandals: These two mandals have $\pm$ 20,000 sheep

population. Otherwise this population ranged between 12 and 15 thousand. Goats population more in Tekmal mandal (11650) and Alladurg (9905). In remaining mandals Goats population found to be between 5800 and 8500. In case of poultry, it is noted that the Sadasivapet mandal has more than 1.5 lakh poultry birds followed by Tekmal (39190). Otherwise bird's population is much below the population of Sadasivpet which they ranged between 10,000 and 20,000.

COMMAND AREA

Table 11.13
Live Stock Population in Medak District and Command Area Mandals (2007 - 08)

Sl. no	Particulars	Units	Medak dist	Pulkal	Munepalle	Andol	Tekmal	Alladurg	Sadasivpet	Sanga reddy	Total
1	Cattle	No's	421852	11380	7403	7103	8688	8207	8104	6065	**478802**
2	Buffaloes	No's	367350	6321	2407	4312	4339	4736	7681	8782	**405928**
3	Sheep	No's	1015545	14949	12364	21082	19232	12216	11895	13140	**1120423**
4	Goats	No's	369945	7097	5796	6457	11650	9905	8509	6029	**425388**
5	Poultry	No's	8638614	12858	10790	15936	39190	14370	153944	20078	**8905780**
Total			**10813306**	**52605**	**38760**	**54890**	**83099**	**49434**	**190133**	**54094**	**11336321**

Source: Complied from Handbook of Statistics Medak Dist

Agricultural Co-operative and Agriculture Finance Programme

11.54 In the Medak district, there are 94 Agricultural Cooperative Credit Societies with a membership of 425735 and working capital of `.253.7 crore during 2007-08. The loan advances among its members accounted for about `. 73.2 crore and the recovery made is ` 59.3 crore indicating 81% recovery against the advances given.

11.55 Similarly at command area mandal levels (7), it is noted that in all 14 Primary Credit Societies are functioning, the maximum being 4 in Pulkal and Sangareddy mandals followed by Andol mandal which has two such societies. The remaining mandals have one society in each mandal. The total membership in these 14 societies accounted for 65.3 thousand with the working capital of about `.68.9 crores. The loan advances to its members during the year stood at about `. 22.0 crore. The recovery during the year 2007-08 accounted for 33.5 per cent. The mandal-wise details are presented in **Table 11.14** for reference.

COMMAND AREA

Table 11.14 Mandal-Wise Working of Primary Agricultural Credit Societies Including Farmers Service Societies (2007-08)

Sl. No	Name of Mandal	No of Societies	Member ship	Paid-up Capital (Share Capital)	Deposits	Borrowing	Working Capital	Loans		
								Advanced	Recovered	Outstanding
1	Pulkal	4	10,908	6426205	398578	74481811	86058190	51025284	24868043	71461156
2	Munipalle	1	5,907	1837977	148445	30392131	32634354	9179040	4344424	181685588
3	Andol	2	14,421	5606330	215951	120553834	126979811	49957832	19037775	9175783
4	Tekmal	1	7,441	1964433	26500	244228138	2660185	7114280	3929252	17792187
5	Alladurg	1	11,030	2724465	32722	54919933	5792959	76775073	14212945	31851730
6	Sadasivpet	1	806	565115	14800	2271723	3499645	3906000	4621258	8204165
7	Sanga reddy	4	14836	4645353	141953	89455849	432083507	22159168	16750825	56680667
	Total	**14**	**65349**	**23769876**	**978949**	**549269789**	**689708651**	**220116677**	**73764522**	**196982543**

Source: Complied from Handbook of Statistics Medak Dist

Steps taken to prevent contamination of water due to Fertilizers and Pesticides

11.56 As stated earlier, laying of canal networking in the command area, as reported, is in progress. In other words, the command area development process is yet be initiated. As such, this aspect is not covered in the present study.

Status of Industrial Development in Command Area (2007-08)

11.57 The number of total working factories in the project command area is reported to be 126. The number workers engaged in these factories accounted for 10811 persons. Among the mandals Sangareddy (52) topped in having working factories, followed by Sadasivapet (37) and Andol (19). In the remaining mandals single digit working factories are existing ranged between 5 and 7 **(Table 11.15)**.

COMMAND AREA

Table 11.15 Mandal-Wise working Factories, Rice mills and Small scale Industries: District and Command Area Mandals (2007 - 08)

Sl no	Particulars	Units	Medak Dist	Pulkal	Munepalle	Andol	Tekmal	Alladurg	Sadasiv pet	Sanga reddy	Total of Comman area Mandals
1	No of Factories	Nos	2081	5	6	19	6	7	37	52	126
1.1	No of workers engaged	Nos	97610	185	183	409	43	59	5076	4856	10811
2	Rice mills	Nos	463	2	-	7	4	4	5	3	25
2.1	Installed capacity	Tonnes	2	2	-	2	2	2	2	2	2 tonnes each
3	Small scale Industries	Nos	223	-	4	-	-	1	-	18	23
3.1	Investment	Rs in Lakhs	30334	-	103	-	-	0.5	-	1867	1970..5
3.2	Employment	Nos	6066	-	31	-	-	7	-	490	528

Source: Complied from Handbook of Statistics Medak Dist

Rice mills are functioning in all mandal except Munipalle mandal. Each of these rice mills are of 2 tonnes capacity. In all, there are 25 rice mills in the command area mandals.

11.58 Establishment of Small Scale Industries (SSI) in command area are reported from Munipalle (4), Alladurg (1) and Sangareddy (18) mandals. In all, there are 23 SSI units found to be working in command area mandals. The details of these are presented in **Table 11.13**. No major or medium type industries are reported in the command area mandals except Sadasivpet (cotton yarn) and Sangareddy (Fabric processing and Dying) mandals.

11.59 Further it is noted that in all 528 persons have been employed in these SSI units with capital investment of `. 1.03 and 18.67 crore respectively in Munipalle and Sangareddy Mandals .

Overall Development in Command Area

11.60 In the preceding section of this chapter, the existing (2007-08) scenario in the command area with reference to population, education, literacy, occupation, medical health, infrastructural facilities, family welfare, immunization including agricultural aspects covering production cropping pattern livestock population industrial development etc., has been presented. In the following paragraphs an attempt is made to present the overall situation with regard to other aspects of development which has reached to villages in the command area mandals. The details are presented in **Annexure XI.10**.

11.61 Post Office Facilities: In all, there are 178 villages in the 7 mandals of command area out of which 41.6 per cent villages have the post office facilities at the village level. The rest of the villages depend for this facility on the villages which have the post offices and the people have to cover maximum distance of 5 km to avail these facilities from the respective villages.

11.62 Medical Facilities: The data on it revealed that about 43 per cent of the villages of command area mandals are having medical facilities at the village level. The people of other 41 per cent villages have to travel maximum 5 km to avail the facilities from the villages having medical health centers.

11.63 Veterinary Services: In all, only 15% villages of command area mandals are having Veterinary service centres at the village level. There are other 22 per cent villages which fall within 2 km to avail existing veterinary services.

11.64 Educational Infrastructures: The data on it revealed that 100 per cent villages are having Primary schools located in the village. The Upper Primary school facilities are available in 40 per cent villages, while 36 per cent villages of command area mandals equipped with high school facilities.

11.65 Banking Facility: With regard to this, it is noted that there are 37 bank branches located at different places in the command area mandals. The banks which are operating their branches are of State Bank of India, State Bank of Hyderabad, United Commercial Bank, Andhra Pradesh Grameena Vikas Bank, Medak District Central Cooperative Bank, Syndicate Bank, HDFC Bank, Central Bank of India.

11.66 Road Connectivity: In all there are 259 habitations in the command area mandals out of which 237 habitants have been extended with all whether roads connectivity. This indicates that almost 91% habitations are connected with road network.

11.67 Drinking Water Facility: Out of the total habitation about 73 per cent of them are getting the drinking water supply through Public Water Supply system. In addition to this almost all habitations are also having the bore well facilities for the purpose.

Findings of Field Survey:

11.68 In the proceeding chapter, the socio-economic environment and agriculture development scenario has been presented based on the authentic secondary sources of information of command area of Singur Project. In the following section, the findings of field survey based on sample data are presented. Methodology adopted for selection of sample is already given under the heading "Methodology".

I. Socio-Economic profile of command area farmers:

11.69 To study socio-economic environment of command area farmers, as mentioned earlier, a detailed survey was carried out by the study team in order to understand their profile and other aspects of households (farmers) in the command area, the ultimate beneficiations of the Singur command area development programme.

Demographic profile of the sample

11.70 In all 220 farmers were selected for the study from 11 villages which fall under command area of Singur Project. The average members per sample household is 5.40, the highest being 5.7 (Palvancha) and the lowest 3.35 (Eskojipet). Amongst the households, majority (71%) of them belonged to Backward caste followed by OCs (13%), SCs (12%), STs (3%). The distribution of sample households and their family members (population) is presented in **Annexure XI.9,** whereas summary of these details is presented in **Table 11.16**.

Table 11.16 Demographic profile of the Sample Households

Particulars	Details
Sample Size	220
Total Family Members	1188
Average Family Size	5.40
Percentage of BC	71

Percentage of SC	12
Percentage of ST	31
Percentage of OC	13

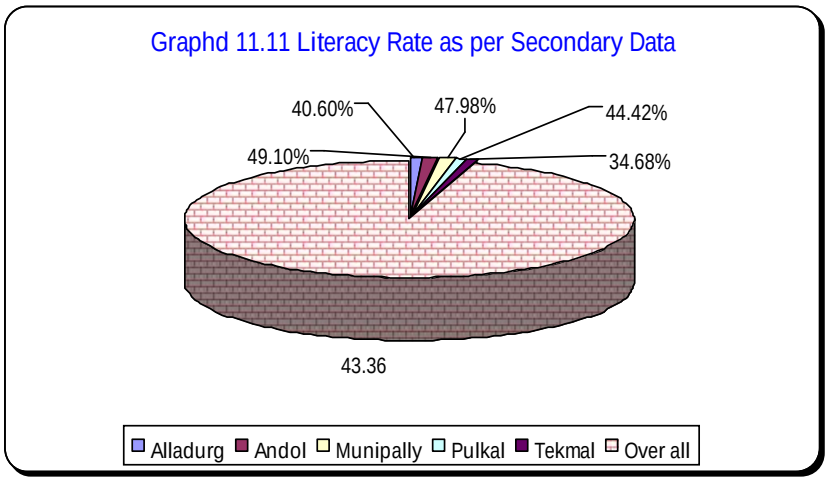
11.71 Sex Ratio: The male population of sample households is 622 while the female population is 566. The average sex ratio of the sample is found to be 910 female per 1000 males, the maximum and minimum being 943 (Dhannaram) and 877 (Pulkal) respectively.

11.72 Housing: Majority of sample households are possessing semi-pacca houses (88%) followed by pucca houses (9.1%). A very few i.e., out of 220 sample households, only 7 of them dwelling in Kutcha houses. This indicates that majority of households having mixed type houses i.e., partly pucca and partly katcha. The portion of katcha structures are having mud walls, otherwise either bricks (in most of the cases) or stone wall (mixed lower are stone and upper area brick). Those who possessed pacca houses, a majority of them has concrete slabs (roof). In pucca and semi pucca houses, a good portion of it has stone flooring. (Refer Table 6.17)

11.73 Literacy: As mentioned earlier, field study survey was conducted in five mandals of command area (Alladurg, Andol, Munipally, Pulkal, Tekmal). The official records of the literacy rate of these mandals are as follows. **(Table 11.17)**

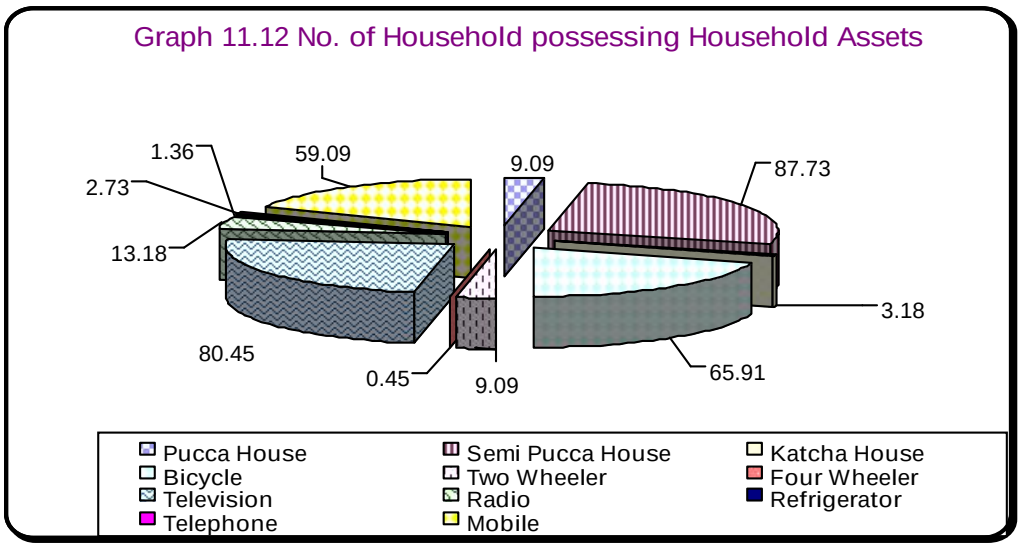
Table 11.17 Literacy Rate as per Secondary Data

Study Mandals	Literacy rate 2007 – 2008
Alladurg	40.6%
Andol	49.1%
Munipally	47.98%
Pulkal	44.42%
Tekmal	34.68%
Over all	43.36

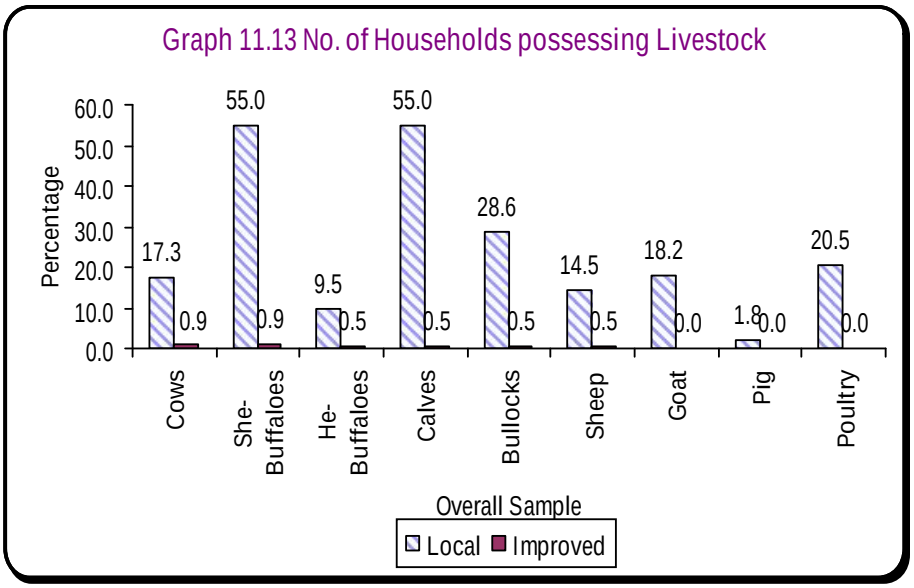


11.74 The analysis of field survey data on this aspect revealed that the over all literacy rate of sample is 40.3% against the overall study mandal literacy rate of 43.4 per cent. The literacy rate found through primary survey is to be closer to the secondary data. Among the villages, surveyed Almaipeta, Mansanpalli and Eskojipet villages have literacy rates over 46 per cent. The illiterate are about 60 per cent of the sample of population.

11.75 Possession of Household Assets: Among the assets, Bicycle, Television, Mobiles (Cell phones) are found to be possessed by majority of the households. Amongst these three assets, television is observed to be possessed by more than 80 per cent household, followed by bicycle (66%) and mobile (59%). About 9 per cent of households have two wheelers. Besides television, about 13 per cent are also possessing radio of sets. The details of possession of assets are presented in **Annexure XI.10**. The notable finding here has been the shift in prioritization in possessing the assets. TV and mobile phones became a priority even over having pucca houses.



11.76 Possession of Livestock: The study revealed that among milch animals, she – buffaloes are possessed by 56 per cent of sample household's followed cows (18%) and he – buffaloes (10%). Bullocks are found to be owned by only 29 per cent, respondents. Poultry birds are possessed by one fifth of sample respondents. The detail of livestock possession is presented in **Annexure XI.11** Further, analysis indicated that the livestock possessed by the sample respondents are local descript. Possession of improved breed is very negligible.



Agricultural Assets

11.77 With regard to agriculture assets it is noted that about 38 per cent of the sample farmers have ploughs followed by sprayers (24%). Assets like cultivators, thresher, etc., are possessed by very few of them. Further it is observed that those who possessed bullocks have bullock carts too. Out of 220 sample farmers, only five of them possessed tractors **(Annexure XI.12)**.

II. Agriculture scenario

11.75 Land holdings: The total land holding (owned) by 220 farms is 275 hectares. On an average, the sample farmers found to own 1.24 ha per household. The total land possessed by sample farmers accounted for 275.0 ha out of which 178.40 ha is under irrigation and 86.20 ha is dry lands (rainfed). The remaining 10.40 ha is waste land. Further, it is observed that in the addition to their own lands, they also leased - in other farmers land to the tune of 10 ha (4.0ha irrigated land and 6.0 unirrigated lands) for the purpose of cultivation. Thus, total cultivated lands with sample farmers accounted for 274.6 ha inclusive of leased – in lands (10.0 ha) and exclusive of waste lands (10.4 ha). **(Table 11.18)**

Table 11.18 Operational Land Holding of Sample farmers in Command Area

Sl No	District	Mandal	Village	No. of Farmers	Irrigated, ha		Rainfed, ha		Waste Land, ha		Total Land, ha	
					Owned	Leased-in	Owned	Leased-in	Owned	Leased-in	Owned	Leased-in
1	Medak	Alladurgu	Neeradigunta	20	15.00	0.00	2.80	0.00	2.40	0.00	20.20	0.00
2	Medak	Alladurgu	Yarraram	20	14.40	0.00	11.00	0.00	0.00	0.00	25.40	0.00
3	Medak	Andol	Almaipeta	20	8.80	0.00	11.30	6.00	2.40	0.00	22.50	6.00
4	Medak	Andol	Dakoor	20	10.20	4.00	9.20	0.00	0.00	0.00	19.40	4.00
5	Medak	Munipalli	Mansapalli	20	19.40	0.00	7.40	0.00	1.60	0.00	28.40	0.00
6	Medak	Pulkal	Eskojipet	20	15.30	0.00	4.60	0.00	0.00	0.00	19.90	0.00
7	Medak	Pulkal	Gangluru	20	21.40	0.00	8.20	0.00	0.00	0.00	29.60	0.00
8	Medak	Pulkal	Gangojipet	20	14.70	0.00	2.70	0.00	0.40	0.00	17.80	0.00
9	Medak	Pulkal	Pulkal	20	22.60	0.00	2.40	0.00	0.00	0.00	25.00	0.00
10	Medak	Tekmal	Dhannaram	20	17.00	0.00	6.00	0.00	0.00	0.00	23.00	0.00
11	Medak	Tekmal	Palvancha	20	19.60	0.00	20.60	0.00	3.60	0.00	43.80	0.00
			Sub Total		**178.40**	**4.00**	**86.20**	**6.00**	**10.40**	**0.00**	**275.00**	**10.00**

11.79 Source of Irrigation: The major source of irrigation of sample farmers is observed to be tube / bore wells (70.5%) followed by canal (3.2%) Tank (2.3%) and open / dug wells (1.4%). The area irrigated through bore wells observed to be 91 per cent.

11.80 As per secondary data also about 91 per cent area is being irrigated by tube / bore wells, followed by canal (4.17%), dug / open wells (3.07%) and tanks (1.53%) **(Annexure XI.13)**. In case of tube / bore wells, it is noted that in command area mandal of the project, the bore wells are found to be drilled extensively and as such large areas of cultivated land is brought under irrigation (92%). The details of which are presented in the following **Table 11.19**, for reference.

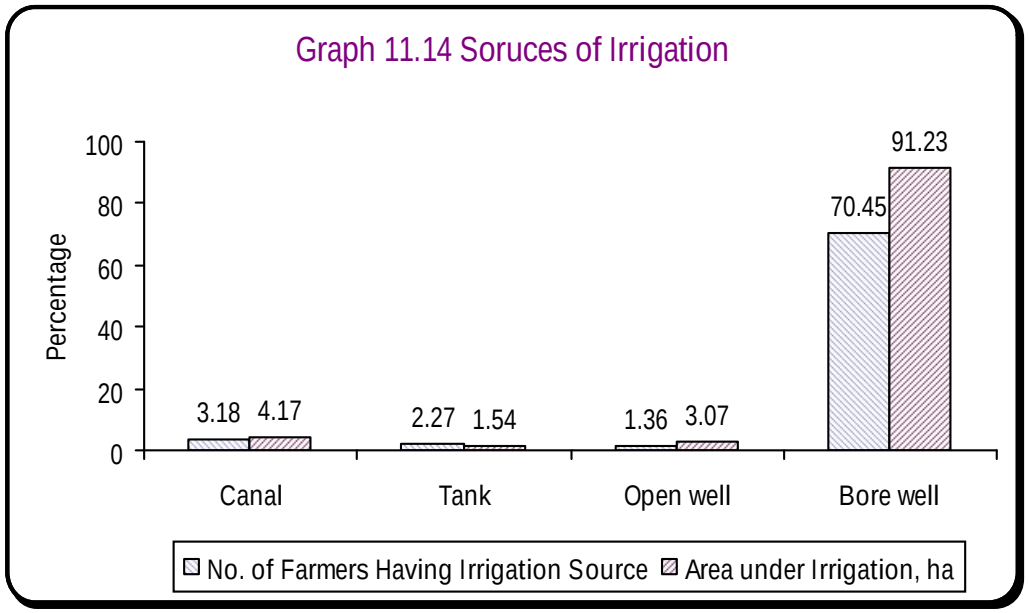


Table 11.19 Irrigated area under Tube / bore wells in command area mandals (2007 – 2008)										
Sl. no	**Name of Irrigation Mandal**	**Total Area Irrigated**		**Area under Tube / Borewells (ha)**						**% to Total area under tube / borewells**
		Kharif	**Rabi**	**Total**	**Kharif**	**%**	**Rabi**	**%**	**Total**	
1	Andol	2809	4505	7314	2613	93.0	4443	98.0	7056	96.0
2	Pulkal	3682	3328	7005	3394	92.0	3147	95.0	6541	93.0
3	Alladurg	2062	2063	4130	1892	92.0	2068	100.0	3960	96.0
4	Tekmal	2348	1243	3591	1682	71.0	1239	100.0	2921	81.0
5	Munnepally	908	396	1304	750	82.0	269	68.0	1019	78.0
Total		**11809**	**1153 5**	**23344**	**10331**	**87.0**	**11166**	**97**	**21497**	**92.0**
Source: compile from Hand Book of Statistics, Medak District 2007 - 2008										

Crops and Crop Productivity:

11.81 The primary data collected through household survey in the sample villages revealed that the crops raised by the farmers are Sugarcane, Paddy, Cotton, Black gram, Green gram, Green Chilies, Jowar and Red gram during the Khariff season. The crops grown in Rabi season are Paddy and Jowar, Sugarcane is an annual crop which continues in Rabi season also.

11.82 Further the study revealed that Paddy occupied about 44 per cent area of gross cultivated area of sample holding, while Sugarcane is raised in about 36 per cent of the area followed by cotton (6.30%), Black gram (5.66%), Jower (4.78%) and Green gram (2.16%). The other crops (Red gram and Green chilies) occupied less than one percent of gross cultivated area. The details of these are presented in **Table 11.20**

Table 11.20
Cropping Pattern and Productivity of Sample Farmers in the Command Area

Sl No	Crop	Kharif		Rabi		Total		Crop	
		Area, ha	**Qt**	**Area, ha**	**Qt**	**Area, ha**	**Qt**	**% Area**	**q/ha**
1	Rice	88.90	3,234.60	41.90	588.20	130.80	4,822.80	44.06	36.87
2	Jowar	2.00	50.00	12.20	100.00	14.20	150.00	4.78	10.56
3	Blackgram	16.00	137.12	0.80	5.88	16.80	143.00	5.66	8.51
4	Redgram	0.40	0.00	0.00	0.00	0.40	2.44	0.13	6.10
5	Green Chillies	1.80	70.00	0.00	0.00	1.80	70.00	0.61	38.89
6	Cotton	18.70	130.50	0.00	0.00	18.70	130.50	6.30	6.98
7	Greengram	6.40	69.00	0.00	0.00	6.40	69.00	2.16	10.78
8	Sugarcane	107.80	67,570.00	0.00	0.00	107.80	67,570.00	36.31	626.81
	Sub Total	**242.00**		**54.90**		**296.90**		**100.00**	

11.83 The Productivity of respective crops grown in the study area by the sample farmers along with the district average is presented in the following **Table 11.21**. It is to be mentioned here that mandal wise productivity data is not available, as such, district average are taken for the purpose of comparison, presented in the following **Table 11.21**.

Table 11.21
Crop Productivity of the Study Area.

Sl. No	Crops	Crop Productivity Q / ha	
		Study area	District average (2007 - 2008)
1	Rice	36.87	30.33
2	Jowar	10.56	12.28
3	Blackgram	8.51	6.96
4	Redgram	6.1	5.04
5	Green chilies	38.89	Not available
6	Cotton	6.98	5.94
7	Greengram	10.78	8.52
8	Sugarcane	626.81	801.07

11.84 From the above table, it can be noted that sugarcane and Jower crop yields / ha is less than the district average yields in the command area mandals.

11.85 Cropping Intensity: It is observed that the cropping intensity of the sample farmers is 122 per cent. The cropping intensity as per the secondary data computed from Hand Book of statistics, Medak district 2007-08 for all project mandals (7) stood at 129 per cent **(Table 11.22)**.

Table 11.22
Cropping Intensity of Study Area

S. No	Particulars	Study Area	Project Command Area mandals
1	Net Area Sown (Kharif)	242	50360
2	Total Net Area Sown	296	65192
3	Cropping Intensity	122%	129%

Further it is noted that the highest cropping intensity is observed in Sadasivapet mandal (141%) followed by Pulkal (139%) and Munepally 137%) mandals. The lowest cropping intensity is observed in Andol & Sangareddy (116%).

Awareness and Adoption of Improved Agriculture Practices (Technology)

11.86 With a view to collect the data on adoption behavior of the sample farmers about the improved agriculture practices against their awareness / knowledge they possessed, the following important improved agriculture technologies were selected / considered.

* Soil testing
* Deep Ploughing

* Use of improved seeds
* Seed treatment
* Improved Nursery
* Efficient water Management
* Use of Chemical fertilizers
* Use of Balanced Organic Manure
* Use of Vermi Compost
* Post Harvest Management

11.87 The data collected on above mentioned aspects has been analysed and presented in the **Annexure XI.14** for ready reference. The field data indicated that the sample farmers have high awareness about soil testing, deep-ploughing, improved seeds, seed treatments, timely application of fertilizers, use of organic manure etc. However, there observed to be a gap between awareness and adoption.

11.88 Soil testing: Deficiencies in soil nutrients have the direct bearing on crop yield. It has to be balanced for realizing the expected yields of the crop. To fill the gaps of soil nutrients, it becomes invariably necessary to carryout the soil testing. In this direction to sensitise the farmers the agricultural department has been campaigning for the same at the field level.

11.89 In this regard the survey data indicated that the agricultural department has done a good job in creating awareness among the cultivator as all the sample farmers (99%) reported to have the knowledge of getting tested their field soils. However, inspite of having awareness for getting tested the field soils, only less than 20 per cent of them got tested their field soils. The field level agricultural staff needs to take necessary efforts in this direction.

11.90 Deep Ploughing: Data on this aspect revealed that farmers are having rich knowledge (99%) about deep ploughing at regular intervals and its advantages. However, only 50 per cent of them adopted it. The informal discussion held with them indicated that due to lack of iron plough they are unable to do so. Further it is also pointed out that hiring cost of trillers and tractors is high in the area which also pushed them back in adoption of this technology.

11.91 Use of Improved Seed and Seed Treatment: In this regard it is observed that the awareness and adoption is very high among sample farmers (more than 90%). In the market treated and improved seeds are easily available, and hence, they did not find any difficulty in adopting the same. Besides, the department also found to be supplying the same, based on the target and availability with it.

11.92 Improved Nursery: Having Knowledge about rising of nursery for transplantation in the main field is found to be among 64 per cent sample farmers. Compared to this only 23 per cent of them followed it. Further, it is observed that farmers of the area also using seed drill for sowing the seeds directly in the field.

11.93 Efficient Water Use Management: In the current era, scarcity of water has become the regular phenomenon of day – to-day. Under the circumstance, it necessitates to adopt the effective use of water management technology based on availability of water so as to take maximum advantage of scarce water. The field data on this indicated that not much emphasis given by the department to sensitize the target group, as only 30 per cent sample farmers reported having knowledge about it and only 18 per cent of them adopted it. It is very important issue which has to be addressed effectively in the given situation by the concerned.

11.94 Use of Chemical Fertilizers: Use of Chemical fertilizers is found to be in vogue among all sample farmers. However, the field data indicated that the knowledge about balance doses of it, is known to only 30 per cent of them, and its adoption (use of balance doze) confined to 11 per cent of them. Informal discussion held with farmers revealed that non-adoption of balance doses of fertilizers is due to the high cost of this commodity. Further it is noted use of fertilizer doses depended on farmers economical conditions too.

11.95 Use of Balanced Organic Manure: In the study area, it is noted that invariably all the farmers are found to be using organic manure (compost). Further, from informal discussion held with the farmer it is observed that use of organic manure has been their traditional practice. However, with respect to balanced doses, data revealed that it was known to about 80 per cent of them and its adoption found to be closer to this percentage.

11.96 Use of Vermi Compost: Use of vermi compost in the agriculture field is very much in vogue in the study area as more than 67 per cent reported having awareness about it. However, the data revealed that its adoption is confined to only 8 per cent of them indicating slow process of adoption, though it has its own advantages of supplementing chemical fertilizers.

11.97 Post–Harvest Management: It is one of the important aspect of improved agricultural practices for managing the post harvest produce to avoid its losses, which has direct bearing on agricultural economy but the field level data shows its gloomy picture as only one fifth of sample farmers possessed knowledge about it and only 7 per cent of them could adopt this technology for managing their agricultural produce.

11.98 There is a need to have well coordination between agricultural department and Department of Food Grain Storage. This process will benefit the farmers in managing their produce in economical terms.

Households Annual Income and Expenditure

11.99 It is a very difficult task to collect and ascertain one's income and expenditure, particularly in rural areas. Reliability of this data always has been at stake for its validation. It has its own limitations. However, to some extent, it gives some trend of this variable's behavior. With these limitations an attempt is made to ascertain the incomes and expenditures of sample households in the study area.

11.100 Income: the data collected on annual income of households indicated that the major source of net income is from agriculture (59.7%), followed by wages (25.4%), Dairy activity (7.4%), Vocational activity (artisans) (3.2%). In addition to this, there are 22 persons in households whose income comes from service / employment (2.6%). Besides there are other sources of income whose percentage is very negligible (Less than 1%). The average house income of the sample is accounted for `.51,085 from different sources as mentioned above. The details of income from different sources in presented in **Annexure XI.15** and **XI.16.**

11.101 Expenditure: Expenditure pattern or standard of living is another index of economic status of households. It also gives a relationship between income and expenditure and expenditure behavior of the households. Analysis of data on expenditure indicated that on an average each of the head of household incurred expenditure of `.36,617/- annually on various items such as food, education, health, fuel, loan payment, functions, etc., out of his average total annual income of `.51,085/-, thus saving about `.14,468/-, **(Annexure XI.17** and **XI.18)**.

11.102 With regard to pattern of expenditure, it is observed that about 45 per cent of the total incomes is being spent on food (food grains and food items) followed by spending on religious functions (24.1%). Further it is also noted that health and education, house improvement and loan payment are the other items on which consumed about 10 per cent of the income on each of these items.

Indebtedness

11.103 The survey data revealed that about 86 per cent of households in the command area have outside borrowings. The data on the source of borrowings indicate that the banks constitute the largest source of borrowings (43%). Besides banks, the farmers have also borrowed money from other sources too. Among these, money tender toped (18%), followed by friends (14%) and cooperative society (19%). Further analysis of sources of lending loans indicated that banks are on top (49%), followed by private money lenders (26.9%) and friends & relatives (14.2%). Details of loans borrowed are presented in **Annexure XI.19** and **XI.20**.

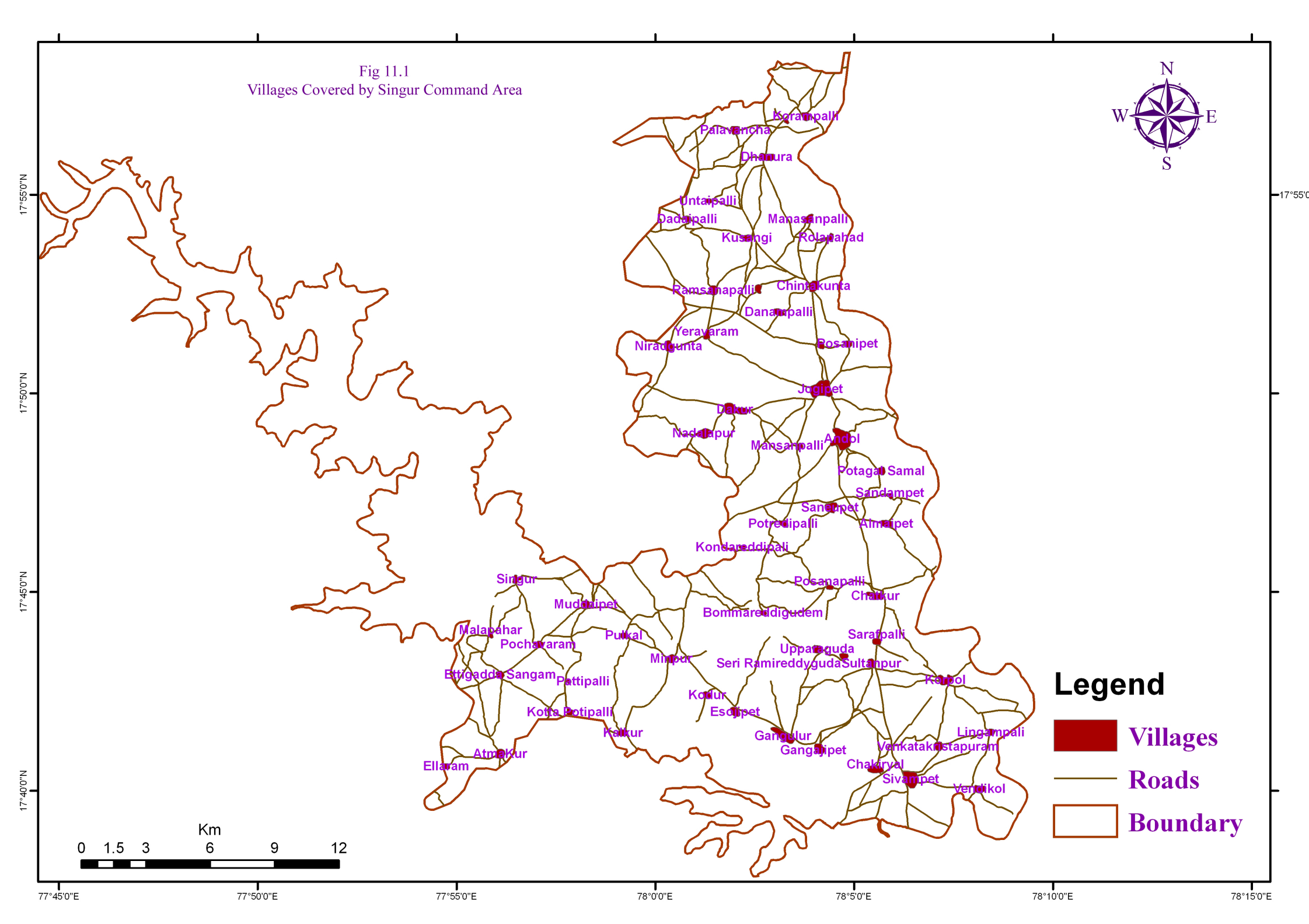


Fig 11.1
Villages Covered by Singur Command Area
N
W
E
S
Koramppalli
Palavancha
Dhamura
Untaipalli
Dadapalli
Manasanpalli
Kusangi
Rolanahad
Ramsanapalli
Chintakunta
Danampalli
Yeravaram
Niradgunta
Posanipet
Jogipet
Dakur
Nadakapur
Mansanpalli
Andol
Potagal Samal
Sandampet
Sanapet
Potredipalli
Almaipet
Kondareddipali
Singur
Posanapalli
Chakkur
Muddapet
Bommareddigudem
Malapahar
Pochavaram
Putkal
Sarafpalli
Uppalaguda
Mirpur
Seri Ramireddyguda
Sultanpur
Ettigadda Sangam
Pattipalli
Kolbol
Kotur
Kotta Potipalli
Esdipet
Kalkur
Gangalur
Lingampali
Venkatakrishtapuram
Gangapet
Ellaram
Atmakur
Chakiryal
Sivanipet
Vemulkol
Legend
Villages
Roads
Boundary
Km
0 1.5 3 6 9 12
17°55'0"N
17°50'0"N
17°45'0"N
17°40'0"N
77°45'0"E
77°50'0"E
77°55'0"E
78°0'0"E
78°5'0"E
78°10'0"E
78°15'0"E

Fig 11.3
Soil Taxonomy of Singur Project Command Area

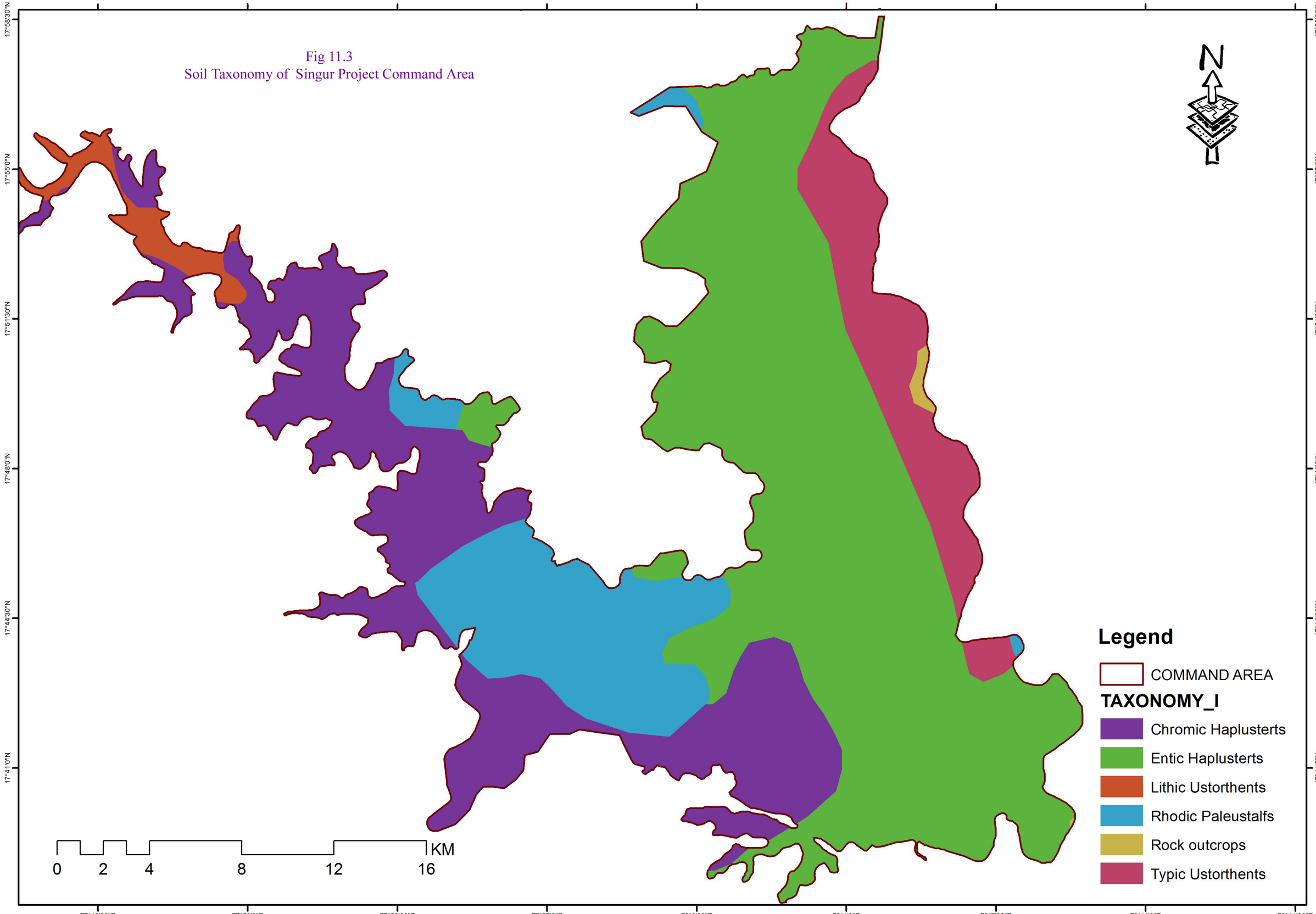
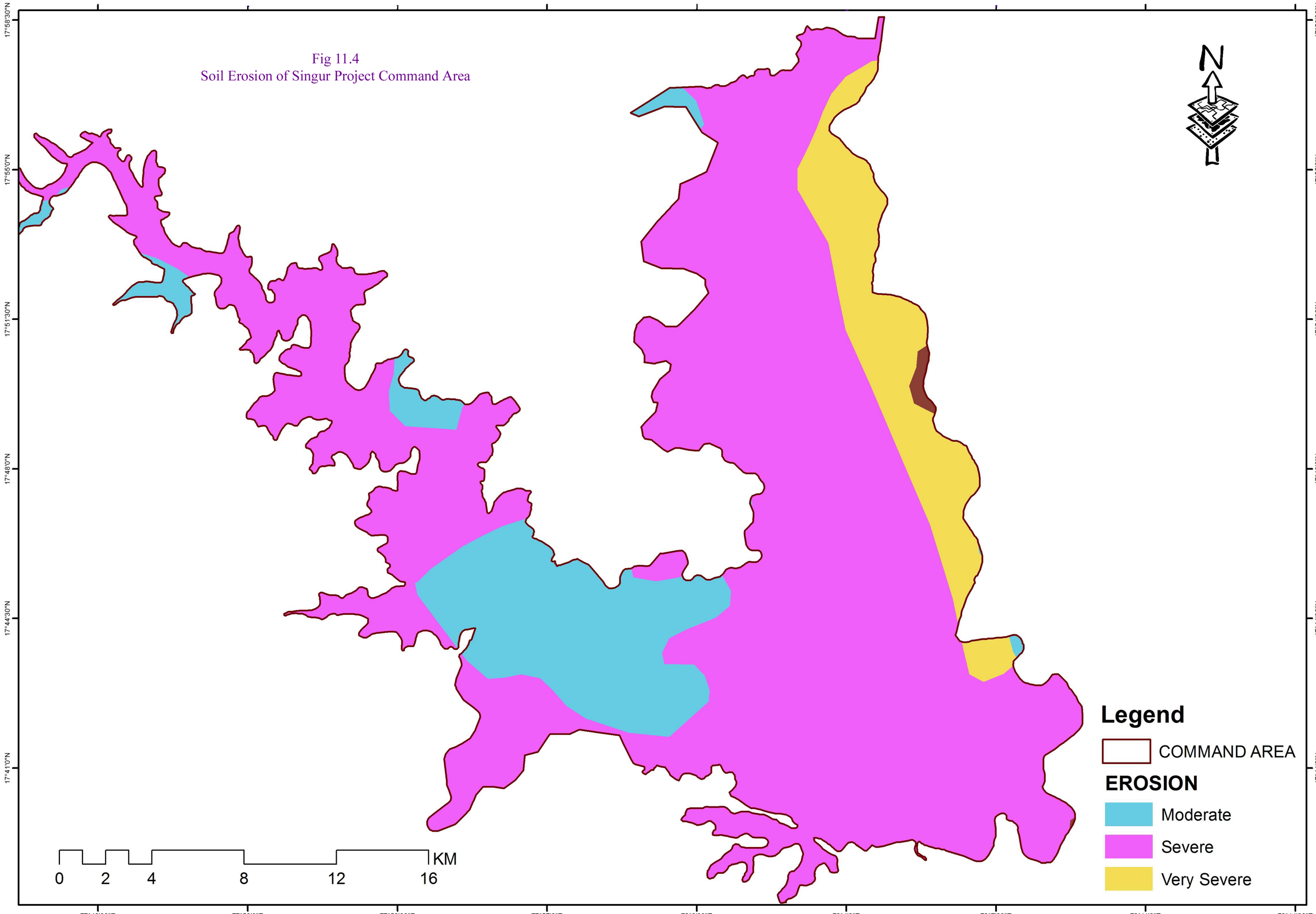


Fig 11.4
Soil Erosion of Singur Project Command Area



Part – I

12 Assessment and Evaluation of Implementation of EMP

AFC, Hyderabad

12

ASSESSMENT AND EVALUATION OF IMPLEMENTATION OF ENVIRONMENTAL MANAGEMENT PLAN

Background

12.01 Environmental Management Plan (EMP) is the key to ensure a safe and clean environment in project affected areas. The desired results from the environmental mitigation measures proposed in the project may not be obtained without proper planning and implementation of EMP. The EMP envisages the plans for the proper implementation of mitigation measures to reduce the adverse impacts arising out of the project activities. If due care is taken right from initial stages of planning Water Resources Projects, they can contribute greatly to enhancement of environment quality with minimal ill effects.

12.02 As per the Environmental Impact Assessment notification, 1994 (Ministry of Environment and Forests, Govt. of India), Environmental Clearance has become mandatory for all new (also for expansion / modernization of existing), hydropower, major irrigation and flood control projects. The environmental clearance is accorded on the recommendation of the interministerial Environmental Appraisal Committee (EAC) in the Ministry of Environment and Forests (MoEF), GoI. Besides, Central Water Commission has published "The Guidelines for Sustainable Water Resources Development and Management (September 1992)" to meet the Indian requirement for data collection and analysis. Impact assessment and management plan (EMP) is also essential to ensure sustainable development and to limit the stress / load on the system within its carrying capacity. Special attention has to be given for the aspects of rehabilitation and resettlement, compensatory afforestation and catchment area treatment (of directly draining areas) in preparation of EMP[1].

12.03 The Environmental Impact Assessment (EIA) for Water Resources Development (WRD) projects has been in practice since 1978 only. Further, carrying out EIA for WRD projects costing more than 100 crores and subsequent preparation of EMP has been made mandatory as per the EIA Notification 1994 of MoEF, GoI. Thus, for the projects sanctioned prior to 1978, there was no stipulation for preparation of EMP.

[1] Goel RS "Environmental Impact Assessment for River Valley Projects : Complexities and Methodology" in "Environmental Management in Hydro Electric Projects", Edited by Kamat Prasad and R.S. Goel, published by Concept Publishing Company, New Delhi, 2000.

EMP of Singur Project

12.04 Singur Major Irrigation Project, initiated and completed during 1976-1980 in Andhra Pradesh was sanctioned prior to 1978. During the preparation of the project report no provision was made for Environmental Impact Assessment and subsequent preparation of EMP. In view of this, it is not possible to assess and evaluate the implementation of EMP.

12.05 However, the Ministry of Environment and Forests (MoEF), Govt. of India while approving Singur project accorded Environmental Clearance for the project subject to the effective implementation of certain environmental safeguards as a mitigative measures to reduce the adverse environmental impacts of the project. They are as follows:

1. Rehabilitation master plan should be detailed avoiding location of new settlements on reservoir periphery;
2. Necessary steps should be taken by the project authorities in collaboration with Archeological Department, to preserve the important archeological sites and sculptures coming under submergence;
3. A green belt should be created along the periphery of the reservoir to arrest excessive siltation; and
4. Land use in catchment should be converted to forestry to the extent possible.

12.06 In the context of above, the progress made against the safeguard measures suggested, by MoEF, GoI, are discussed in the following paragraphs.

Resettlement and Rehabilitation of Displaced Families:

12.07 The Project Displaced Families (PDFs) of the Singur Major Irrigation Project were assessed to be 6357. These PDFs were rehabilitated in identified and selected 29 centres. These rehabilitated families (PDFs) were from 3 villages whose lands and structures got fully submerged under the dam water. The rehabilitated centres are located on the uplands of reservoir periphery which are 2 to 4 km away from reservoir water spread area at FRL 523.6 m.

12.08 As stated earlier, there was no fixed policy for resettlement and rehabilitation (R & R) of PAFs. However, the project has adopted the World Bank's board policy of R & R for rehabilitating the PAFs. Thus, for rehabilitation of displaced families a master action plan was worked out. Town Planning department prepared the rehabilitation (residential) layouts. As per the master plan the PDFs have been provided 200 sq mt house sites free of cost to each of the ousted family PDFs, irrespective of their financial status. Out of 6357 PDFs, about 2800 PAFs (below poverty line) were provided constructed two rooms tiled roof houses (free of cost) and rest were given a grant of `. 15000/- (each PDF) towards construction of houses in allotted sites. Besides, land and structural property holders (submerged) were given compensation against these. In

addition to compansation, the displaced families were given resettlement grants of `. 5000/- in case of those loosing lands and houses, ` 1000/- in case of those loosing either lands or houses,

12.09 Besides this, in rehabilitated centre a number of infrastructural facilities also have been created such as approach road, internal roads, facilities for drinking water supply, electricity, schools, public health & veterinary services etc., Thus, care has been taken by project authorities for settling the displaced families though around the reservoir periphery but quite away from the reservoir water spread area which was one of the suggested safeguards concerning the environment by MoEF.

Preservation of important archaeological sites and sculpture coming under submergence

12.10 The Ministry of Environment and Forest insisted to keep the monuments under a roof. For this, purpose project authorities allotted an area of 1.2 ha to Archaeological Department in Singur camp and provided ` 1.00 lakh. Out of this amount the department incurred ` 60 thousand for shifting the stone sculptures from different submerged villages and transported them to the camp area.

12.11 The field visits to camp area and discussions with elderly local persons in the project camp village revealed that the stone sculptures are lying under a tree without any roof. Further, the villagers informed that the dismantling of temples and transportation of sculptures was done without much care. As a result of this most of the sculptures got damaged. Further, it is found that the interested oustees of rehabilitation centres picked up the idols of their choice and placed in the newly constructed temples.

12.12 Commissioner, Archaeology & Museums Department, Hyderabad vide his Lr RC No H2/166/99 dated 25-01-2000, furnished that the proposed shifting of sculptures from Singur project dam site to Khajana building Museum at Hyderabad is under active consideration[2]. However, so far, necessary efforts have not been made by the department to shift the monuments collected from submerged area (lying at dam site) to the proposed venue (Hyderabad).

Development of Green Belt along the periphery of Reservoir to arrest excessive siltation

12.13 In pursuance of the suggested safeguard measures by MoEF, with regards to development of green belt along the periphery of Singur reservoir, initiative was taken by the project authorities. The total area proposed for green belt lies between (+) 523.60 m and + 523.00 m is about 4000 ha. The work of formation of green belt has been worked

[2] Govt. of Andhra Pradesh, Irrigation and CAD Department" Status Report on Environmental Aspects of Singur Project, 2004.

out in consultation with the Forest Department, Medak District. The Government had accorded approval for ` 135/- lakh vide G.O.MS 131 dated 07.4.1994.

12.14 Further, it is to be mentioned here that the Director, Singareni Collaries Company Ltd, Kothagudem had come forward to have massive afforestation programme with an agreement to finance the entire expenditure of afforestation programme. For this purpose, the authorities proposed to hand over an extent of 1350 ha to Singareni Company and the balance 2650 ha to Forest Department, Social Forestry Division, Sangareddy. However, in the meanwhile, the Conservator of Forest, Nizamabad circle indicated through his Lr R.C. No. 3045/16/D, dated 05.05.1997 addressed to Principal Chief Conservator of Forest (PCCF) that the non-forest lands available i.e., 1350 ha in the periphery of Singur project can not be spared for proposed compensatory afforestation to Singareni Collaries company. As such, execution of work of afforestation could not be taken up.

Simultaneously, for the development of green belt in the remaining area i.e., 2650 ha, Social Forestry wing of Forest Department, Sangareddy, was made responsible for the purpose. As such, the Deputy Director, Social Forestry prepared an Action Plan (1995-96 to 2002-2003) with the budget estimates of ` 302.35 lakh and submitted to the project authorities. In turn, accepting the proposal, project, authorities deposited an amount of ` 7.75 lakh in favour of the Forest Department (Social Forestry) for initiating the green belt formation work The Forest Department could tackle the work to an extent of 95 ha incurring about `. 7.15 lakh. To continue the work, forest department requested the project authorities to arrange further funds, which they could not do due to unavailability of funds and as such, work could not be taken up further and forest department returned the balance amount to project authorities.

During the year 2001, again the Deputy Conservator of Forest, Social Forestry Division, Sangareddy prepared the revised Action Plan for the total area of 3905 ha (i.e., 2650-95= 2556+1350ha) with the budget estimated of ` 615.6 lakh and submitted to project authorities for its approval and release of funds for execution of green belt work (Lr RC NO. 2931/94 dated 19.4.2001). It is observed that till date, the green belt formation work with revised action plan has not been initiated.

Catchment Area Treatment (CAT):

The catchment area of Manjira river is spread over three states viz Maharashtra, Karnataka and Andhra Pradesh. The state-wise distribution of its catchment area is as follows:

Sl. No	State	Catchment Area
1	Maharashtra	10.479 Th.sq.km
2	Karnataka	4.0145 Th sq km
3	Andhra Pradesh	1.6084 Th. sq km

The catchment area which falls in the state of Andhra Pradesh is about 10 per cent of the total catchment area. The Govt. of India, Ministry of Environment & Forest, through its letter No. 3354/19-HT/EN/5/Ka dated 24.10.1989 informed that the coordination for the preparation of the schemes for soil conservation and catchment area treatment shall be the responsibility of Govt. of Andhra Pradesh. To ensure effective preparation and implementation of soil conservation and CAT program and the purpose, an inter state Coordination Committee could be constituted. Thereafter, in the year 1992, the issue of CAT was discussed with Secretary, MoEF by Govt. of Andhra Pradesh and its was agreed that CAT Plan may be prepared only for the land (1610 sq km), situated in the state of Andhra Pradesh.

The Environmental Monitoring Committee in its 15th meeting held at Hyderabad on 27.11.1993 had advised the Singur project authorities to contact All India Soil and Land Use Survey Organisation (Ministry of Agriculture and Cooperation, Govt. of India) to identify critically degraded areas of the catchment for affording treatment on priority. Besides, committee also requested the Soil Conservation Department and Forest Department to formulate an intigrated plan for catchment area treatment. In turn the project authorities approached these departments for the purpose.

Progress Made

Sl. No	Particulars	Area
1	Total catchment area treatable under Singur Project catchment area	13961.00 ha
	i) Work done by Forest Department	3781.00ha
	ii) Work done by agricultural department under RVP Zaheerabad	200.00 ha
2	Total work done	3981.00 ha
3	Balance area to be tackled (work to be done)	9980.00 ha

Thus, the catchment area which falls under Singur project accounted for CAT 13961.00 ha out which 3981 ha have already been treated. The balance area of 9980 ha needs to be taken up for CAT. For this, a detailed plan on priority basis has been drawn and presented in Chapter 13.

Part – I

13
Status of Implementation of CAT

AFC, Hyderabad

13

STATUS OF IMPLEMENTATION OF CATCHMENTS AREA TREATMENT PLAN

Introduction

13.01 The Singur project was constructed across the river Manjira, a right bank tributary of Godavari River near Singur village in Medak District of Andhra Pradesh. The dam is located at about 30 km from Sangareddy, the District head quarters of Medak. The project contemplates with a capacity of 850 M cum (30 TMC) to provide-

a) Drinking water supply to twin cities of Hyderabad and Secundrabad consuming 1133 M cum (4TMC) per year,
b) To act as a balancing reservoir and regulate releases into river to the downstream irrigation systems viz., Ghanpur anicut and Nizamsagar project,
c) To irrigate 16,000 ha (40,000 acres) in Kharif with ID crops in Medak district by saving from the water allocated to Nizamsagar project (After modernization under NWMP Phase-II), and
d) To arrest silt flowing into Nizamsagar Reservoir this has silted up considerably.

13.02 The project construction was initiated during 1976 and was completed by 1989 except for the identification and developing the command area. The command area has been now identified and is in developing stage.

13.03 The Environmental Appraisal Committee of Ministry of Environment and Forests, GoI has accorded environmental clearance for the Singur project vide letter No.3/54/79-ENV5 dated 20/1/1983 subject to effective implementation of certain safeguards during the construction of the project. The committee has suggested the following mitigative measures related to the catchments area.

1. A greenbelt need to be created along the periphery of the reservoir to arrest excessive siltation.
2. Land use in the catchments need to be converted with forestation to the extent possible.

The methodology and the suggested implementation is discussed in the fore going paragraphs.

Need for Catchments Area Treatment

13.04 Reservoirs formed by dams across rivers get sediment from the catchments area. The process of sedimentation embodies the sequential processes of erosion, entrainment,

transportation, deposition and compaction of sediment. The eroded sediment from catchments when deposited on streambeds and banks causes brailing of river reach. The removal of top fertile soil from catchments adversely affects the productivity and degradation of vegetation. Thus, a well-designed catchments area treatment plan is essential to ameliorate the above ill effects.

13.05 Soil erosion can be defined as the detachment and transportation of soil. Water is the major agent responsible for the erosion. In a river catchments area, erosion due to water is a common phenomenon. Water or wind, moving across the ground surface exerts an abrasive force, which picks up soil particles and carries them away in suspension. In a natural undisturbed environment, the dense cover of vegetation retards this surface transportation of soil to a slow pace. Erosion abrades at one place and aggregates at another. The accelerated phenomenon of soil removal is known as soil erosion. The lifespan of the reservoir is greatly reduced due to the erosion in the catchments area. The main objectives of catchments area treatment would be:

- Prevention of further land degradation
- Reduce rate of soil Erosion
- Arrest silt accumulation in the tributaries, streams and in Manjira River
- Maintain ecological balance to facilitate the increase in productivity of the cultivable lands.

13.06 Nizam Sagar Project across Manjira River on downstream is an example in respect of heavy siltation due to soil erosion. This reservoir constructed in 1931 has already silted up to 43% of its original capacity by 1975. The land use in the catchments area of this project comprises about 91.32 percent plain area and only 3.90 percent wooded area. One of the reasons for the construction of Singur Project was to provide regulated supplies to Nizam Sagar Project, which has lost almost 50% of its capacity.

13.07 The above indicates that soil conservation measures are utmost essential besides afforestation in forest and other areas.

13.08 An evaluation study was conducted relating to soil conservation in the catchments area of Nizam Sagar Project below Singur project which has a catchments area of 20,95,813 ha in 1988. The catchments area is in the states of Maharastra, Karnataka and Andhra Pradesh under Manjira River basin.

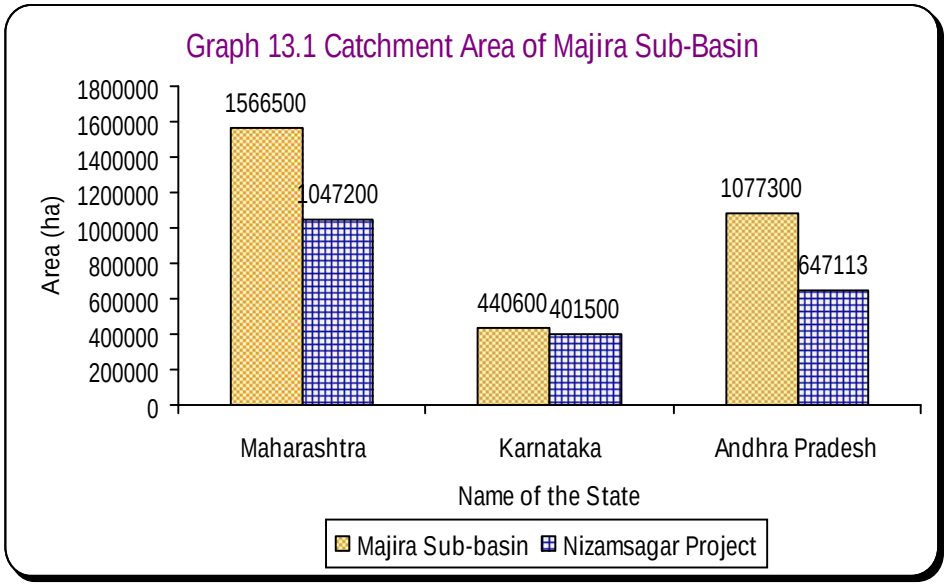
Table- 13.1

Catchments Areas of Manjira Sub-Basin, Nizamsagar and Singur Projects

Sl.No	State	Catchments Area (ha)			
		Manjira Sub-Basin	Nizamsagar	Singur Project	Percentage
1	Maharastra	15,66,500	10,47,200	10,47,200	100
2	Karnataka	4,40,600	4,01,500	4,01,500	100
3	Andhra Pradesh	10,77,300	6,47,113	1,61,000	24.88
	Total	30,84,400	20,95,813	16,097,00	76.81

Source: Compiled from "Water Balance Study of Manjira Sub-basin of Godavari Basin" (New Delhi: National Water Development Agency), 2003

13.09 Comparative catchments areas of Manjira sub basin, Nizamsagar and Singur projects are given in **Table 13.1**The table infers that the catchments area of Nizamsagar is 67.95 % of the total CA of Manjira sub-basin, whereas the catchments area of Singur project is 76.81 % of Nizamsagar project. The catchments areas in Maharastra and Karnataka states in respect of Nizamsagar and Singur projects are the same whereas in AP the CA of Singur is 24.88 % of Nizamsagar CA. Hence, the evaluation study relating to soil conservation for Nizamsagar can be adapted in respect of the first two states. Manjira Sub-Basin and Nizam Sagar project occupied first position; second position goes to A.P and Karnataka respectively. These details could be seen below **Graph. 13.1**.



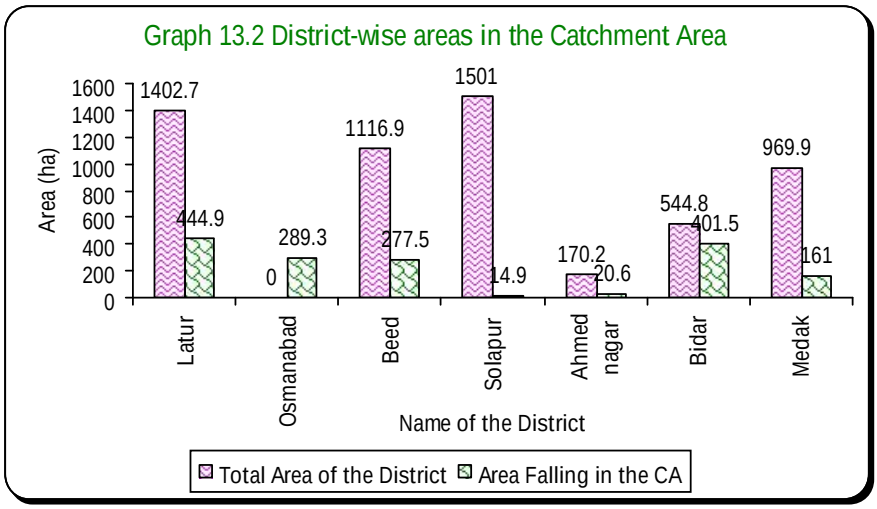
13.10 The catchments area is located in 5 districts in Maharastra, 1 district each in Karnataka and Andhra Pradesh. **Table 13.2** shows the areas falling in the above districts.

Table 13.2
District wise areas in the catchments area

State	District	Total Area of the District	Area Falling in the CA	% of the Area of the District
Maharastra	Latur	1402.7	444.9	31.72
	Osmanabad	-	289.3	-
	Beed	1116.9	277.5	24.85
	Solapur	1501	14.9	0.99
	Ahmed Nagar	170.2	20.6	12.1
Karnataka	Bidar	544.8	401.5	73.69
Andhra Pradesh	Medak	969.9	161	16.6
Total (CA)			**1609.7**	-

Source: Compiled from "Water Balance Study of Manjira Sub-basin of Godavari Basin" (New Delhi: National Water Development Agency), 2003

13.11 Latur district occupied first position in catchments area, compared to other districts. Second position goes to Bidar followed by Osmanabad, Beed, Medak respectively, these details could be seen from the below **Graph.13.2**.



Characteristics of the Catchments Area

13.12 The main characteristics of the catchments in terms of topography and physiology, geology, soils, climate, rainfall, etc., are narrated in the following paragraphs.

Topography and Physiology

13.13 The overall drainage pattern of the area is Sub-dendrietic. The catchments area is an undulating upland plain with an altitude of 560 m to 785 m. Most of the area is flat to gently undulating except for a few hillocks. The catchments area has long ridges, valleys and isolated hills with a number of small streams. There are two well-designed physical regions in the catchments area, namely a) High Lands of Beed and Osmanabad districts of about 160 km from the source of the river and (b) plains from the Bidar district up to the borders of Andhra Pradesh.

Geology

13.14 The main geological rock formations of the sub-basin are peninsular Granites, the Puranas and Gondwanas. These formations have considerable effect on the run off in the catchments area. The types of soils generated from the formations are mostly permeable.

Soils

13.15 Based on the information furnished by the State Soil Survey Agencies, the soils can be broadly classified into six groups. They are, Black Cotton Soils (Very Deep), Black Cotton Soils (Moderately deep to deep), Sandy Loam Soils, Red Earths, Forest Soils and Laterite Soils. Coverage of each group of soils is given in **Table 13.3**.

Table-13.3
Coverage of Soils in Districts

Sl. No	Type of Soil	Districts
1	Black Cotton Soils (very deep) to deep	Bidar, Solapur, Beed, Latur, Osmanabad, Ahmednagar and Medak
2	Sandy Loam Soils,	Medak, Bidar, Latur and Osmanabad
3	Black Cotton Soils (moderately deep to deep)	Medak
4	Red Earths	Bidar and Medak
5	Forest Soils	Bidar, Medak, Osmanabad, Latur and Beed
6	Laterite Soils	Medak

Source: Compiled from "Water Balance Study of Manjira Sub-basin of Godavari Basin" (New Delhi: National Water Development Agency), 2003

13.16 The black cotton soils under groups 1 and 3 cover about 68 per cent of the catchments area and are more susceptible to sheet erosion. Laterite soils of group 6 are found on the top of hills, along the slopes and foothills, which cover about 11 per cent of the area. Red earths and sandy lands cover about 16 per cent of the area. Shallow black soils cover about 5 per cent.

Climate

13.17 The climate of the catchments area is characterized by hot summer and a mild winter. The monsoon sets early in June and continues up to October. Winter is from November to mid February and summer is from mid February to the end of May.

13.18 The catchments lies in medium rainfall zone. Most of the rainfall is received during the southwest monsoon. Average annual rainfall during 1967-1976 at Bidar (Karnataka) rain gauge station was 735.07 mm. Maximum annual rainfall of 986 mm occurred during 1975 and minimum of 382 mm during the year 1972. Average annual rainfall at Nilanga rain gauge station in Maharastra during 1963-1972 was 581 mm only. Maximum of 922 mm reported during 1963, while minimum of 220mm during 1972 during which period the area experienced an acute drought. In the tail part of the catchments, i.e, in Andhra Pradesh an average rainfall of 730 mm was reported. In this 88 per cent occurred during south-west monsoon period.

13.19 Monthly average maximum and minimum temperatures observed during 1960-70 for different IMD stations are given below.

		Mean Maximum	Mean Minimum
1.	Beed (Maharastra)	33.5^{o}C	19.0^{o}C
2.	Bidar (Karnataka)	34.1^{o}C	19.5^{o}C

13.20 The relative humidity is high during the southwest monsoon and low during non-monsoon period. In summer, the weather is dry and the humidity is low. The RH for IMD stations of Bhir and Bidar are given below

		Relative Humidity (%)	
		08.30 hrs	17.30 hrs
1.	Beed (1960-70)	66	44
2.	Bidar (1931-60)	65	45

Monthly wind speeds recorded at the observatory stations are,

1.	Beed (1960-70)	6.3 km / hr
2.	Bidar (1931-60)	13.3 km / hr

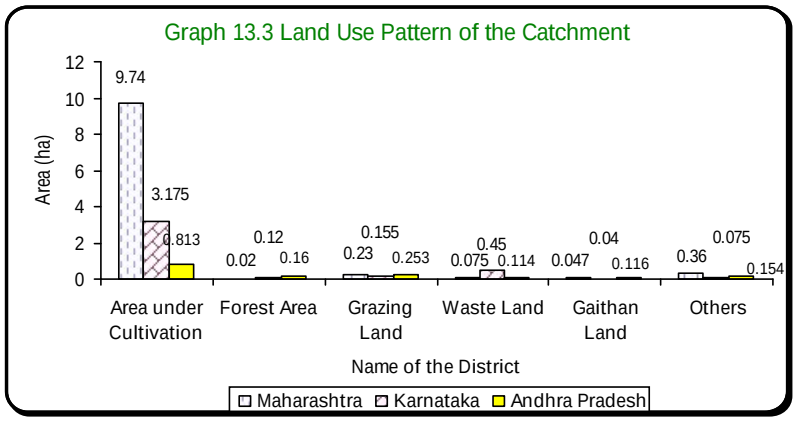
Land use pattern of the total Catchments

13.21 The catchments is predominantly an agricultural area. A major climatic constraint is the scanty as well as erratic distribution of rain. The catchments in Maharastra and Karnataka are almost devoid of vegetative cover. However, varieties of horticultural crops are grown. The land use pattern of the catchments is shown in **Table- 13.4** and **Graph. 13.3**.

Table: 13.4
Land use Pattern of the Total Catchments (Area in Lakh ha)

Land Use	Maharastra	Karnataka	Andhra Pradesh	Total	% of Total
Area Under Cultivation	9.74	3.175	0.813	13.728	85.28
Forest Area	0.02	0.12	0.16	0.3	1.86
Grazing Land	0.23	0.155	0.253	0.638	3.96
Waste Land	0.075	0.45	0.114	0.639	3.98
Gaithan Land	0.047	0.04	0.116	0.203	1.26
Others	0.36	0.075	0.154	0.589	3.66
Total	**10.472**	**4.015**	**1.61**	**16.097**	**100**

Source: Compiled from "Water Balance Study of Manjira Sub-basin of Godavari Basin" (New Delhi: National Water Development Agency), 2003



Study of the Catchments Area and Treatment Measures Suggested.

13.22 Singur project across Manjira River, a tributary of Godavari River was constructed during the period 1976-1980. The detailed project report does not consist of any environment management plan to have knowledge about the treatment measures suggested. As per the available information, a reduced quantum of sediment load 233 MCM (10 TMC) was provided as dead storage for the reservoir (100 year) against 431 MCM (17TMC) worked out on prorata basis based on the observations at Nizamsagar project located downstream of Singur project on the same river. The project proponents reported that suitable soil conservation measures would be taken up in the catchments area to compensate the difference of silt load of 198 MCM (7TMC). Environmental Appraisal Committee under MoEF while according approval to Singur project suggested developing greenbelt along the periphery besides afforestation in the catchments area.

Progress of the Bioengineering and Civil works carried out so far

Areas where Soil Erosion and Sediment Yield arrest has been successful

13.23 As per the evaluation studies made on soil conservation measures pertaining to Nizamsagar project the catchments area considered was 20.95 lakh hectares. The catchments area of Singur project is 16.097 lakh ha. As per AISLUS, about 15.2% (3.19 lakh ha) was determined under priority categories of very high and high classes. Numbers of watersheds classified under very high and high priorities are given in **Table 13.5.**

Table-13.5
Priority of Sub Watersheds (Nizamsagar Catchments Area)

State	Very High Priority		High Priority		Total	
	No. of Sub-Watersheds	Area (ha)	No. of Sub-Watersheds	Area (ha)	No. of Sub-Watersheds	Area (ha)
Maharastra	-	-	-	-	-	-
Karnataka	5	19,154	36	1,08,627	41	1,27,781
Andhra Pradesh	28	1,01,918	20	89,638	48	1,31,556
Total	**33**	**1,21,072**	**56**	**1,98,265**	**89**	**3,19,337**

Source: Compiled from "Water Balance Study of Manjira Sub-basin of Godavari Basin" (New Delhi: National Water Development Agency), 2003

13.24 The above table infers that there was good vegetation cover developed in the catchments in Maharastra area and lie in medium and low categories of priority. However, soil conservation measures were carried out in Maharastra also along with other states involved in the catchments. From inception up to 1985-1986 or just after completion of Singur Project 5.76 lakh ha including 0.15 lakh ha of afforestation has been treated with soil conservation. **Table 13.6** gives the summary picture of treatment in different states in the catchments area of Nizamsagar Project.

Table-13.6
Soil Conservation Treatment (ha)

State / Scheme	Agriculture Land	Afferestation	Total
Maharastra			
RVP Schemes	8763	783	9546
Other Schemes	420621	2510	423131
Karnataka			
RVP Schemes	15304	1252	16556
Other Schemes	72419	3933	76352
Andhra Pradesh			
RVP Schemes	8905	232	9157
Other Schemes	3500	6212	41412
Total RVP Schemes	32972	2287	35259
Total Other Schemes	528040	12855	540895
Grand Total	**561012**	**15142**	**576154**

Source: Agriculture and Forest Departments, of the three states RVP & NRVP officers of the three states

13.25 It is noticed that the catchments area in Maharashtra and part of Karnataka state reached saturation levels by developing vegetation cover to the maximum possible extent. This may be due to afforestation and soil conservation measures taken up as a part of construction of several major and medium irrigation projects in the Manjira basin in their states. Thus, the catchments area is intercepted by several projects. Hence, it is now considered to propose afforestation and soil conservation measures in the directly draining catchments area falling in Andhra Pradesh state to a maximum extent and in small portion in Karnataka. Priority sub-watersheds will be refixed in the light of the present context for the free catchments area, suitable mitigative measures are proposed, and cost of the revised EMP is worked out.

13.26 The free catchments area at Singur project has been worked out as 4239.25 sq km. The catchments area falls mostly in Andhra Pradesh, Karnataka, and a small portion in Maharashtra. The state-wise distribution of free catchments area of Singur project is as follows:

Sl. No	State	Area (Sq km)	% in total
1	Maharashtra	840.64	19.83
2	Karnataka	2315.90	54.63
3	Andhra Pradesh	1083.70	25.54
Total		**4239.25**	**100.00**

Catchments Area Treatment

13.27 The Catchments Area Treatment plan (CAT) highlights the management techniques to control erosion in the catchments area of water resources project. The life span of a reservoir is greatly reduced due to erosion in the catchments area. Adequate preventive measures are thus, needed for the catchments for its stabilization against future erosion. The treatment involves:

- Understanding of the erosion characteristics of the terrain
- Suggesting suitable remedial measures to reduce the erosion rate

Methodology

13.28 In the present study, 'Silt Yield Index' (SYI) method has been used. In this method, the terrain is sub divided into various small sub watersheds and the erodability is determined on relative basis. SYIs provided a comparative erodability criteria of catchments (Low, moderate, high etc.,) and do not provide the absolute silt yield. SYI method developed by All India Soil and Land Use Survey (AISLUS), is widely used and can be applied to large areas like sub-water sheds of Singur project.

13.29 A detailed database on natural resources, terrain conditions, soil type, socio-economic status etc., is a pre requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used to estimate soil erosion and preparation of the CAT plan. Due to the spatial variability of site parameters such as soils, topography, land use and rainfall, all areas do not contribute for erosion equally. In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving land use data and ground truth studies too have been conducted. The various steps involved in the study are data acquisition, data preparation and out put presentation. The steps are briefly described below-

(i) Data Acquisition

13.30 The requirement of the study was first defined and the outputs expected were listed. Various data layers of the catchments area used for the study are

- Land use classification map
- Slope map
- Soil map
- Surface drainage map

(ii) Estimation of Soil Loss using Silt Yield Index (SYI) method

13.31 The Silt Yield Index (SYI) considering sedimentation as product of erosivity, erodability and Arial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) in 1972. The methodology has been progressively refined overtime

and tested for validity. The sediment detachment process predominated in the upland phase whereas sediment transport and deposition are the main processes in low land phase. The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of detached soil material.

The relationship can be expressed as

Soil erosivity = f (climate, physiography, slope, soil parameters, land use)

13.33 Sediment delivery from a hydrologic unit to a reservoir is a multiplicative function of the potential soil detachment representing the erosive factor, transportability of the detached material (Delivery ratio) and area of hydrologic entity. This can be expressed as

Sediment Yield = f x delivery ratio x area

13.34 So, the erosivity is simulated whereas the delivery ratio is adjusted with the weight age of sediment yield value, by the likely delivery of the eroded material.

(iii) Silt Yield Index

13.35 The silt yield index is defined as the yield per unit area and SYI value for hydrologic unit by using suitable empirical equation.

(iv) Prioritization of Sub-watersheds

13.36 The prioritization of smaller hydrologic units within the catchments area was based on the SYI of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating suitable breaking points. The sub-watersheds are subsequently rated into various categories corresponding to their respective SYI values. The application involves the evaluation of the following factors;

a) Climatic factors comprising of total precipitation, its frequency and intensity,
b) Geomorphic factors comprising land farms physiography, slope and drainage characteristics
c) Surface cover factors governing the flow hydraulics and
d) Management factors

The various steps involved in the application of model are:

* Preparation of a framework of sub-watersheds through systematic delineation
* Generation of map indicating erosion intensity mapping units
* Assignment of weightage values to various mapping units based on relative silt yield potential

* Computing SYI for individual watersheds / sub-watersheds
* Grading of watersheds / sub-watersheds into very high, high, medium, low and very low priority categories

13.37 The area of each of the mapping unit is computed and SYI of individual sub-watersheds are calculated using the following equation:

$$\text{Silt Yield Index SYI} = \sum \frac{(Ai \times Wi \times Di)}{AW} \times 100$$

Where i = 1 to n

Where,

Ai	=	Area of ith unit
Wi	=	Weightage value of ith mapping unit
n	=	No. of Mapping units
AW	=	Total area of sub-watershed
Di	=	Adjusted delivery ratio assigned to ith mapping unit

13.38 In general no adjustment is initially carried out for sub-watersheds located within the periphery of 40 km from the reservoir site. The SYI values obtained thus are further, adjusted by multiplication with a suitable factor to account for the deposition of the material enroute the reservoir site.

13.39 The gradation and assignment of priority ratings to the sub-watersheds are based on the descending values of SYI / runoff the potential index values. An abrupt change in the number of sub-watersheds is indicative of the breaking points and is deciding factor for fixing upper and lower limits of different priority categories. The boundaries for the various categories are shown in **Table 13.7**.

Table 13.7 Boundaries for the various categories of prioritization of sub-watersheds

Sl. No	Priority categories	SYI Values
1	Very high	>1300
2	High	1200-1299
3	Medium	1100-1199
4	Low	1000-1099
5	Very low	<1000

Source: AISLUS

Characteristics of Catchments Area

13.40 As already explained elsewhere, the catchments area in Maharashtra and Karnataka states is largely intercepted by medium and major projects constructed on Manjira river / tributaries. Also the area is saturated and also soil conservation works

taken up to considerable extent. As such, the free draining area upto Singur project is considered for treatment works (AP area). The free draining catchments area is worked out as 4239.25 sq km or 423925 ha. The drainage map of this catchments area along with sub-watersheds delineation is shown in **Fig 13.1**.

13.41 Characteristics of catchments area such as land use / land cover, slope and soils have been generated through RS imageries. The details are as below:-

Land use and Land cover

13.42 The spatial distribution of land use and land cover analysis generated through RS imageries for the free draining catchments area is shown in **Fig 13.2**. The analysis is furnished below-

Table 13.8 Land Use in Sub-Watersheds

Sl. No	Particulars	ha	%
1	Agricultural crop land (Two crop area)	124664	29.41
2	Agricultural crop land (Single crop)	216682	51.11
3	Built up area	5049	1.19
4	Water bodies (Reservoirs, tanks, river, stream) (14489+4707)	19196	4.53
5	Agricultural land (Fallow land – current fallow)	30940	7.30
6	Waste lands	24053	5.67
7	Agricultural plantations land	368	0.09
8	Forest lands	2973	0.70
Total		**423925**	**100.00**

13.43 As seen from the table, forests lands reoccupy only 0.70 per cent whereas the reservoir portion is 3.42 per cent. Major extent is occupied by single croplands, which is 51.11 per cent whereas double cropland is 29.41 per cent (**Table 13.8)**. Total croplands occupied 80.61 per cent. The land use and land cover map of the free draining catchments with sub-watersheds delineation is given in **Fig 13.2.** Sub-watersheds wise land use and land cover in the catchments of Singur is given in **Annexure XIII.1**

Slope Classification

Six slope groups are observed in the catchments area which are given below:

1	0 - 1	Percent
2	1 – 3	Percent
3	3 – 5	Percent
4	5 – 10	Percent
5	10 – 15	Percent
6	15 – 26	Percent

13.44 Slopes ranging from 0-5 percent occupied maximum area of about 90 per cent. This may be due to the max areas occupied by croplands and follows, which is about 87.91 per cent. Slope classification along with the delineation of sub-watersheds of free draining catchments of Singur project is shown in **Fig. 13.3.**

Soil Characteristics

13.45 Physically, the soils in the free draining catchments can be classified as Red sandy soils, laterite soil and black cotton soils. The plateaus, undulating plains and uplands have moderately deep (40-60 cm) well drained red sandy soils. The plains, valleys and flood plains are having deep and fine textured clay soils and are rarely well drained. The erodability of soils is rather high in the single cropland areas in flat lands slope ranging from 3 -10 per cent and it is low in flat lands up to 3 per cent slopes. The soils are free from salinity hazard the area has been divided into 9 mapping units based on physiography and soil properties. The unit wise physiography, soil taxonomic classification is given below. Soil map with delineation of sub-watershed for the above is shown in **Fig. 13.4**.

1	Chromic	Haplusterts
2	Entic	Haplusterts
3	Lithic	Rhodustays
4	Lithic	Ustorthents
5	Rhodic	Paleustays
6	Typic	Haplustays
7	Typic	Haplustays
8	Typic	Rhodustays
9	Vertic	Haplustepts

Erosion Status

13.46 The soil inventory of the catchments area indicates a moderate to severe hazard. The plateaus, undulating uplands, and undulating plains are also subject to erosion due to inadequate protection. However, the plains have slight erosion owing to gentle slopes. The map of soil erosion status of free draining catchments of Singur project is presented in **Fig. 13.5**.

Prioritization of Sub-watersheds – Ratings

13.47 The free draining catchments area of Manjira river upto Singur project has been worked out with the help of Remote Sensing applications as 423925 hectares. For the preparation of watershed management plan, the catchments are divided into small sub-watersheds for the purpose of prioritization to take up watershed management measures. The catchments area has been suitably divided into 43 sub-watersheds. The priority ratings of the sub-watersheds based on the SYI method developed by AISLUS are

furnished in the **Table 13.9**.

Table 13.9 Priority Ratings of Sub-watersheds

Sl. No	Watershed Code	Area in ha	SY Index	Priority
1	4E6G1.1	13099.45	1248	High
2	4E6G3.2	7842.56	1264	High
3	4E6G3.3	7152.06	1256	High
4	4E6G3.4	3461.10	1280	High
5	4E6G2.5	3236.19	1200	High
6	4E6G2.6	10305.38	1272	High
7	4E6G5.7	9758.35	1140	Medium
8	4E6G1.8	7194.61	1256	High
9	4E6G5.9	8970.93	1232	High
10	4E6G5.10	11149.00	1050	Low
11	4E6G5.11	12006.00	1050	Low
12	4E6G5.12	10674.09	1140	Medium
13	4E6G5.13	7715	1043	Low
14	4E6G5.14	10761	1043	Low
15	4E6G5.15	9848.98	1132	Medium
16	4E6G5.16	6681.00	1064	Low
17	4E6G5.17	11010.81	1309	Very High
18	4E6G5.18	10975.02	1301	Very High
19	4E6G5.19	7886.93	1241	High
20	4E6G5.20	5855.28	1207	High
21	4E6G5.21	11390.35	1168	Medium
22	4E6G5.22	16843.48	1216	High
23	4E6G5.23	10760.14	1309	Very High
24	4E6G5.24	12130.09	1318	Very High
25	4E6G5.25	15125.61	1176	Medium
26	4E6G5.26	14089.43	1144	Medium
27	4E6G5.27	13038.50	1267	High
28	4E6G5.28	9115.47	1267	High
29	4E6G5.29	11313.87	1184	Medium
30	4E6G5.30	11375.87	1177	Medium
31	4E6G5.31	18922.49	1208	High
32	4E6G5.32	10891.76	1208	High
33	4E6G5.33	5066.74	1208	Medium
34	4E6G5.34	11090.91	1224	High
35	4E6G5.35	6162.00	1163	Medium

Table 13.9 Priority Ratings of Sub-watersheds				
Sl. No	**Watershed Code**	**Area in ha**	**SY Index**	**Priority**
36	4E6G5.36	11088.00	1050	Low
37	4E6G5.37	9412.00	1073	Low
38	4E6G5.38	8924.40	1272	High
39	4E6G5.39	6416.16	1163	Medium
40	4E6G5.40	8619.05	1155	Medium
41	4E6G5.41	8230.64	1163	Medium
42	4E6G5.42	7140.87	1153	Medium
43	4E6G5.43	9554.71	1140	Medium

Catchments Area Treatment Proposed

13.48 Areas prioritized under different categories of the free draining catchments area of Manjira river at Singur project are given in the following tables.

Table 13.10 Manjira Catchments (Free) Prioritized Sub-water sheds				
Sl. No	**Categories**	**No. of Sub-watersheds**	**Area Prioritized**	**Percentage total area**
1	Very low	Nil	-	Nil
2	Low	7	70448	16.61
3	Medium	15	144767	34.15
4	High	17	163834	38.65
5	Very High	4	44876	10.59
Total		**43**	**423925**	**100**

13.49 It is inferred from the above table that about 10.59 per cent of the area is prioritized as very high category and is proposed for treatment. Suitable treatment measures are proposed to be provided to the four sub-watersheds in the Andhra Pradesh area which are under very high category. The other category sub-watersheds have not been recommended for any treatment measures. The sub-watershed wise treatable areas for the very high priority zone are given in **Table 13.11**. The priority of sub-watersheds is presented in **Fig 13.6.**

Table 13.11 The sub-watershed wise Treatable Area

#	Sub-water shed No	Total Area	Double crop + Agri plantation		Single Crop		Builtup Area		Water bodies		Fallow land		Waste Lands		Forest Land		Total TP
			Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	
1	S17	11011	1221	0	5041	1500	111	10	328	0	2362	1180	1948	1558	-	0	4248
2	S18	10975	1801	0	5062	1500	227	22	1509	0	1131	565	1182	946	63%	0	3033
3	S23	10760	603	0	5195	1560	104	10	3653	0	292	145	913	730	-	0	2445

#	Sub-water shed No	Total Area	Double crop + Agri plantation		Single Crop		Builtup Area		Water bodies		Fallow land		Waste Lands		Forest Land		Total TP
			Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	Area	TP	
4	S24	12130	1235	0	8125	2440	169	18	1213	0	443	220	945	756	-	0	3434
Total		**44876**	**4860**	**0**	**23423**	**7000**	**611**	**60**	**6703**	**0**	**4228**	**2110**	**4988**	**3990**	**63%**	**0**	**13160**
***Notes: TP indicates Treatment Proposed, # Indicate Serial Number**																	

13.50 No forest lands are involved in the sub-watersheds proposed for treatment except for forest clad of 63 ha which is neglected. In the areas other than forest area, single crop agricultural area, wastelands, fallows occupy considerable areas which contribute much erosion and transport of sediment to the reservoir. Sub-watersheds wise areas proposed for treatment measures are shown below:

1	Agricultural land inclusive of single crop land fallows	9110
2	Waste lands	3990
3	Built up area for raising greenbelt around villages	60 ha
	Total area proposed for Treatment	**13160 ha**

13.51 The total treatable area works out to 3.10 per cent of the free catchments area. Greenbelt development is proposed around the villages, which will be about 10 per cent of the built-up area. Afforestation / social forestry is essential in the agricultural lands, single crop areas and fallows land to arrest drifting of soil to the reservoir. This may be possible by raising greenbelt along the boundaries and fallow lands, which are not suitable for cultivation. This is estimated to be about 30 per cent for single croplands and 50 per cent for the fallow lands. The cost of plantation in the private lands (single croplands) shall be born by the farmers. It is proposed to develop greenbelt in the wastelands. Generally, the area pertains to Govt. lands. If private land exists, necessary subsidies may be provided to raise plantations or other such afforestation measures. No treatment is proposed for the double croplands where intensive soil conservation measures already exist. Thus, out of the total area of the prioritized watersheds, the following classes of land cover have been excluded from the treatment, as they are not to be disturbed.

- Settlements
- Existing water bodies
- Double crop cultivated area

Conservation and Management Measures

13.52 Generally, it is commented that although environmental problem is the creation of science and technology, it can also be controlled by science and technology only. For a sustainable action plan, the watershed development concept has been applied. The approach is holistic, multidisciplinary and practicable approximation of systems planning. Keeping it in view, different types of measures have been drawn out on the basis of topography, relief, degree of degradation, classes of land cover etc.,

13.53 It is an established fact that forests and vegetation play the most crucial role in the protection of river catchments. The gap between demand and supply of fuel and fodder has been the most important reason for degradation of the ecosystem, thereby causing severe erosion of soil. There are about 3990 ha of wastelands in the catchments accounting to 30.32 per cent of the proposed treatable area.

13.54 Plantation costs are fixed based on Government approved minimum wages rates of labour (unskilled). For the purpose of compilation of the report, the cost per ha is fixed at an approximate rate of ` 26000/- per ha with due allowance for escalation (see greenbelt development of periphery of submergence). Provision is made for engaging guards and maintenance for four years after plantation. Since, conservation of soil and water in the area is the primary objective of the plantation, contour terracing for planting has been provided for as an essential component.

Afforestation Technique and Choice of Species

13.55 Saving and planting will be done at a spacing of 4.5 m in plating pits of size 30 cm x 30 cm x 30 cm dug in rough contour trenches about 45 cm wide. Contour trenching may be necessary in exceptional cases where soil i.e., refractory and moisture conservation is a must for success of plantation. Nursery work may be done in advance, particularly for species like Teak, Champ, Diptercarps, Eucalputs, etc., Barbed wire fencing is not necessary and engaging of plantable seedling by organizing Kisan Nurseries may also be looked into. Intensive weeding and cleaning for the first two years and jungle clearing thereafter for 2 years are provided for.

13.56 The choice of species to be sown or planted will depend on the altitude of the site and environmental needs and local experience, success being an important factor. In many cases of wastelands, areas may be partially stacked with natural growth of colonizing free species as well as bamboo and enrichment planting at spacing of 5m x 5m or 3.5m x 3.5 m may give the desired results. The species recommended in such cases are: *Alnus neplaenis, Betula Spp, Grivellia robusta, Macaranga Spp, Cupressue cashmeriana, Pinus Kesiya* and *Acacia auriculifarmia*. Planting of only nursery grown tall seedlings are recommended in such cases.

Phasing of Planting Target and Expenditure

13.57 An eight-year programme of afforestation for the wastelands is proposed, excluding the first year, which is marked for advance work only. The phasing of the planting target is proposed as follows.

1	1st year	Advance work	
2	2nd year	Plantation	1000 ha
3	3rd year	Plantation	1000 ha
4	4th year	Plantation	1000 ha
5	5th year	Plantation	990 ha
6	6th year	Maintenance	1000 ha

			2000 ha
			990 ha
			1000 ha
7	7th year	Maintenance	1000 ha
			990 ha
			1000 ha
8	8th year	Maintenance	990 ha
9	9th year	Maintenance	990 ha

Silvi pasture development for fallow lands

13.58 The catchments area has about one per cent of fallow lands and there is scarcity of cattle fodder in the area. Under the present circumstances, large-scale development of pastureland in this catchments appear to be necessary. However, from the point of view of environmental conservation and catchments protection, unregulated grazing is not to be encouraged. The crossbreed cattle also need good pastureland for higher milk production.

13.59 Properly managed pastures may be the best use of land that cannot support cropping and a combination of widely spaced trees, preferably leguminous raised in combination with developed grassland may considerably enhance productivity. Belts of trees in between pasture can provide shade, food for livestock and small timber and firewood, at the same time shielding the animals from hot sun, cold wind and water stress. This variation of agrisilvi-culture with a strong pastoral bias is commonly known as silivi-pastoral system.

13.60 The World Bank recommended an average density of 200 trees per ha to ensure optional grass yield, but agreed that depending on local conditions the number could be increased. A spacing of 4.5 m x 4.5 m or 500 tress per ha may be recommended for planting. The tree species recommended for planting are *Melia azaderach*, *Leucaena leucocephal*, *Morus alba, Morus laevigata, Bauhina purpunla, Atbizzia lebbeck, Artocarpus Sp. Ficus hispida* and *Alnus nepalensis, Bucklandia populnea, Quercus Sp, Ficus nemoralis, Sauraunia nepalensis and Brassiophis Sp* at slightly higher altitudes. Trees may be lopped for fodder from the third year onwards and only 50 per cent lopping is recommended.

13.61 Reseeding of selected land with grasses like *Apluda aristata, Aurundinella nepalensis, Bromul inermes, Chyrsopgen aciculatus, Eragrostis Curvula, Panicum antidoltala, Panicum maximum, Penisteum polystachyam* and legumes like *stylesanthes, Macroptilium purpureum, Centrosoma pubescens,* etc., are generally recommended. Final selection may haven be done in consultation with the Indian Grassland and Fodder Research Institute, Jhansi. Social Forestry including agro forestry should be given due importance in land management in areas under dry cultivation or fallow lands so as to have a balance land use.

Afforestation, Reforestation and Soil Conservation

13.62 As an integral part of future Forestry Management Plan, a big plan of 9 years including 4 years maintenance **has** been proposed for 3990 ha of wastelands. The entire programme will be financed out of the funds under modified EMP for Catchments Area Treatment Plan. It is suggested that the work should be progressively under taken by the State Forest Department under their normal afforestation and Soil Conservation programmes like operation soil watch, Afforestation and Eco-Development programme, waste land development, Rural fuel wood plantation etc. Land use maps of the very high-prioritized sub-watersheds are shown in **Fig. 13.7, 13.8, 13.9 and 13.10**. The cost for 3990 hectares works out to ` 1037.40 lakh

Staggered Trenches

13.63 Staggered trenches will be constructed for silvi-horticultural plantation as well as for treatment of degraded areas for detention and conservation of rainwater and eroded soil. Run-off water from mixed crop strips will flow through staggered trenches in silvi-horticultural strip, resulting in settling of sediments and arrest of run-off water to recharge soil profile and ground water. Staggered contour trenches will be constructed in rows, spaced at 10 m, depending upon the slope with a spacing of 3.30 m within the rows. In the alternate row, the trenches will be located directly below one another. The trenches in successive rows will be staggered, with the trenches in the upper row and inter-space in the lower row being directly below each other. After every 5 rows of staggered trenches on contours, one continuous trench will be laid out to arrest escaped run-off water. The trenches may be of trapezoidal in section with side slope of 1:1 for stability purposes. Each trench will be followed by a bund on the down streamside, with 1.00 m top width, 0.85 m height and 1.1 side slope. These bunds will be constructed by the excavated materials from the trenches. As per design, there will be 40 trenches of 5.00 m (length) x 0.50 m (depth) x 0.45 m (width) per hectare and their capacity to conserve run-off volume will be 45 cum. As this storage will be available reportedly during monsoon period, their total storage capacity will be about 5 times of above volume. Details of design and cost estimate have been provided in **Annexure- XIII.2**. Cost per hectare works out to ` 4883/-. Area proposed for formation of staggered trenches in respect of fallow lands worked out to 2011 ha. The cost worked out to ` 103.03 lakh.

Staggered Contour Trenches and Development of Pasture & Fodder Grasses (subsidy)

13.64 Staggered contour trenches along with development of pasture and fodder grasses, in the inter-spaces, have been planned. These are mostly fallow lands. It is assessed that staggered trenches @ 5 numbers per ha can recharge soil profile and ground water to meet the water requirement of pasture and fodder grasses of the patchy areas. Further, planting of fast growing species, as recommended under Forestry and Silvi-Pasture Management will be made for this area. In accordance with rate analysis, cost for constructing staggered trenches works out to ` 4883/- per hectare. For raising 'fuel-wood

and fodder' plantations a subsidy of ` 2,500/- per ha has to be provided in the estimate. The cost worked out to ` 52.75 lakh. Total cost of staggered trenches and development of pasture and fodder grasses worked out to 155.78 lakh.

SOIL AND WATER CONSERVATION – ENGINEERING / MECHANICAL MEASURES

Objectives and Strategies

13.65 Engineering / Mechanical measures are suggested for treatment of excessively erosive and vulnerable areas, which have lost considerable soil and vegetative cover. The slope in the upper catchments of the Manjira river system is mostly in the range of one per cent to 10 percent. Further, about 15 percent of the catchments area is having nearly flat slopes (0-1 percent). Slope range from 1 per cent to 10 per cent occupies about 75 per cent of the area. Further, considering the resource potential, socio-economic needs, etc., of the area besides, the present position of the catchments i.e., land use / land cover, soil erosion status, basin's relief, etc. The soil and water conservation measures / programme have been drawn up and designed to suit the specific requirements of such areas as well as to create a long-term interest in land and water resources management by the people.

Pre-Requisite for Soil and Water Conservation Measures

13.66 The pre-requisite for Soil and Water Conservation Measures are Physiography, Soil Properties, Vegetative Cover and Land Use Practices and Rainfall and Runoff.

Suggested Erosion Control Measures and Design

13.67 Engineering measures for such purposes is aimed at constructing barriers across the direction of flow of run-off water to retard or retain the run-off and thereby to reduce the siltation into reservoir. The important principle for conservation treatments is to create favourable conditions by:

i)	Increasing the time of concentration and thereby allowing more run-off water to be absorbed and held in the soil profile,
ii)	Intercepting a long slope into several short ones, so as to maintain less than critical velocity for the run-off water, and
iii)	Protection against damage owing to excessive run-off

To achieve this, following engineering measures are suggested:

- ❖ Gully Control Structures for arresting gully erosion
- ❖ Contour and Staggered Trenches along with development of pasture and fodder grasses for an area of 2110 hectares

- ❖ These measures, will however be in addition to other measures, like afforestation / reforestation etc, suggested separately.

Gully Control Structures or Gully Plugging

Gully Development and Checking the Growth of Gullies

13.68 Gully erosion is an advanced stage of rill erosion, while the later is an advanced stage of sheet erosion. It is seen during the field survey that at some places in the catchments area, especially in very high priority areas, sheet erosion is in process, which if not checked immediately, may take shape of rill erosion. Thereafter, unabated rill erosion will lead to gully erosion.

13.69 Stabilisation of gullies through vegetative or biotic measures is a difficult task as they are mostly used for conveying or temporarily evacuating the run-off during the time when plantations for afforestation, reforestation etc are started. In such cases, engineering measures are to be adopted to prevent washing away of the plantations by large volume of run-off, as once the vegetation is established, it will take care of gullies.

Principles

13.70 In control of gullies, the erosive velocities are reduced by flattening out the steep gradient of gullies, by constructing, a series of check or rock fill dams, which transform the longitudinal gradient into a series of steps with low risers, and long flat treads. Temporary structures are selected for small and medium gullies to function as a provider or necessary protection, until vegetation is established on their beds. Similarly, semi-permanent or permanent gully control structures are necessary for conservation of water, in addition to stabilization of bed. These are erected across steep gullies traversing hilly or mountainous region and at locations where high degree of safety is needed during disposing time of the peak run-off. Further, the semi-permanent and permanent structures are need to be supported by temporary structures for conveying run-off over critical portion of gully. They have longer life and do not require any maintenance. All the three types of gully control structures are generally constructed by locally available materials and thus become cheaper.
The two main purposes, being served by gully control structures, are:

- To collect sufficient soil and water to enable the proper growth of vegetative cover, and
- To check channel erosion until sufficient stabilizing vegetation can be established at critical points.

Planning

13.71 Based on the field survey and other maps generated from Satellite Imageries (drainage system and drainage pattern, lineament maps, soil erosion status maps, slope maps), it is roughly estimated that an area of 5860 ha is to be protected from soil erosion

due to gullies at their different formation stages in respect of Singur project. Practically all the gullies have originated from high altitudes and got aggravated. In addition, it is seen that, in some cases gully erosion is taking place not due to steep gully slopes but is mostly due to poor vegetation and soil condition. After taking care of all such facts, the following gully control measures are proposed in **Table 13.12**. Areas proposed for staggered trenches and Bench terraces are shown.

Table 13.12

Suggested Type and number of Gully Control and Other Structures in prioritized sub-watersheds

Sl. No.	Sub watershed No	Type and No of Gully Control structures			Percolation tanks (water conservation)	Staggered Trenches ha	Total area to be protected (ha)
		Double Row Post Brush dam	Loose Boulder check dam	Total			
1	17	72	23	95	4	1180	2130
2	18	94	23	117	14	565	1735
3	23	54	14	68	5	145	825
4	24	48	47	95	4	220	1170
Total		**268**	**107**	**375**	**27**	**2110**	**5860**

13.72 In the above planning, only two types of gully control structures have been proposed for construction based on present status of gullies. For land slope upto 5%, these can be spread at 0.90 m to 1.20 m vertical interval, whereas for slope above 5%, the vertical interval may be kept at 1.80 m to 3.60 m. Further, the number and area shown in Table **13.12** are approximate and may vary at the time of execution.

Design

Double Row Post Brush Dam

13.73 This type of check dam is generally used to control medium and deep gullies (about 2 m to 2.50 m deep and 6 m wide) which have contributory watershed of about 10 ha and more. This can be repaired immediately as all the construction materials for the purpose are locally available, besides being inexpensive.

13.74 Before commencing the construction of the check dam, the sides of the gully at the selected sites are sloped to 1:1 and the gully bottom, for the whole length of the dam, is lowered by about 15 cm. In addition, 15 cm excavation is carried up into the bank as high as required, to give the necessary notch capacity for discharging the run-off. The country wood stakes, about 10 cm to 13 cm in diameter, are driven 0.90 m apart, in two rows, to go at least 0.90 to 1.20 m into the hard bed of gully. The distance between the rows will be around 0.90 m. The tops of the stakes are kept at such heights as to form a distinct depression in the middle to form a notch of the required waterway to enable the maximum run-off to discharge. The first layer of straw and brushwood is laid across the gully between two rows of wood stakes. Over it, long branches of specially selected species are laid lengthwise of the gully and well pressed. The process is repeated till the required height is obtained. The brush is anchored on to the stakes by means of

galvanized iron wire. Intermediate stakes of shorter lengths are driven and the brush is anchored onto them to prevent lifting from bed by water. Estimated cost for each Double Row Post Brush Dam is given in **Annexure- XIII.3**. Cost per each of average dimension works out to ` 1560/-.

Loose Boulder Check Dam

13.75 This is used for forming check dams when loose boulders of good size are available in large quantities. The site where the dam is to be erected is cleared and the sides are sloped to 1.5:1. The bed of the gully is excavated to a uniform depth of about 0.30 m and dry boulders are packed, over pressed straw, from that level. In the center of the dam portion, sufficient waterway is allowed to discharge the maximum run-off from the catchments. The boulder filling should go up to 0.30 m to 0.60 m into the stable portion of the gully side to prevent end cutting. In the rear, sufficient length (0.90 m) and width of apron has to be provided to prevent scour. The thickness of apron packing should not be less than 0.45 m and gully sides above the apron have to be protected with stone pitching to a height of at least 0.30 m above the anticipated maximum water level to prevent side scouring. Cost per each of such check dam of average dimension is shown in **Annexure XIII.4,** which works out to ` 11384/- each.

Water Conservation Structures

Percolation Tanks (PTs)

13.76 At places where there is sudden depression and hump on either side or in wide and deep gullies at the location of entering gentle slope areas where maximum water can be stored an earthen bund with stone revetment on the upstream side and a surplus weir on one side are to be constructed. The catchments constitutes about 75 per cent of the area with slopes upto 2 percent only, which enables suitable places for construction of mini percolation tanks in the area prioritized this helps in good water conservation as well as drinking water facilities to human and cattle in the nearby settlement besides serving as a silt trap. The technical details of the mini-percolation tanks are presented in **Annexure XIII.5.** In total numbers of such tanks are proposed under at lump sum cost of ` 2,00,000/- for each. The total cost is worked out as ` 54 lakh. The drainage maps with marked engineering structures are shown in **Fig 13.11, 13.12, 13.13 and 13.14**.

Financial Involvement

13.77 The total work earmarked under engineering / mechanical measures will be carried out in 5 years. Cost aspects are shown in **Table 13.13**

Table 13.13

Breakup of Expenditures for erosion control by Engineering / Mechanical measures

Sl. No.	Item of Works	Unit	Rate	Singur Project		Total Cost in ` lakh
				No.	Cost in ` lakh	
I	**Gully Control structures**					

Table 13.13						
Breakup of Expenditures for erosion control by Engineering / Mechanical measures						
Sl. No.	**Item of Works**	**Unit**	**Rate**	**Singur Project**		**Total Cost in ` lakh**
				No.	**Cost in ` lakh**	
A	Double row post brush dam	each	1,560	268	418080	
B	Loose boulder check dam	each	11,384	107	1218088	
II	**Water Conservation Structures**					
A	Mini percolation tanks	each	200,000	27	5400000	
III	**Staggered trenches including planting and development of pasture and fodder grasses**	ha	12,265	2110	25879150	
Total			**225,209**	**2512**	**32915318**	

Agricultural Land – Single Crop

13.78 Agriculture in the catchments area is mostly rainfed. Dry crops like Maize, Jowar, millets and pulses are mostly grown as single crop. The single cropped area proposed for treatment is 7000 ha.

Slope

13.79 The slope in agriculture lands in the catchments area is ranging from nearly level (0 to 1%) to gentle sloping terrain (1-5%). Rainfed crops are in about 15 per cent to 75 per cent of the catchments area and to a greater extent it is bunded or terraced. Due to sloping nature, the Kharif lands are prone to moderate to severe erosion and may cause siltation into the proposed reservoir if not treated properly. Out of the total area of prioritized watersheds, 7000 ha requires treatment measures.

Treatment of Agricultural Land

a) Formation of graded bunds: Graded bunds across the slope are constructed in the Kharif agricultural lands to remove excess water safely out of the field; and erosion of fertile top soil is prevented to conserve rainwater. In fact, the bund serves only to guide the water to waterway or drain. Graded bunds are designed essentially for diverting excess water safely from the cropped land. Suitable outlets are required to move the water drained into them. In the absence of natural waterway, artificial waterways are constructed and suitably vegetated.

13.80 In the catchments upto 1% slope, bunding is not proposed and soil erosion can be checked by cultural practices like contour cultivation. Out of the lands above 1% slope approximately an extent of 7000 ha of agricultural land needs treatment. The spacing adopted for graded bunding is as in **Table 13.14**

Table - 1.3.14 Catchments Area Treatment Spacing for Graded Bunding Singur Project			
Slope (*%)	**Vertical distance (m)**	**Horizontal distance (m)**	**Length of bund/ha (m)**
1 - 2	1.35	67.5	148
2 – 3	1.80	60	166
Above 3		45	221

13.81 While laying out the bunds the vertical interval is fixed on the basis of slope of the land by adopting the following formula.
Vertical interval = S/2+1.0m . Horizontal distance = 300/S+15m (S=% of slope).

Grade: The grade depends upon soil type and length of the bund. The grades suitable in different soils are as follows:

Soil Type	Grade (%)
Clay Soil	0.1 to 0.2
Medium (loamy soils)	0.3 to 0.4
Sandy soils	0.5

13.82 On an average 0.3 per cent grade can be adopted in this catchments area treatment. In view of the if the length of the bund is small i.e., 15m to 200m, a uniform grade is to be given. However, if the length of the bund is large, variable grades are to be given, starting from mild grade initially to higher grade in the last reaches.

Cross Section of the Bund

13.83 It is suggested to form 0.5 sq m section bunds uniformly. However, in black soils the section can be increased to 0.65 sq m. For total bund length of 400 mt per area, the quantity of earthwork will be about 200 cum. At a rate of ` 50 per cum the total cost will be ` 10000/- per ha. Total rate inclusive of vegetation can be adopted as ` 12000/- ha.

Water Ways

13.84 The existing watercourses can be utilized for waterways to the extent possible. In case natural waterways do not exist, nearby artificial waterways need to be provided. This treatment is required on agricultural lands where single crop is grown in the upper reaches of the sub-watersheds.

13.85 These bunds can be stabilized with vegetation of local grasses. In the areas with higher percentage of slope, species like Khusgrass, Bodhgrass, Kooper grass, Lemon grass, Citronella or any other vegetation or fodder crop like stilo hamato may be used.

13.86 The cost of treatment of agricultural land worked out to ` 840 lakh. Fifty per cent of the total cost is proposed to be born by the farmers. Hence, financial provision of ` 420 lakh is made in the modified EMP.

Greenbelt around Built Up Areas

13.87 Greenbelt is proposed to be formed around the settlements in the prioritized sub-watersheds. Sixty hectares has been proposed for greenbelt. Proposing a greenbelt width of 20 meters around the village, a length of 30 km will be planted with vegetation. The villages shall be selected in the upper reaches where very high erosions is noticed. Five rows of trees may be planted at an interval of 5 m c/c. The species, procedure etc., may be followed as given under Reservoir Rim Treatment in the ensuring paragraphs. The total cost worked out to ` 15.60 lakh.

Greenbelt development / Reservoir Rim Treatment

13.88 Singur Project envisaged construction of a dam across Manjeera River near Singur (V) in Medak District of Andhra Pradesh, to impound 850 MCM of water at FRL/MWL + 523.60m. The impended water is proposed to meet the irrigation requirement and supply of drinking water facility to Hyderabad and Secundrabad cities. The submergence occurred due to the project is 16438 ha.

13.89 Under the reservoir, the total identified submergible area up to FRL contour will be impounded with water during monsoon period in which normal precipitation and run off from the Manjeera basin is anticipated. Flash floods occur only for a few weeks and the reservoir attain above FRL / MWL and floodwater will be let into the river through the spillway. The area above FRL will be under submergence for a few weeks only. After cessation of rains, the water levels recede to FRL or even below leaving some area below foreshore area cleared with water. This area can be better utilized for development Green Belt by plantation with suitable productive plant species, which can with stand floodwater period. The foreshore is better suited for foreshore plantations / reservoir rim plantation with the available moisture and sediment deposits.

Advantages

1. The trees planted on foreshore prevent soil erosion and movement of silt towards reservoir from the catchments area to some extent.
2. The tress will be useful as perches to the water birds by laying their eggs and help in their breeding.
3. These trees when grow up provide fuel, fodder, timber and other forest produces for the benefit of the society.
4. Foreshore plantation will help to maintain ecological balance in nature, and
5. Compensates the ecological loss due to the submergence to some extent

Plantation

Spacing and number of plants proposed: A spacing of 3 to 4 meters is proposed. The plantation is proposed above FRL / M W L cantor to form a reservoir rim.
Plantation method: Bagged plants preferred over direct sowing of the seed. But unlike other seedlings, special care should be taken as it developed long tap root and seedling

should be planted at an young age of about 4 months.

Pitting and Planning: Pits of 0.30 m x 0.30 m are dug and bagged seedlings are planted in the pits and filled up. In case if it is not, raining small quantity of water is put for settlement of soil. Planting is done in the months from June to August.

After care: For the initial 2 years, weeding and soil consolidation around the plants is recommended. Gap filling can be taken up in the third year in case of any causality. Watch and word for 5 years need to be ensured. After five years, the surviving trees would be large enough to with stand grazing.

Area for Reservoir Rim Treatment / Green Belt Development

13.90 The reservoir periphery is having considerably moderate slopes of about 0 to 10 per cent. The proposed width for the reservoir rim treatment with plantation differs according to the slope of the ground. Nevertheless, uniform width is proposed to farm a greenbelt. The length of reservoir periphery is as below:

1. Left flank of the river : 51000m
2. Right flank of the river : 58000m

Total length of Perifery : 109000m or 109 km

13.91 Greenbelt is proposed between FRL 523.6 m and 523.0 m. The proposed extent of green belt development is 4000 ha, with a width of 30 meters and seven rows of plantations. The area works out to 327 hectares only. Hence, reservoir rim treatment is proposed along the periphery of the reservoir with a width of 30 meters and 7 rows of plantations at 5 m intervals.

13.92 The balance extent of 3673 ha will be handed over to the Dy, Conservator of Forest, social forest division Sanga reddy for developing green belt in the prioritized water sheds discussed separately. Since there is escalation of changes in every aspect, needs revision. The estimated cost per hectare (About 500 plants) for afforestation / green belt development in shown in **Table.13.15**

Table 13.5 Cost of plantations per Hectare (500 plants) for afforestation

Sl. No	Item of work	Cost / ha (`.)
I	**Advance work**	
1.	Nursery Cost (including seed collection)	5000
2.	Survey and demarcation	1000
3.	Jungle clearance and burning	1000
4.	Cantour terracing / trenching	2000
5.	Digging planting pits at 5.0 intervals of size 30cm x 30cm x 30cm	2000

Table 13.5 Cost of plantations per Hectare (500 plants) for afforestation		
Sl. No	**Item of work**	**Cost / ha (`.)**
Total		**11000**
II	**Creation of plantation (1st year)**	
1.	Nursery Cost (watering etc)	1500
2.	Sowing and planting	1500
3.	Weeding – 3 times @ `.1000 / ha	3000
4.	Fire protection and watching (one watcher for 2 ha)	1500
5.	Infilling vacancies	500
6.	Inspection paths, camp shed etc	500
Total		**8500**
III	**Maintenance of plantation (2nd year)**	
1.	Weeding – 2 times @ `.1000 / ha	2000
2.	Infilling vacancies	500
3.	Fire protection and watching	1500
Total		**4000**
IV	Maintenance of plantation (3rd year)	
1.	Jangle clearing – 1 time @ `.500 / ha	500
2.	Fire protection and watching (1 for 4 hectares)	750
Total		**1250**
	Grand Total	**26000**

13.93 There is no provision for barbed wire fencing which has been found unnecessary and unproductive. On the other hand provision has been made for engaging watchers (local persons) for cattle watching and fire protection during the formative stages of the plantations. Since, conservation of soil and water in the area will be a primary objective of these plantations, contour terracing has been provided as is an it essential component and should be insisted upon at the time of implementation of the programme.

Species

13.94 The following common species available in the catchments area may be selected for plantation after due consultation with the social forestry wing of Forest Department of GoAP.

- *Acacia Arabica*
- *Eucalyptus hybrid*
- *Limania acidissiona*
- *Polyathia longifolia*
- *Pongamia pinnota*
- *syzigium cumini*
- *Ziziphus regosus*
- *Dendrocalamus strictus*
- *Leucana leucocephala*
- *Phyllanthus embalica*
- *Polyathia pendula*
- *sapiondus emarginatus*
- *Teetona glandis*

Cost of Green Belt Development / Reservoir Rim Treatment

13.95 The cost of the green belt development along the Reservoir Rim for an area of 327 ha proposed to be implemented by the social forestry department worked out to `.85.05 lakh. The proposed action plan is shown in **Table 13.16**. The total period including maintenance works is assessed to be nine years.

Table 13.16 Cost of Greenbelt along Reservoir Rim

Sl. No	Year	Advance plantation		Plantation and 1st year maintenance		2nd year maintenance		3rd year maintenance		4th year maintenance		Total cost `. Lakhs
		Extent (ha)	Cost in Lakh `.11000/ ha	Extent (ha)	Cost in Lakhs `.8500/ ha	Extent (ha)	Cost in Lakhs `.4000/ ha	Extent (ha)	Cost in Lakhs `.1250/ ha	Extent (ha)	Cost in Lakhs `.1250/ ha	
1	2011 – 2012	67	7.37	-	0	-	0	-	0	-	0	7.37
2	2012 – 2013	65	7.15	67	5.695	-	0	-	0	-	0	12.845
3	2013 – 2014	65	7.15	65	5.525	67	2.68	-	0	-	0	15.355
4	2014 – 2015	65	7.15	65	5.525	65	2.60	67	0.8375	-	0	16.1125
5	2015 – 2016	65	7.15	65	5.525	65	2.60	65	0.8215	67	0.8375	16.934
6	2016 - 2017	-	0	65	5.525	65	2.60	65	0.8215	65	0.8125	9.759
7	2017 - 2018	-	0	-	0	65	2.60	65	0.8215	65	0.8125	4.234
8	2018 - 2019	-	0	-	0	-	0	65	0.8215	65	0.8125	1.634
9	2019 - 2020	-	0	-	0	-	0	-	0	65	0.8125	0.8125
Total												**85.056**

Catchments Area Treatment Cost under Modified EMP

13.96 The cost of the catchments area treatment comprises cost of components such as biotic treatment with soil and water conservation measures, engineering and gully control works and greenbelt development along reservoir periphery and around built up areas. The treatment measures are proposed in Govt. as well as private lands. The treatment works shall be taken up by Forest / Agricultural department with the funds provided by the project authorities. The total cost estimated is only approximate and may vary depending upon field surveys and designs made by the line departments and the escalations in priced. The estimated cost for the recommended treatment measures is ` 1699.14 lakh. Details of cost of different types of treatments are in **Table 13.7**.

Table 13.17
Cost of Catchments Area Treatment

Sl. No	Recommended Treatment	Area covered (ha)	Cost ` lakh	Total
I	Forestry and silvi pastoral measures			
1	Afforestation	3990	1037.4	
II	Soil and Water conservation measures			
1	Engineering and Mechanical measures	-	16.36	
2 (a)	Staggered Trenches	2110	103.03	
(b)	Planting and development of fodder grasses (subsidy)	2110	52.75	
3	Mini percolation tanks	-	54.00	
III	Greenbelt development around built up areas	60	15.60	
IV	Reservoir Rim Treatment	-	-	
V	Treatment of Agricultural land @ 50 per cent cost	7000	420.00	
Grand Total		**15270**	**1699.14**	

Fig 13.1:
The Drainage of Free Catchment Area of Singur Project and its Sub - Watersheds Delineation

N
W E
S

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

18°26'30"N
18°20'0"N
18°13'30"N
18°7'0"N
18°0'30"N
17°54'0"N
17°47'30"N
17°41'0"N

76°45'0"E 76°51'30"E 76°58'0"E 77°4'30"E 77°11'0"E 77°17'30"E 77°24'0"E 77°30'30"E 77°37'0"E 77°43'30"E 77°50'0"E 77°56'30"E

Legend

- Drainage
- Canals
- River
- subwatershed

0 5 10 20 30 40 KM

Fig 13.2:
Sub - Watershed wise Land Use and Land Cover of Free Catchment Area of Singur Project

N
W E
S

4E6 G1.1
4E6 G5.9
4E6 G1.8
4E6 G5.11
4E6 C4.12
4E6 G1.7
4E6 G5.10
4E6 G3.2
4E6 G3.42
4E6 G1.6
4E6 C4.13
4E6 G3.3
4E6 G2.43
4E6 D3.15
4E6 G3.41
4E6 G2.33
4E6 C4.14
4E6 G3.4
4E6 G1.5
4E6 G2.35
4E6 C6.32
4E6 D3.16
4E6 G3.40
4E6 G2.38
4E6 C6.34
4E6 C6.29
4E6 G3.39
4E6 D3.17
4E6 C4.28
4E6 D5.27
4E6 G2.36
4E6 G2.37
4E6 C6.31
4E6 D5.26
4E6 D3.18
4E6 C6.30
4E6 D5.25
4E6 D2.19
4E6 D4.24
4E6 D4.23
4E6 D2.20
4E6 D4.21
4E6 D4.22

Legend

DESCRIPTION

- subwatershed
- Agricultural Land-Crop Land-Two crop area
- Agricultural Land-Crop Land-single crop
- Agricultural Land-Fallow-Current Fallow
- Agricultural Land-Plantation-Agriculture PInt.
- Built Up Area
- Forest-Deciduous (Dry/Moist/Thorn)-Open
- Forest-Forest Blank
- Forest-Forest Plantation
- Forest-Scrub Forest
- Forest-Tree Clad Area
- Wastelands
- Waterbodies-Reservoir/Tanks
- Waterbodies-River/Stream

0 5 10 20 30 40 KM

18°26'30"N
18°20'0"N
18°13'30"N
18°7'0"N
18°0'30"N
17°54'0"N
17°47'30"N
17°41'0"N
17°34'30"N

76°38'30"E
76°45'0"E
76°51'30"E
76°58'0"E
77°4'30"E
77°11'0"E
77°17'30"E
77°24'0"E
77°30'30"E
77°37'0"E
77°43'30"E
77°50'0"E
77°56'30"E

Fig 13.3:
Slope Classification of Free Catchment Area of Singur Project

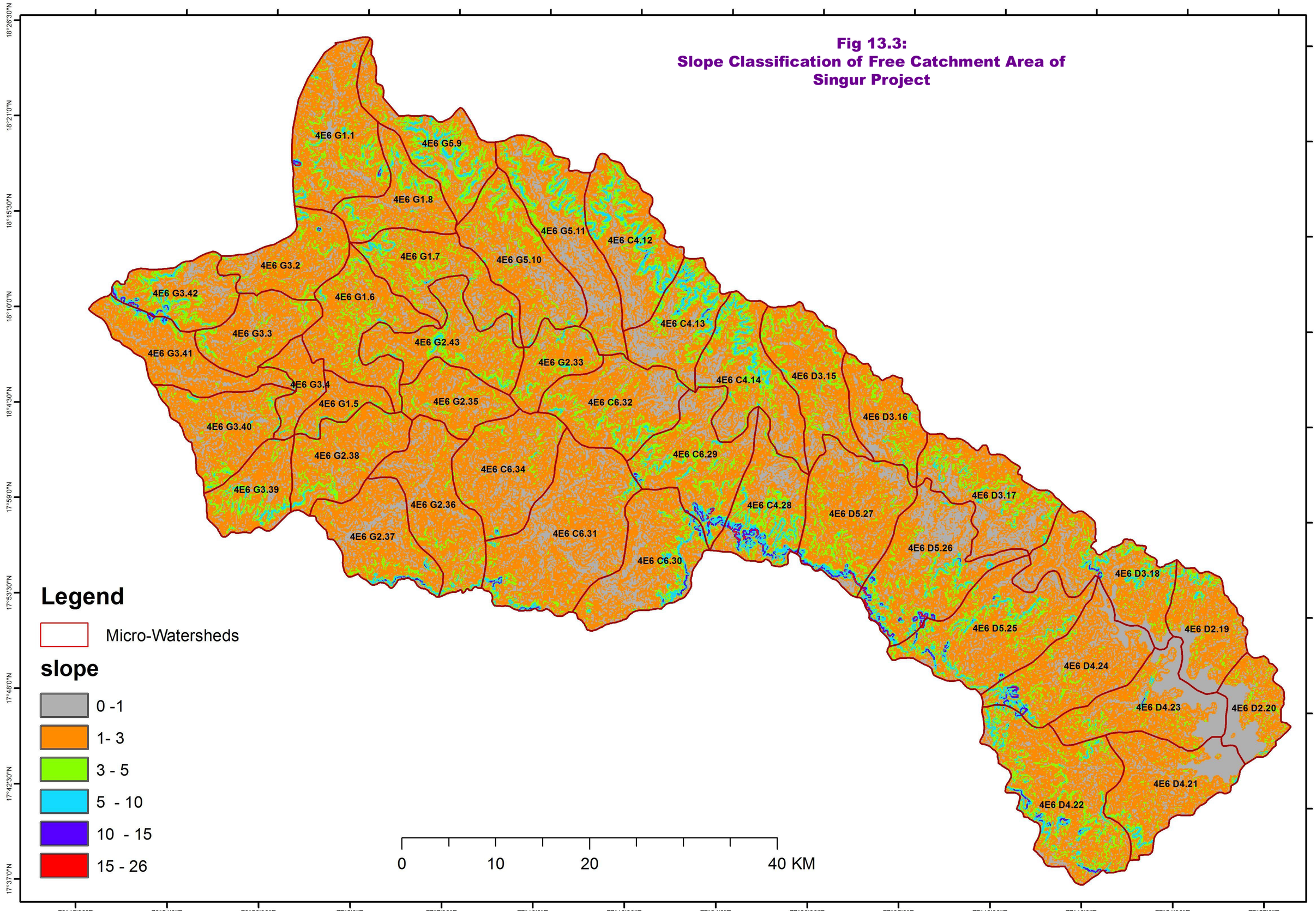


Fig 13.4:
Soil Mapping of Free Catchment Area of Singur Project

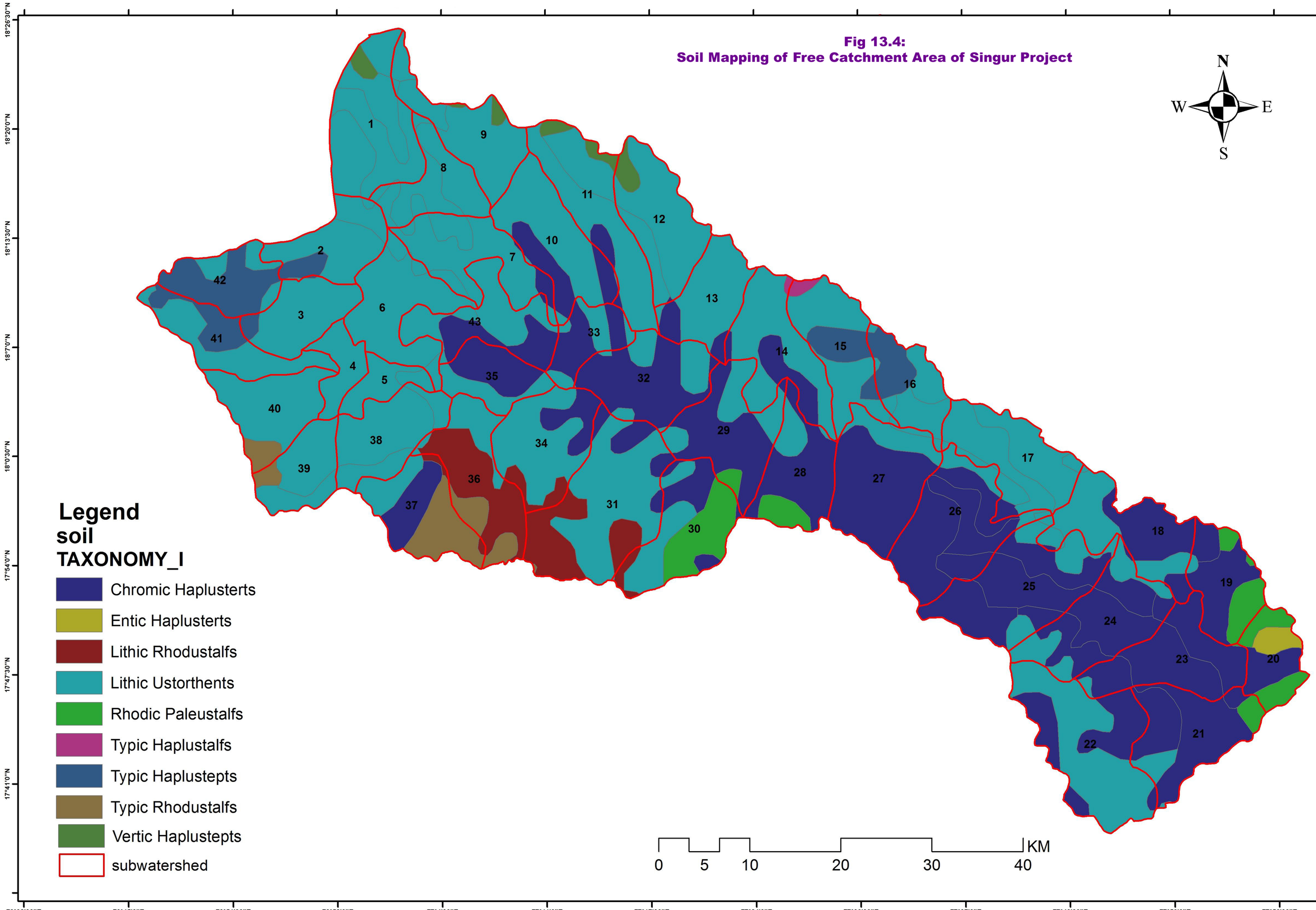
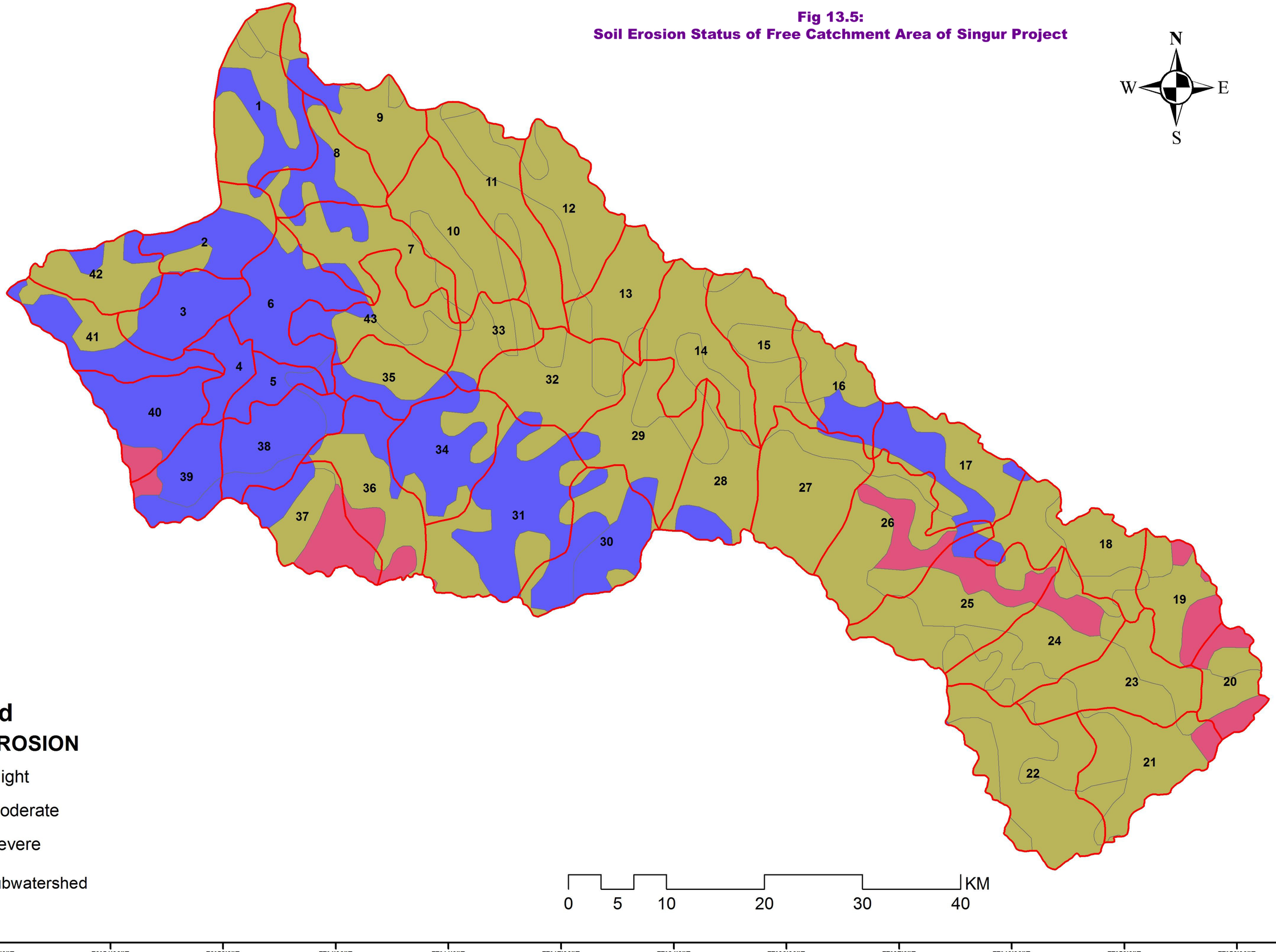


Fig 13.5:
Soil Erosion Status of Free Catchment Area of Singur Project



Legend

SOIL EROSION

- Slight
- Moderate
- Severe
- subwatershed

0 5 10 20 30 40 KM

18°26'30"N
18°20'0"N
18°13'30"N
18°7'0"N
18°0'30"N
17°54'0"N
17°47'30"N
17°41'0"N

76°38'30"E
76°45'0"E
76°51'30"E
76°58'0"E
77°4'30"E
77°11'0"E
77°17'30"E
77°24'0"E
77°30'30"E
77°37'0"E
77°43'30"E
77°50'0"E
77°56'30"E

Fig 13.6:
Prioritisation of Sub - Watersheds in the Free Catchment Area of Singur Project

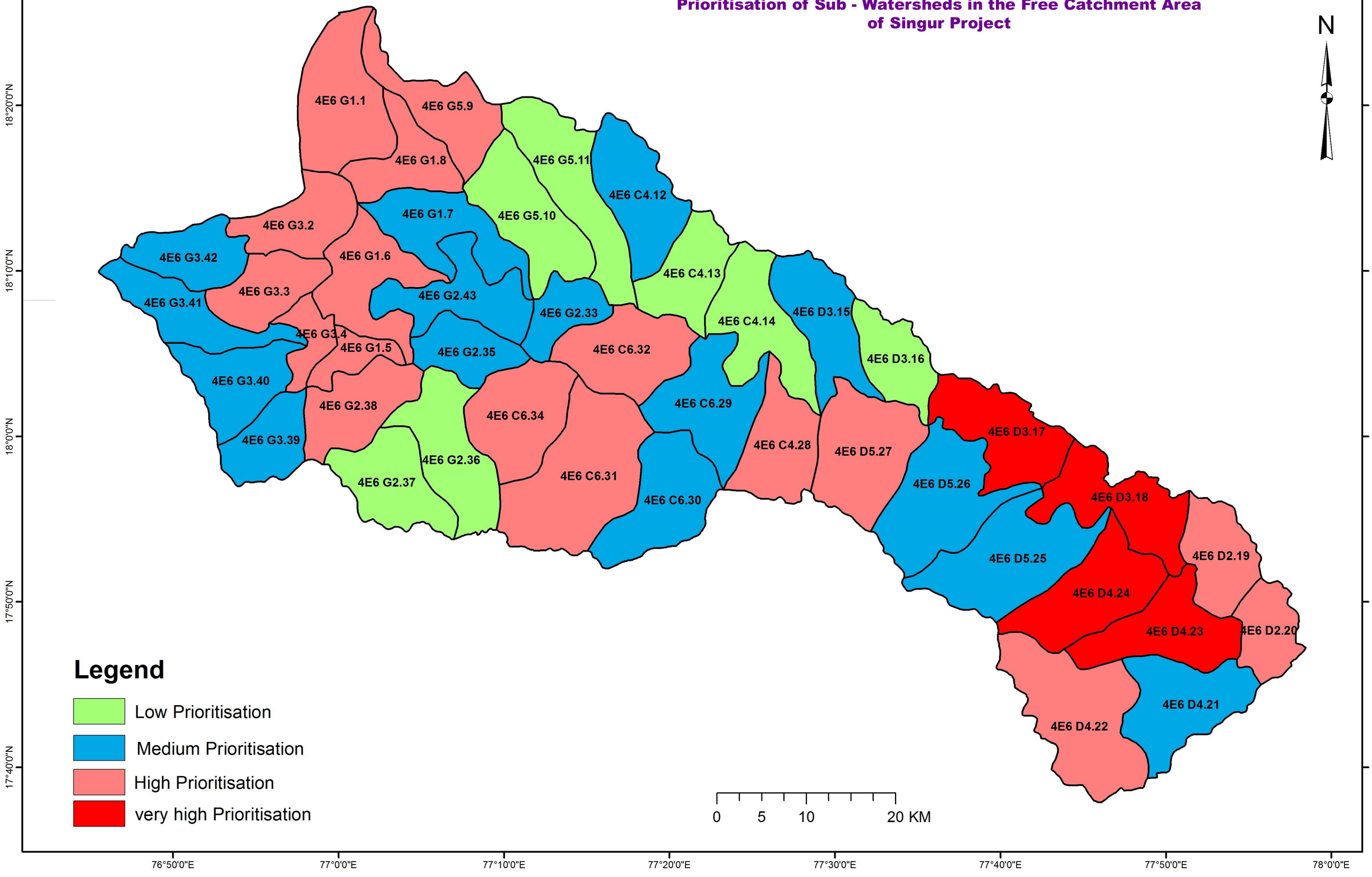


Fig 13.7:
Land Use and Land Cover Details of Sub - Watershed 4E6D3.17

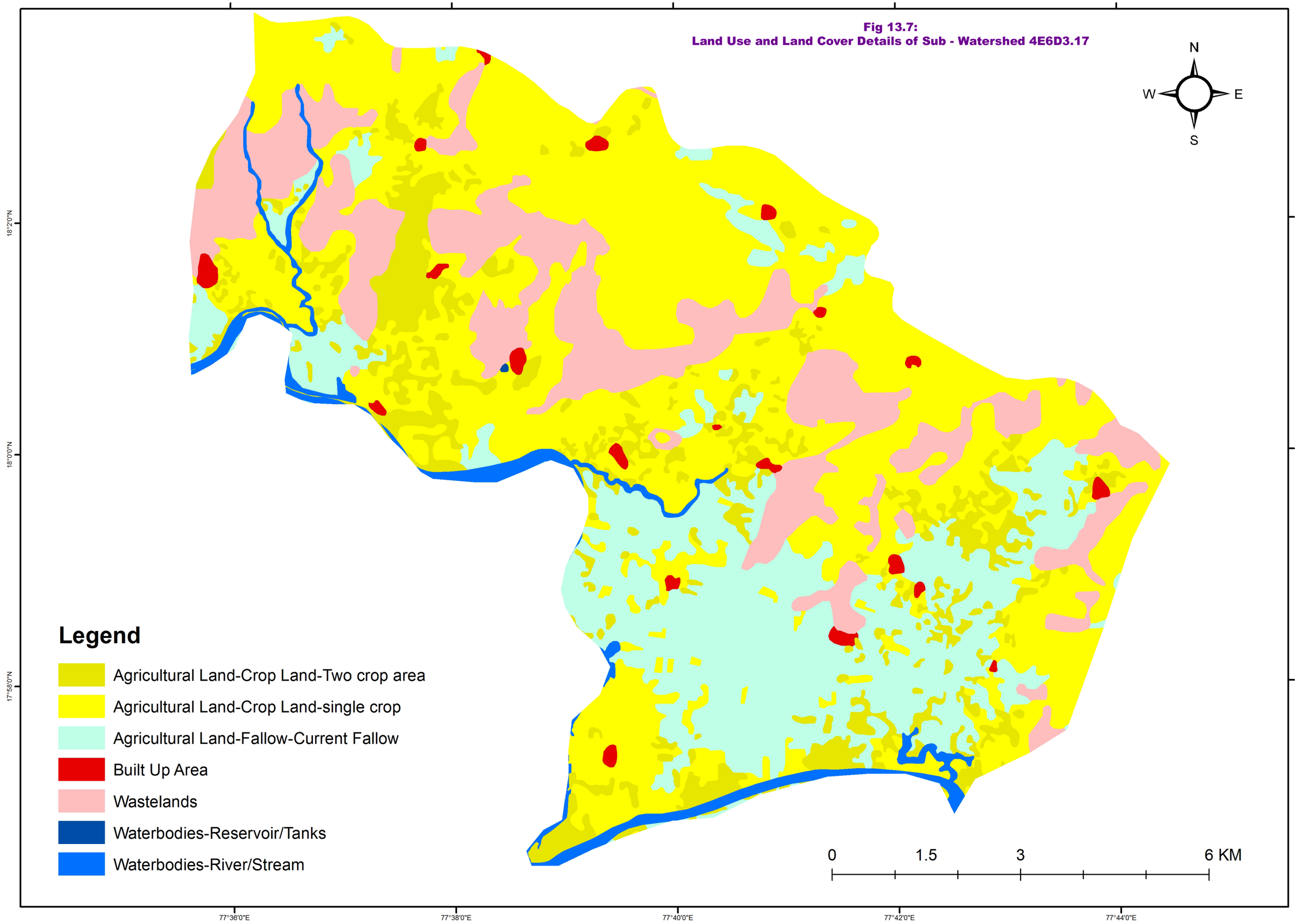


Fig 13.8
Land Use and Land Cover Details of Sub - Watershed 4E6D3.18

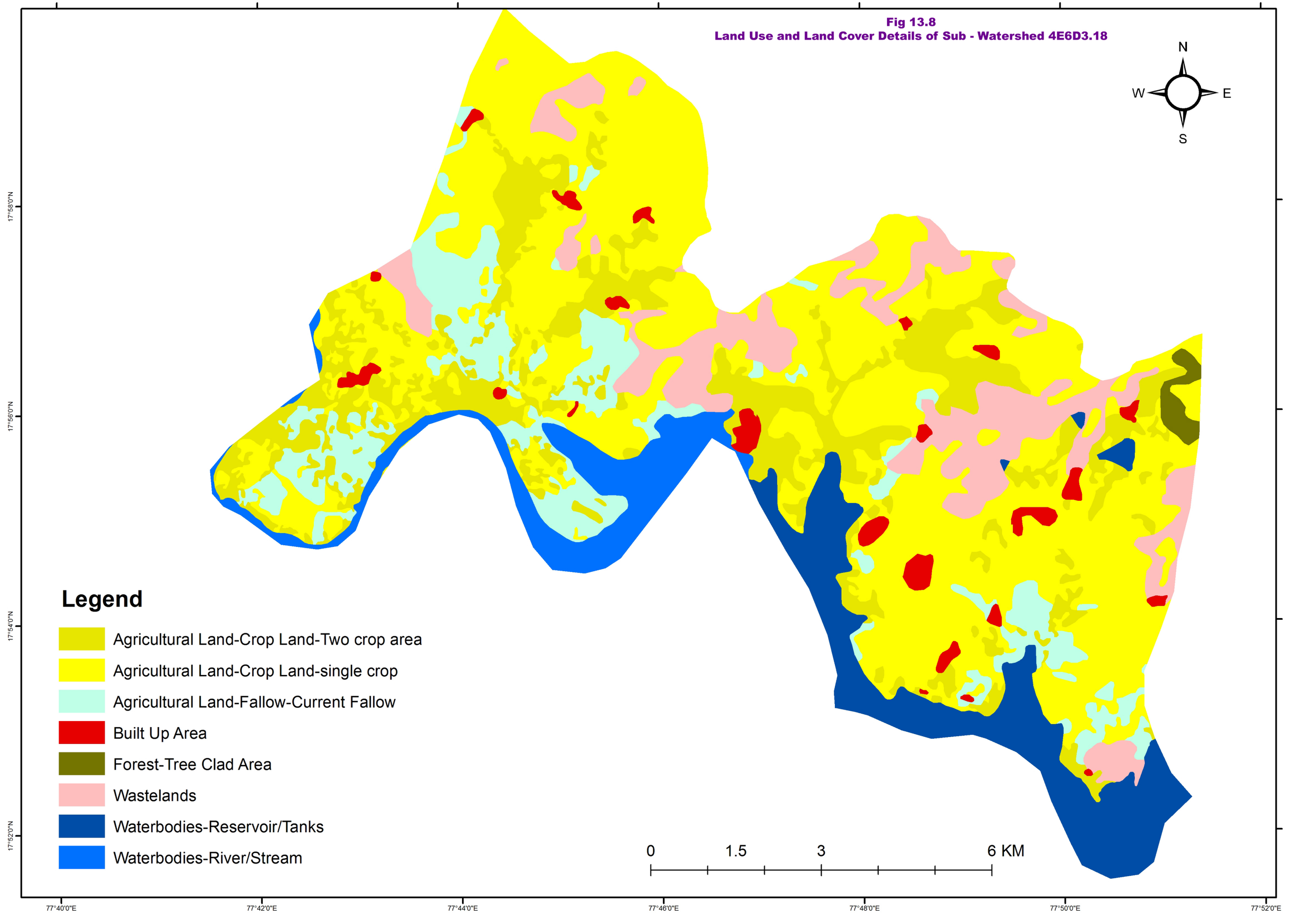


Fig 13.9:
Land Use and Land Cover Details of Sub - Water Shed 4E6D4.23

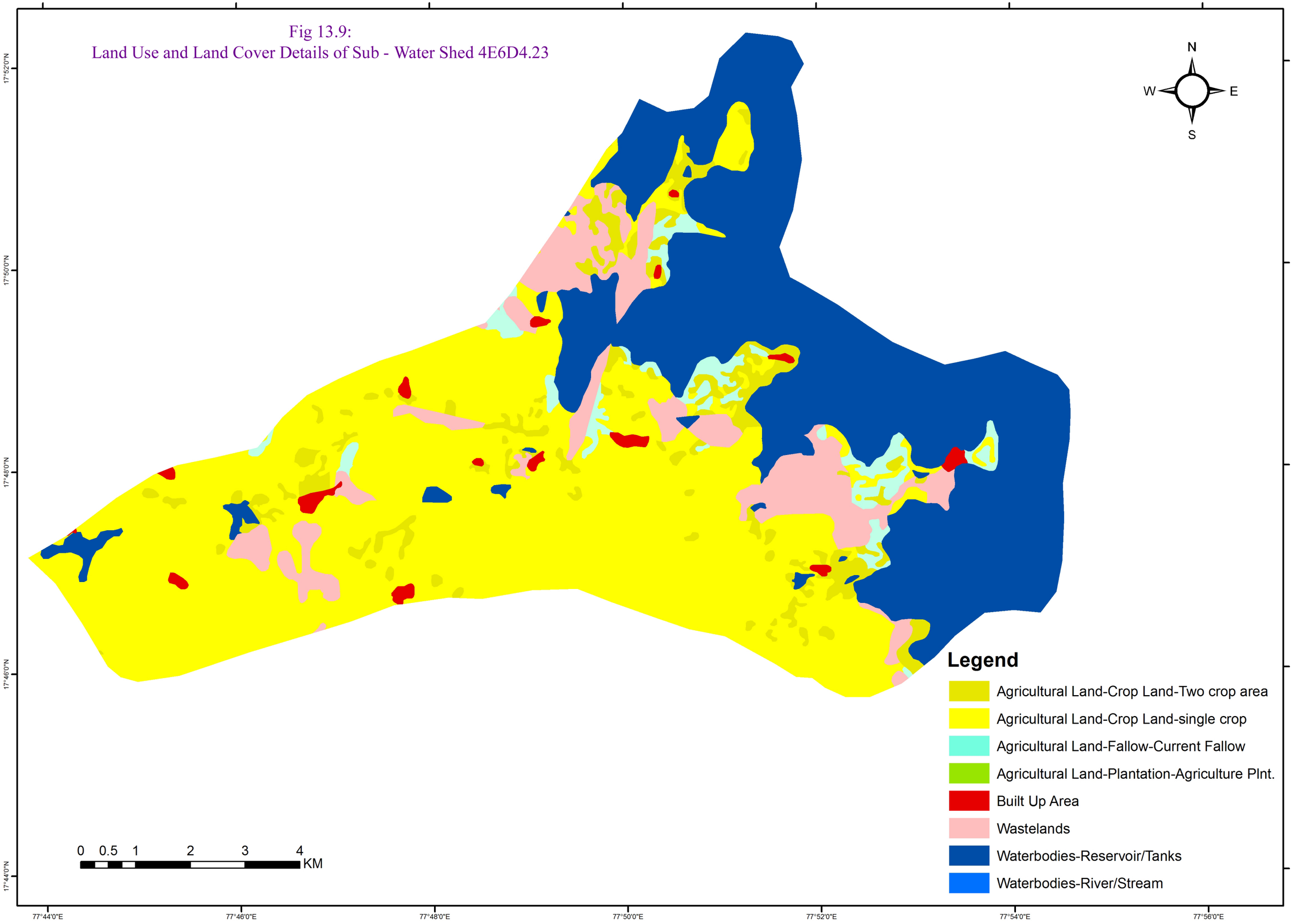


Fig 13.10
Land Use and Land Cover Details of Sub - Watershed 4E6D4.24

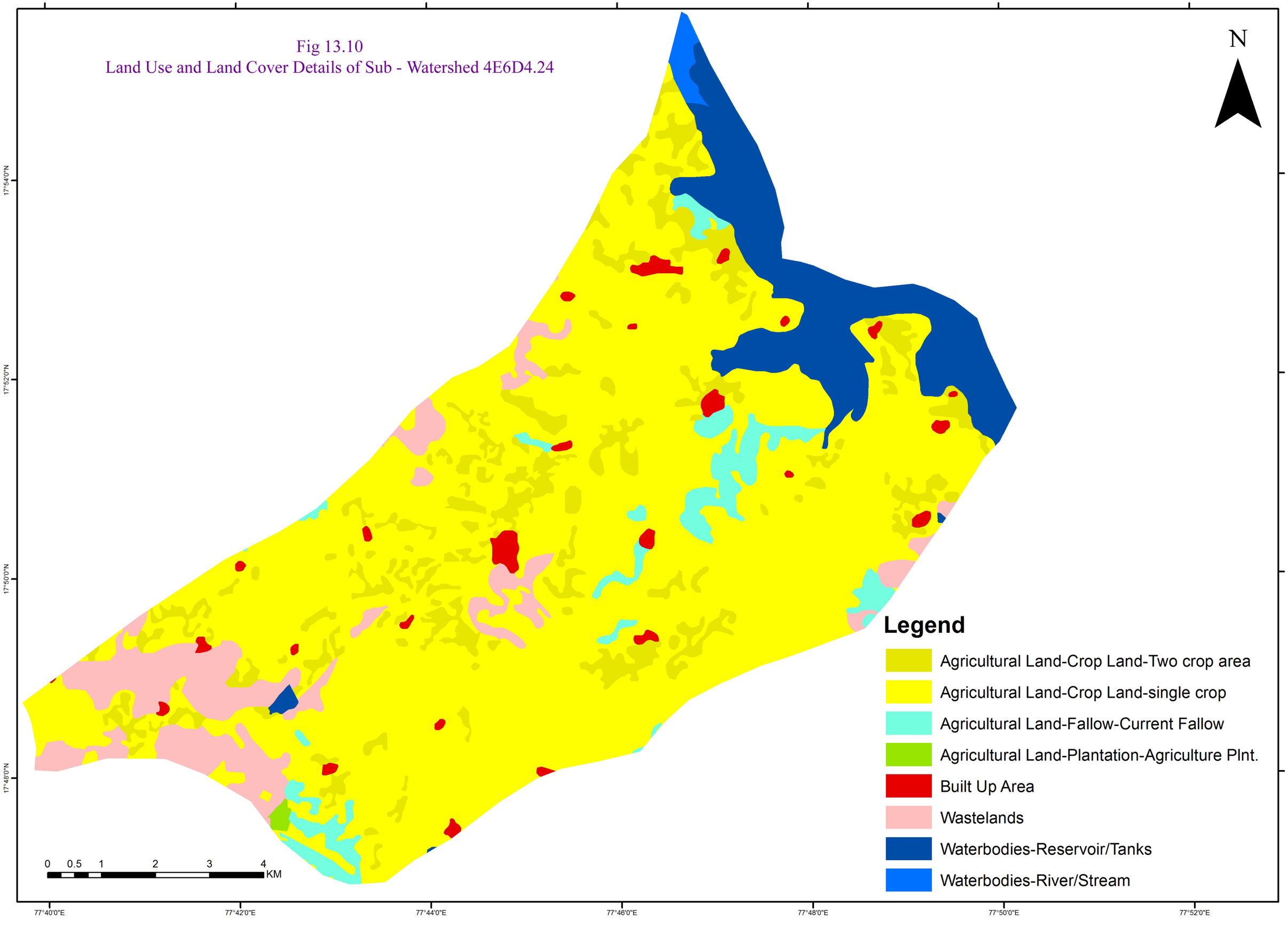


Fig 13.11
Drainage of Sub - Watershed 4E6D3.17 with marking of Proposed Engineering Structures

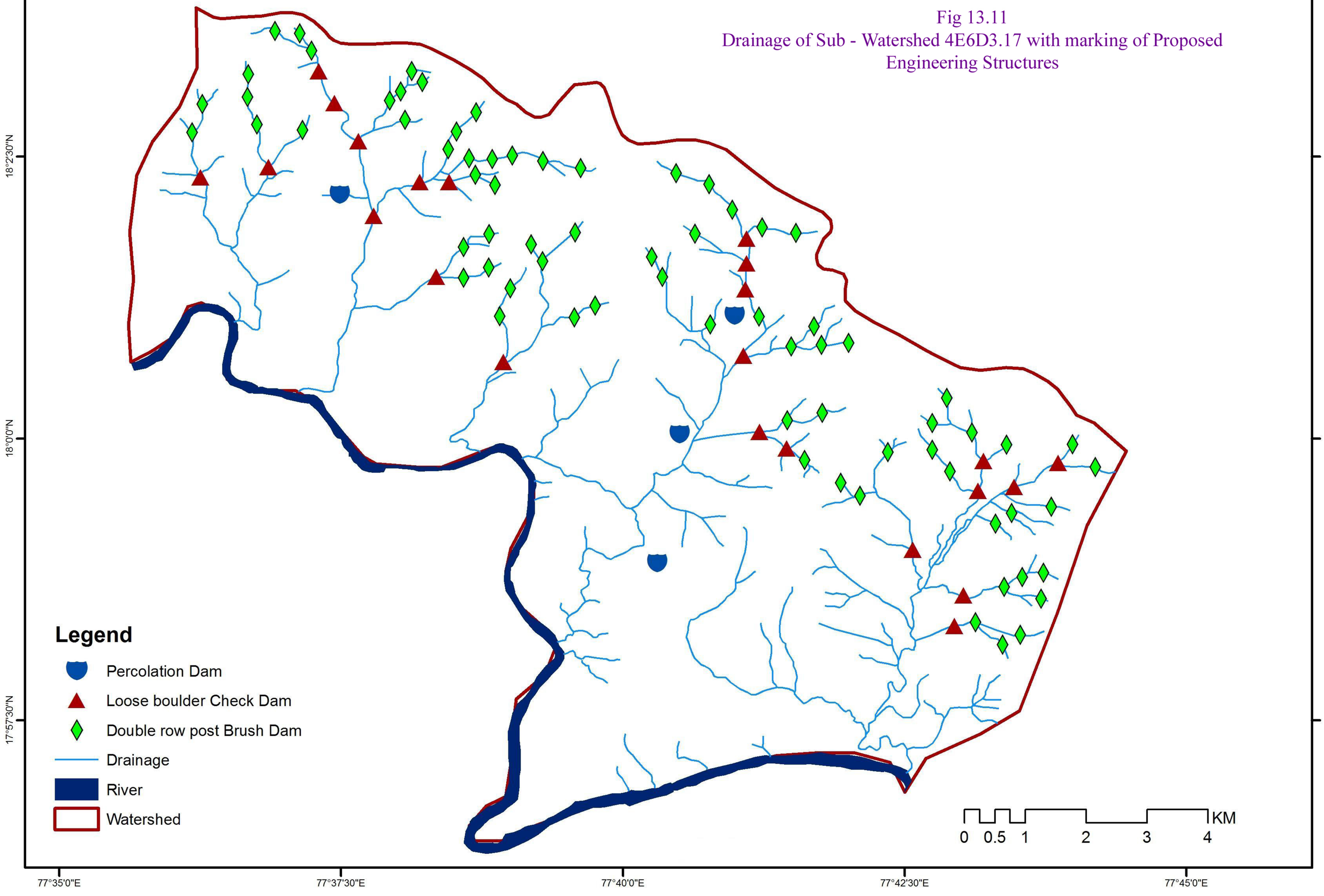


Fig 13.12
Drainage of Sub - Watershed 4E6D3.18 with marking of Engineering Structures

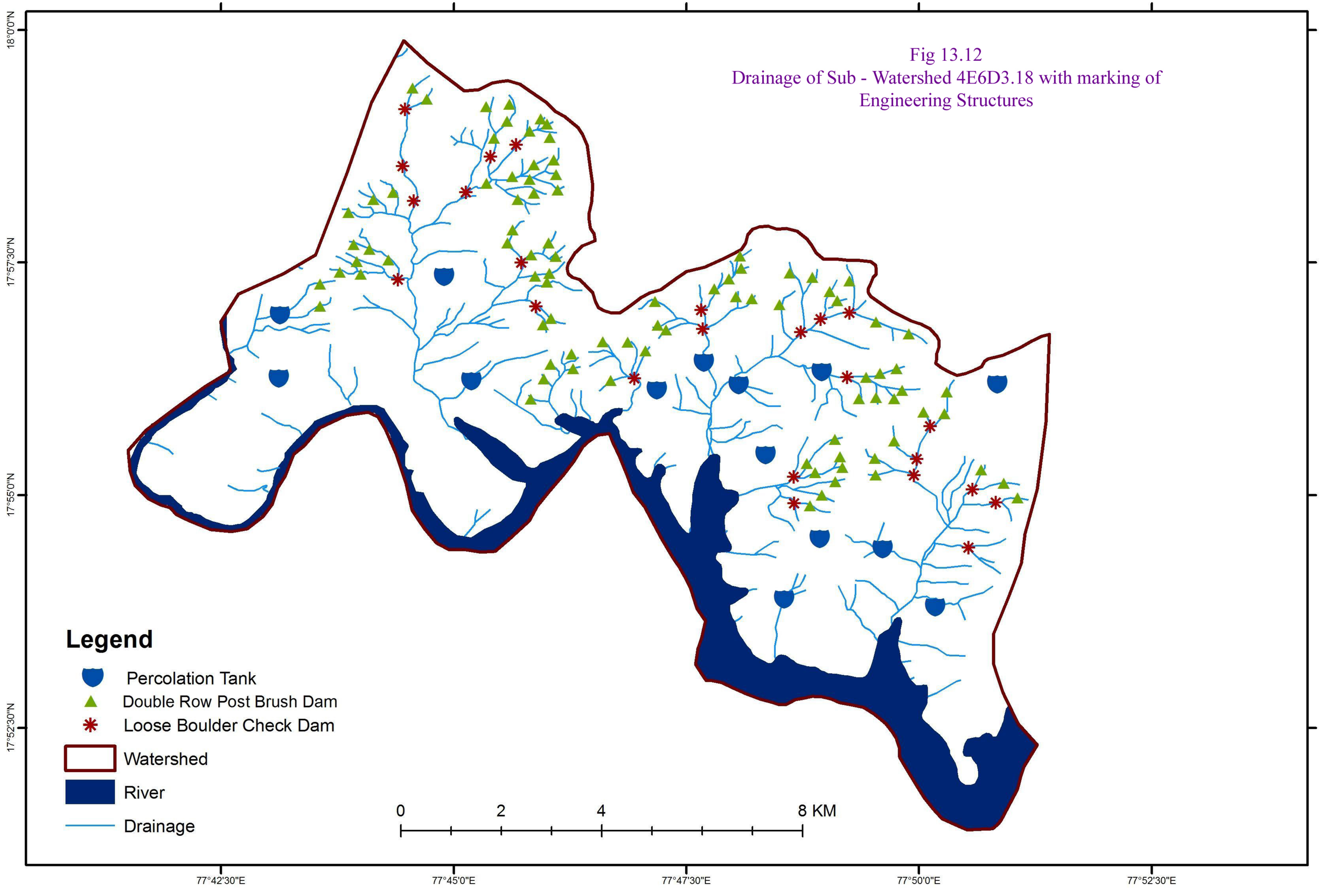


Fig 13.14:
Draingae of Sub - Watershed 4E6D4.24 with marking of Engineering Structures

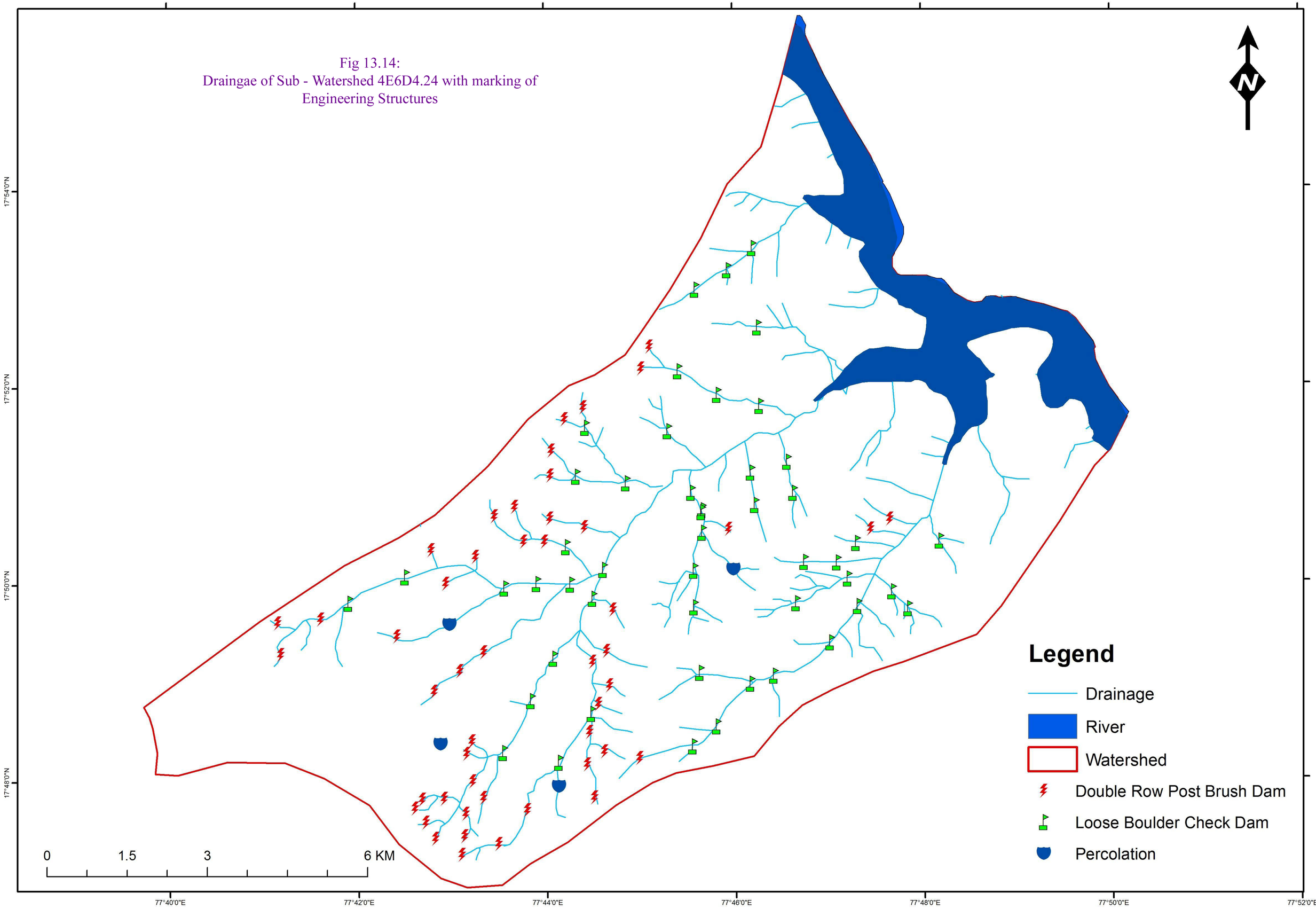
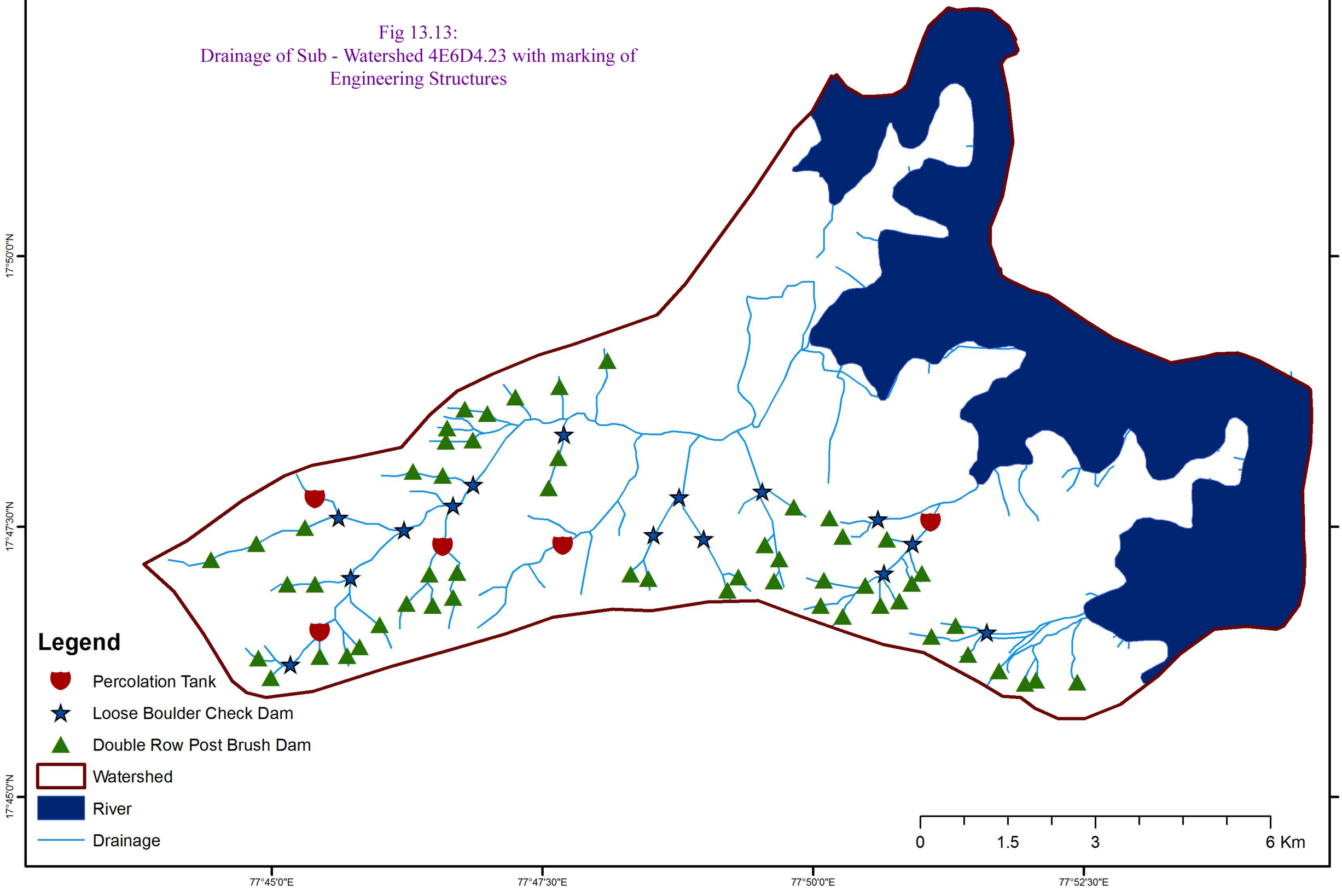


Fig 13.13:
Drainage of Sub - Watershed 4E6D4.23 with marking of Engineering Structures



Part – I

14

Conclusions and Recommendations

14

CONCLUSIONS AND RECOMMENDATIONS

Summary of Singur Project

14.01 The Singur project was constructed across the river Manjira, a right bank tributary of river Godavari near Singur village in Medak district with a storage capacity of 850 (M Cum) or 30TMC. The location of the dam is at about 90 km from Hyderabad and about 30 km from Sangareddy, the district headquarters of Medak.

14.02 The project was aimed at providing additional drinking water requirements to the twin cities of Hyderabad and Secundrabad at the rate of 4 TMC per year. The other objectives of the project was to 1) Regulate releases to downstream irrigation systems (viz) Ghanpur and Nizamsagar anicuts, 2) Arresting silt transportation to Nizamsagar project, 3) Generate 15 MW (Units of 7.50 MW each) of power and 4) Irrigate a command area of 16000 hectares in Medak dist.

14.03 The project components

1. Construction of 3993 meters of earth dam on the left flank and 3110 meters on the right flank in the TBL at 52785 meters
2. Construction of ogee spillway in the gap portion of river for a length of 327 meters
3. Construction of 17 radial crest gates of 15 m x 13 meters
4. Construction of 2 head regulators on the left and right flanks
5. Construction of 12 km of irrigation channel on right main canal and 48 kms of irrigation channel on left main canal

14.04 The formation of the reservoir submerged an area of 16540 ha of which 15632 ha was in Andhra Pradesh and balance of 908 ha in Karnataka. The total water spread area is 523.6 meters submerging 69 villages in Andhra Pradesh and 17 villages in Karnataka. The total number of structures submerged due to the project was 7672 including the 569 structures falling in the area between FRL and MWL of the Reservoir and 100 meters from FRL.

14.05 The total cost of the project as budgeted till 2008 was ` 231.83 crores including land acquisition and civil works. The total expenditure till 2008 was ` 220.28 crores of which the expenditure on civil works was ` 98.80 crores and on land acquisition was ` 122.48 crores.

III Effects on Rehabilitation

14.07 It is observed that the size of the land holding is reduced after displacement. Most of the farmers (80%) had become either marginal farmers are landless agricultural laboures due to inability to acquire same size of land holding lost in submergence. The consequential burden had the impact on the income levels resulting in deterioration in standard of living. The drainage systems in rehabilitated villages are logged leading to mosquito menace. There is no provision of individual soak pits or common toilet provisions due to which open defecation is resorted to by the residents chronic health problems are observed due to low sanitation. Internal roads are not laid. In 14 centers on the left flank in particular drinking water is not available from the project reservoir. The people are consuming contaminated water due to poor operation and maintenance problems of the created structures. Required efforts are not put in building the livelihoods in PAF villages.

Recommendations

Drinking Water:

14.08 In view of the acute deficiency of pure drinking water especially in 14 centers on left flank, a separate system by lifting water from the adjoining reservoir directly be provided to these centers under PWS scheme. The operation and maintenance may be entrusted to the respective panchayats.

Sanitation:

14.09 Individual soak pits be provided for all the houses in the rehabilitated centers and the scheme may be implemented through an experienced and committed NGO's in all the centers.

Drainage systems:

14.10 Whenever necessary the drainage canals be expanded and the clogging of drains is removed by regular maintenance. The job may be entrusted to the respective panchayats.

Livelihoods:

14.11 Sustainable livelihoods need to be identified in all the rehabilitated centers and training for enhancement of skills is given akin to Livelihood Enhancement Action Plan (LEAP) through an identified and experienced NGO in order to provide income generating economic activities.

Maintenance of structures:

14.12 The common structures created like schools, community halls need to be inspected and structural leakages be repaired and brought to normal livable conditions.

Payment of Compensation & End Use

14.13 The study revealed that the part payments of compensation in installments resulted in acquisition of unproductive assets or squandering of money received for unproductive expenditures by the people. Most of them could not purchase land, a long term asset.

Recommendation

14.14 The compensation in future be paid in lumpsum and at a time which would be useful to purchase a productive and long lasting asset.

IV Socio-Economic Impacts

14.15 The submergence of the villages in the affected mandals and consequent displacement of persons brought changes in the socio-economic conditions of the people. The socio-economic study was conducted from three angles. The three angles consist of published data with pre and post comparisons, field survey of sample households and PRA through Focus Group Discussions. The impacts were studied from the authentic and published data. Secondly the impact was also tapped through primary survey of sample households of both fully affected and partially affected villages separately.

14.16 It is seen from the secondary data that incase of project affected mandals the increase in primary schools is low as compared to upper primary and high schools. There is also significant increase in number of teachers in all categories of schools and Nyalkal mandal has the highest increase. As far as adult education programs are concerned there was a shift to continuing literacy programs and new literacy centers were opened in the project affected mandals. The literacy rate in all project mandals had increased significantly with female literacy rate dominating the male literacy rate. Even when compared to non-project mandals, the project mandals registered higher literacy rate of 23.12 per cent. Total workers had increased and there is decline in farmers. Noticeable increase in female cultivators is also seen. As far as financial institutions are concerned the number of commercial banks in project mandals decreased. The HDI had improved due to higher literacy rate and lower mortality rates.

14.17 The field survey results indicated that in fully affected villages the total population has remained more or less same whereas the sex ratio has increased from 836 to 886 as far as female for 1000 males is considered. In partially affected villages similar situation with regard to total population is obtained. However, the sex ratio that is female to male has tremendously increased. The occupation details of fully affected villages indicated that 59 per cent are cultivators followed by agricultural labourers. The increase in literacy rate in fully affected villages is seen as 25 per cent and that of partially affected villages stood at 13 per cent increase from pre-project situation. The Katcha houses are reduced by 9 per cent and increase of 31 per cent in semi-pucca houses is observed. The household asset in post project situation in fully affected villages has

shown phenomenal positive increase in television and mobiles and two-wheelers. However, in both fully affected villages and partially affected villages though the absolute income levels had increased due to time gap of two decades, the real incomes have not gone up resulting in lack of surplus in the hands of the affected persons due to higher expenditure patterns and increased level of indebtedness.

Recommendations

14.18 Measures to improve income of the oustees need to be initiated by enhancing livelihood skills on LEAP Model.

V Effects on Agriculture (PA mandals)

14.19 The impact on agriculture in project affected mandal villages indicated that the farmers lost their fertile land and post project land holding is also reduced substantially. The productivity of crops is also reduced due to poor soil conditions in the newly acquired lands. Bore wells were dug by the farmers up to a depth of 150-200 ft. However, the irrigation efficiency is not satisfactory on the left flank either due to low yield of water or due to limited availability of power. As far as livestock are concerned strength of cows is reduced and buffaloes population is increased. The project affected villages have not been covered with any special agricultural or special animal husbandry.

Recommendations:

14.20 Soil testing arrangements be made in the fields of all the project affected farmers.

14.21 After completion of soil testing and analyzing the causes for low fertility, measures for improving the fertility be initiated though deficiency replenishment measures and high yielding technology.

14.22 The villages on the left flank are devoid of sufficient irrigation water due to inefficient bore wells. A scheme for lift irrigation be conceived which can lift water from the adjoining reservoir and supply the same through well laid field channels. This would motivate the farmers to take up commercial crops and enhance their living standards.

14.23 Special agricultural programmes like distribution of pure and treated seeds, introduction of organic farming may be thought of to preserve the soil fertility and improved crop productivity.

14.24 Special farm development schemes may be introduced for soil and water conservation in the project affected mandals villages. Field channels be laid at a cost of about Rs. 2500 per ha.

14.25 Breed improvement schemes for dairy and sheep may be taken up under livelihood Enhancement schemes through an experienced NGO under the overall supervision of animal husbandry department.

VI Summary of Impact on Ground Water and Drainage

Groundwater

14.26 The chapter focuses on assessment of quantity and quality of surface water of Majira River as well as of ground water in bore wells recharged due to project. The soils in the command area fall under heavy textured having clay content of 20-30 per cent as in category- II and category – III. The irrigation water having EC less than 2000 micro mhos/cm would be quite suitable for growing all types of crops. The analysis of surface water in the Manjira basin indicated suitability for irrigation purpose. Likewise the analysis of groundwater in the surrounding bore wells also revealed that it is suitable for both irrigation and drinking water purposes. It is also observed that no contamination of groundwater or surface water due to use of pesticides, manures is observed and hence, no preventive steps are found necessary.

14.27 The water level in the shallow aquifer got depleted due to increase of bore wells and less recharge to this aquifer. However, the yield in bore wells did not deplete in view of recharge of deeper aquifer due to the Singur Reservoir. Further, though the water level below ground level in the bore wells had gone down due to impermeability of water through impervious hard rock in the top layer aquifers, the total water discharge capacity of bore wells is satisfactory. The entire six project affected mandals are in safe zone and gives scope for conjunctive use of water to lead to greater irrigation efficiency. The proposed out lay for conjunctive use of groundwater under modified EMP is ` 450 lakh (i.e.,) 1500 tube wells @ ` 30000/- per tube well.

14.28 Since, the Project is located in scanty rainfall area there is an inevitable necessity for effective and efficient usage of available surface and groundwater for irrigating the crops in the command area. The crop planning in the command area also need to be taken up by scientific assessment of water requirements of the proposed crops and match it with the available water resources in such away that optimum water is used for getting maximum output from unit area of land in the command area. Keeping in view the above requirements the following recommendations / suggestions are made.

14.29 Suggestions / Recommendations

1. Since number of bore wells is existing in the command area at present conjunctive use of water is recommended for crop planning. This type of crop planning would lead to expansion of command area from the proposed level of 16000 ha to about 20000 ha under extensive cultivation methods. Alternatively under intensive cultivation practices the crop rotation can be improved with positive effects on cropping intensity in the command area. Efficient use of irrigation water is possible by adopting conjunctive usage of water available from the project and the recharged bore wells.

2. The groundwater resources from the bore wells must be effectively used to supplement the surface water from the project through proper conjunctive use.

3. Advanced methods of pressure irrigation systems like drip and sprinkler systems need to be introduced in the area depending upon their suitability to the proposed crops.

4. Crops like Black gram, Green grams and Cotton may be given irrigations through Drip irrigation method.

5. Pressure irrigation systems may be also tried on crops like sugarcane and banana as it is proved that such systems are successfully used elsewhere with positive results.

6. At tail end of the command area where the surface water flow may be scarce during scanty rainfall years, vegetable crops and groundnut may be grown on sprinkler method of irrigation to conserve water and soil on these soils.

7. The farmers in the command area, if not already exposed to participatory water use systems, may be enrolled as members of water users association and be involved in the decision making process in crop planning in command area.

Drainage

14.30 It is observed that most of the proposed command area of Singur project is level or gently sloping. The flow of water may not be that rapid under sub-soil conditions and therefore became susceptible to water logging. However, as the soils are mostly sandy loamy, they will allow the stagnated water to percolate deep in to the soil. In some parts of command area the ground water level during post monsoon is observed to be less than 1.5 mgbl and irrigating these lands would lead to water logging necessitating drainage improvement and on-farm development measures. The cost of providing field drainages in the water logged areas of 8300 hectares is worked out to ` 290.50 lakh. In regard to on-farm development works (OFD) alternative provision of about ` 2500 per hectare may need to be put in place.

Recommendations

14.31 Proper drainage outlets to the fields will be provided to-ward off water logging conditions wherever necessary.

VII Impact on Archeological Monuments

14.32 The artifacts and sculptures recovered are not kept under a shelter as suggested by the MoEF. During shifting of these sculptures the structures were partially damaged and due to improper supervision same structures are lying under a tree and some of them were lifted by locals and kept in newly constructed temples

Recommendations

14.33 Efforts be now atleast made by the Department to salvage the lost and misplaced idols and structures and restore them all under a protected roof. Damaged structures may be got repaired and restored to original shape for future use.

VIII Impact on Forests, Flora and Fauna

14.34 This study evaluated the status of flora and fauna of the catchment and command areas of Singur project with specific reference to rare or endangered endemic or threatened species and any changes brought about if any due to the project. Flora and fauna studies were carried out during pre-monsoon period to assess the list of terrestrial plan and animal species that occur in core area. It is observed that there are no thick forests in the catchment or command area. There is very little qualitative change in the flora and fauna of the Manjira catchment but perceptible. Quantitative changes seem to have taken place on account of population explosion, urbanization and industrialization on account of severe biotic pressure same invasive species such as the *Prosopis*, *Joliflora*, *Parthenium*, *Iparmea Carnea* have became more abundant in most of the catchment area. Waste lands and open grazing lands were covered mainly by non-palatable animal and perennial weeds.

14.35 The study brought out similarity between the catchment area and command area. More than 81.6 per cent species were common to both the areas. There are no thick forests or wildlife sanctuaries in the vicinity of the project. Grasses and sledges found in the command area are similar to that of catchment area mostly in respect of floristic composition also.

14.36 There are no marine habitats in the area. However, fishing activity is seen in abundance with large presence of fish even weighing 8 kg. It is therefore, concluded that the reservoir has not contributed to any undesirable changes in flora and fauna.

VII Impact on Public Health & Drinking Water

14.37 The Chapter on the impact on public health and drinking water focused on analysis of health and sanitary conditions in the rehabilitation centers as compared to the situation in pre-project period. The study covered the infrastructure facilities for health and incidence of important diseases in pre and post project situation.

14.38 It is observed that government hospitals got reduced by 9 per cent but primary health centers showed an increase of 35 per cent. However, there was decline in doctors and number of beds. The incidence of diseases like Malaria, TB, Cholera and Typhoid which were prevalent during pre project also prevailed in post project but on a minor scale. The number of persons immunized had gone up in the post project period in respect of DPT, BCG and Measles. Sterilization programs have also significantly increased. However, Tubectomies are more than vasectomies. The field survey results indicated that the water borne diseases such as Malaria, Jaundice and Fluorosis have increased by 16, 12 and 2 per cent respectively. The vector-born diseases have also been brought under

control. The number of persons immunized had gone-up in the post project period. The use of condoms had increased, Tubectomies have increased more than vasectomies showing a three fold increase. The sanitary condition in the villages is however, not satisfactory with open and overflowing drains creating stagnated water pools and a cause for vector-born diseases.

Recommendations

14.39 The existing drains be deepened and indened to improve the sanitary conditions wherever required.

14.40 The PHC's be provided with regular doctors and required medicines to conduct regular health check-ups and treatment for visiting patients.

14.41 The drinking water in the project affected villages may be provided by direct pumping form the adjoining reservoir as already recommended else where

X Changes in Land use Pattern

The Land use pattern changes in Catchment Area are studied with the help of satellite images obtained through RS & GIS technology for 1989 to 2008. Exclusively the Catchment Area is only studied after grouping the land into 5 main categories namely

Changes in Land use Pattern (Area Sq Km)				
Sl. No	**Category**	**1989**	**2008**	**% Increased / Decreased**
1	Crop land	3718.12	3726.54	+0.23%
2	Forest Land	36.12	29.73	-17.69%
3	Water bodies	185.00	191.96	+3.76%
4	Builtup area	48.02	50.49	+5.14%
5	Waste lands	251.99	240.53	-4.55%

The study brought out following observations. The increase in crop land between the above two years is observed to be 8.42 sq km. However as first impounding of water took the place in the year 1989 the crop land submerged is assessed to be 84.25 sq km and after adjustment of this area the net reduction in crop land is assessed to be 75.83 sq km. the double crop land is reduced by 20.35%. Where as the current fallows increased by 108.60% due to comparatively less rain fall during the period under comparison. The area under forest land got reduced by 6.3 sq km due to encroachment. The number of water bodies increased by 91.93% due to increase in Reservoir and tanks. This increase in river and streams is due to change in the Manjira river course. Wastelands registered a decrease of 11.66 sq km (4.60%) because marginal lands are used for cultivation purpose. The built-up land had increased as the submerged built-up land was again reconstructed as water lands and crop lands.

1989

1) Crop land Assessed during 1989 : 3718.12 Sq Km.
Add Crop land submerged during 1st impounding of water : 84.25 Sq Km

Actual crop land to be taken for comparison : 3802.37 Sq Km

2008

Crop land during 2008	:	3726.54 Sq Km
Change in Crop land	:	75.83 Sq Km
% Change	:	1.99%

The percentage change is therefore 1.99 per cent and not 0.23 per cent as given in the table since the land submerged during 1989 was not added to the assessed crop land.

XI Summary of Status of Command Area

14.42 The Government of Andhra Pradesh accorded permission vide G.O.MS.No 455 to utilize 56.6 Mcm (2TMC) of Singur project water for irrigating 16000 hectares of command area in Kharif season. Accordingly administrative and technical sanctions were given vide GOMS No. 136 in the year 2005 for command area development works which included excavation of left canal for a length of 48 kms and right canal for a length of 12 km. The work was awarded to M/s. Mahalaxmi Construction Corporation Limited, Pune in the year 2006. The work in regard to distributaries of left and right canal was completed and the distributaries work for main branch canal is in progress. The work has been slow due to land acquisition process which still remains pending for 135.74 acres out of proposed 1312.74 acres of land. In view of this the benefits from the project have not trickled down to command area. Hence, presently the status of command area as obtained through primary and secondary data is presented.

14.43 The male and female sex ratio stand at 1000:967 for all mandals put together. The percentage of population of SC's to total rural population (Sl. No 3 & 4 of Annexure XI.2) is 25.26 % and that of STs to total rural population is 5.18%. The density of population stands between 181 and 581 per square kilometer. There is significant improvement in schools, teachers and student turnover compared to pre-project period. The literacy rate has gone up for all project affected mandals and stand at 49.5 per cent of total population on an average. The total irrigation area of all mandals stands at 16800 ha in Kharif and 14095 ha in Rabi. Tube wells are the main sources of irrigation in the command area. The major crops grown are paddy, Red gram, maize, green gram and sugarcane and the productivity levels are more or less near to district averages. As far as livestock is concerned sheep population is more followed by cattle and buffaloes. There are 14 primary agricultural cooperative societies. The industrial scenario comprises of 126 factories engaging 10811 workers, 25 rice mills and 18 small scale industries. The infrastructure facilities like existence of partial communication network, medical facilities; veterinary services, and Banking facilities are satisfactory. However, the road connectivity is provided so far to 91 per cent of villages and there are still 9 per cent of villages yet to be covered 27 per cent the villages are yet to be provided with public water supply system. The internal roads of the villages need lot of improvement.

14.44 The field survey was done in 11 villages with a study sample of 220 farmers. It is seen that more or less the observation made in the secondary data has corroborated nearly in respect of all the parameters.
However, since this is not an impact study of command area the observations can be taken as a benchmark to be used after full development an envisaged in the project taken place.

Command Area

14.45 The Singur Project is expected to provide 2 TMC of irrigation water to 16000 ha of command area spread over 7 mandals and about 54 villages. The work in regard to excavation of main canals and distributaries to command area is in progress. Therefore, the impact of the project on command area could not be assessed. However, the situation in command area is trapped through secondary sources of data and interaction with the respective departments.

14.46 It is observed that presently the command area fields are serviced by borewells as the project water has not yet reached the fields.

Recommendations

14.47 Besides, the main canals and distributaries field channels be provided to the command area fields under the 50 per cent subsidized scheme at a cost of ` 2500 per / ha for the total area of about 16000 hectares. The total cost of providing field channels to the proposed command would workout to ` 400 lakh.

XII Status of EMP

14.48 Environmental Management Plan is the key to ensure a safe and clean environment in project affected area. For the projects sanctioned prior to 1978, there was no stipulation for preparation of EMP carrying out EIA for Water Resource Development Projects Costing more than 100 crores and Subsequent preparations of EMP has been made mandatory as per the EIA notifications 1994 of MoEF, GoI.

14.49 Singur Project was sanctioned prior to 1978 but the environmental clearance for the project was subjected to ensuring of four main parameters namely.

1. Avoiding of new settlement on the reservoir periphery.
2. Preservation of important archeological sites and structures.
3. Development of greenbelt along the periphery.
4. Conversion of land in catchment to foresting as far as possible. The study focused on evaluation of status of above parameters

14.50 It is observed that the new settlements were made on the uplands of the reservoir periphery which are 2 to 4 kms away from the water spread area. The new settlements were well planned with satisfactory layouts for roads & houses coupled with all amenities.

14.51 Some of the sculptures got damaged during transport to the temporary shed provided for keeping the monuments by the Department.
14.52 The Total area proposed for greenbelt is 4000 hectares. The Department of forests prepared a plan for 2650 hectares initially with an outlay of 302.35 lakh of which work in an area of 95 hectares could be completed as reported due to non – release of funds. Further a revised plan for 3905 hectares was prepared in 2001 with an out lay of 615.6 lakh and waiting for approval and release of funds.

14.53 The conversion of land in catchment area in to forest has been under progress. The forest Department has shown progress in 378 hectares so far out of total catchment area of 13961 hectares.

Conclusions and Recommendations

XIII Catchment Area:

14.55 The catchment area is spread in 3 states namely, Andhra Pradesh, Karnataka and Maharashtra. The total catchment area is 1609.68 thousand hectares. During the study it is observed that the intercepted catchment area is reduced due to construction of projects upstream.

Recommendations

14.56 An Integrated plan for Catchment Area Treatment is formulated and enclosed which may be implemented

Implementation of Catchment Area

14.57 The catchment area plan for Singur project was not prepared earlier. However, the Environmental Appraisal Committee of MoEF prescribed safeguards during the construction of the project which include creation of green belt along the periphery of the reservoir to arrest siltation and convention of catchment area land in to forest land to the extent possible.

14.58 The catchment area is located in 5 districts in Maharashtra and area district each in Karnataka and Andhra Pradesh the catchment is predominantly and agricultural area and the total catchment spreads to 16097 hectares of which 85 per cent is the area under cultivation followed by 3.980 under wasteland, 3.96 per cent under grazing land and the rest under others.

14.59 The progress of bio-engineering and civil works so far done revealed that about 15.2 per cent area under catchment was determined under priority categories of very high classes. Good vegetation cover was developed in the Maharashtra area and Karnataka through active afforestation measures. Hence, presently it is proposed to consider

afforestation and soil conservation measures in the directly draining catchment area falling in Andhra Pradesh largely and to same extent in Karnataka. A detailed catchment area plan is now prepared using Silt Yield Index (SYI) method and presented in chapter 13 for the identified sub-watersheds the plan consists of afforestation in 3990 hectares, staggered trenches in 2110 hectares, greenbelt development in 60 hectares and Treatment of agricultural land in 7000 hectares. The total cost of the CAT plan is estimated at 16991.4 lakh.

Recommendations

14.60 The CAT plan suggested may be implemented for ensuring environmental protection.