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Royal Netherlands Embassy
New Delhi

ENVIRONMENTAL IMPACT ASSESSMENT

Andhra Pradesh
Surface Water
Lift Irrigation Schemes

APLIFT PROJECT

Agriculture and Rural Development Area
Administrative Staff College of India
Bella Vista, Hyderabad - 500 049
INDIA

April 1994

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Acknowledgements

We had discussions with and benefitted from the advice of many subject matter experts and several officers of the State and Central Governments. Notably, the following are remembered for the help, support and guidance provided by them in conducting the study:

- T. Sai prasad, Executive Engineer, APSIDC, Mahboobnagar
- S. Subash Babu, Deputy Executive Engineer APSIDC, Chirala
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- P.G. Sastry, Director General, WALAMTARI, Hyderabad.

We owe a debt of gratitude to the resident-farmers of Mahboobnagar and Prakasam districts for their co-operation in providing us information.

24 April 1994

(S. SATISH)
Project Leader

ACRONYMS

ADB	:	Asian Development Bank
APLIFT	:	Andhra Pradesh Surface Water Lift Irrigation Schemes
APSIDC	:	Andhra Pradesh State Irrigation Development Corporation
APSRAC	:	Andhra Pradesh State Remote Sensing Application Centre
ASCI	:	Administrative Staff College of India
APWELL	:	Andhra Pradesh Ground water Borewell Irrigation Schemes
CEC	:	Cation Exchange Capacity
CGWB	:	Central Ground Water Board
DFL	:	Netherlands Guilders
DGIS	:	Directorate General for International Co-operation
EC	:	Electrical Conductivity
EIA	:	Environmental Impact Assessment
EIS	:	Environmental Impact Statement
ESCAP	:	Economic and Social Commission for Asia and Pacific
ESP	:	Exchageable Sodium Percentage
FYP	:	Five Year Plan
GEC	:	Ground Water Estimation Committee
GOAP	:	Government of Andhra Pradesh
GOI	:	Government of India
GON	:	Government of Netherlands
Ha	:	Hectare
HC	:	Hydrological Clearance
ICRISAT	:	International Crop Research Institute for Semi Arid Tropics
ID	:	Irrigated Dry
IEE	:	Initial Environmental Examination
IGPH	:	Indian Gallons per Hour
IRDAS	:	Institute for Resource Development and Social Managament
ITK	:	Indigenous Technical Knowledge
MCM	:	Million Cubic Metres
MYRADA	:	Mysore Rehabilitation and Development Agency
NEERI	:	National Environmental Engineering Research Institute
NGOs	:	Non Governmental Organisations
PMU	:	Project Management Unit
RSPM	:	Respirable Suspended Particulate Matter
SAR	:	Sodium Adsorption Ratio
SC	:	Scheduled Castes
SPM	:	Suspended Particulate Matter
ST	:	Scheduled Tribes
TDS	:	Total Dissolved Solids
TOR	:	Terms of Reference
TSS	:	Total Suspended Solids
USA	:	United States of America
WALAMTARI	:	Water and Land Management Training and Research Institute
WHO	:	World Health Organisation

GLOSSARY

AYACUT	:	Irrigated area commanded by a project
BAJRA	:	Pennisetum typhoides, known as pearl millet, is the poor man's crop
CASTOR	:	Ricinus Communis , a non-edible oil seed crop
GRAM	:	Pulse crop. Green gram, Black gram, Cowpea, Horsegram, Dolichos, Lenten, Lathyrus, Beans, and Peas are the major pulses. Pulses meet the requirement of dietary protein
JOWAR	:	Sorghum bicolor, an important food crop after rice in Andhra Pradesh
KHARIF	:	A crop season (June to October months)
KORRA	:	Foxtail or Italian millet, staple food of the poor in the tribal and hilly areas
RABI	:	A crop season (November to February months)
RAGI	:	Elusine Coracana, known as finger millet, is the poor man's food crop
DISTRICT/TALUQ/ MANDAL/VILLAGE	:	Level of administrative boundaries within a State, village being the lowest
LAKH	:	100,000
CRORE	:	1,00,00,000
DUTY	:	Area irrigated by 1 Cusec (0.028 m^3/second) water
IRRIGATED DRY	:	Crops which do not require water continuously. Irrigation is provided intermittently
EXCHANGE RATES	:	(March, 1994)

1 US$	=	Rs. 31.00
100 Rs	=	US$ 3.23
1 US$	=	Dfl. 1.90
1 Dfl	=	Rs. 16.32

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CHAPTER - 1

INTRODUCTION

1.1 Background and objectives

Development and environmental issues are interrelated and any degradation of the environment will limit development. On the other hand, development may result in serious adverse effects, such as soil degradation, aquifer depletion and eco-system destruction. These adverse impacts can and do undermine the objectives of development. Adverse environmental impacts have three potential costs to the present and future human welfare:

-human and animal health may be harmed as a result of degradation of the environmental quality, notably the quality of surface and ground water and the air quality;

-economic productivity may be reduced as a result of inappropriate natural resource management; and

-amenity values may be lost due to inappropriate land-use practices.

Development should include protecting the environment. In the absence of adequate protection, as stated, development suffers. In turn, the society will be short of resources, and the environmental problems aggravate. It will be clear that environmental management, the difficult task to balance the needs of society with the limits set by the environment to ensure development on a sustainable basis, becomes more and more important and should be addressed in any project, plan or policy.

This was also recognised by the Directorate General for International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs, who, in the policy document "A World of Difference" (DGIS, 1990), defined sustainable development as one of its main policy objectives. The preservation of the "ecoscope" by means of protection, conservation and improved management of nature and the natural resources is considered very important and Environmental Impact Assessment (EIA) of plans and programmes is thought to be one of the ways to meet this objective. The other priority objectives in the Netherlands development cooperation policy are poverty alleviation and autonomy to woman.

In the DGIS publication "Environmental Impact Assessment in Development Cooperation" (DGIS, 1993) the environment is defined as the living and non living surroundings of organisms, including humankind. As such, constituents of the environment are not only for instance climate, the soil, the vegetation, the fauna and their interrelationships, but also the people's socio-cultural ways. An important concept in this respect is also the concept of the "ecoscope", as discussed in "A world of difference". According to this document the ecoscope includes all economic functions of the environment. In a certain stage of its evolution, an ecosystem can provide a limited amount of resources and also can absorb a limited amount of polluting substances, without degradation. Over-exploitation of the resources does not only affect the productive capacity of the environment but also its regulation and information function. Every use of non-renewable resources, over-exploitation of renewable resources and pollution reduces the ecoscope. Sustainable use of the resources means that the essential processes in the ecosystem are not disturbed and that the ecoscope is maintained while mitigating measures and alternatives are taken into account to prevent, correct or compensate damage. EIA as a process to provide information on the environmental effects of proposed activities, projects and programmes, is a very useful tool in environmental planning and decision making and may help to avoid a reduction in the ecoscope. EIA is concerned with identifying, predicting and evaluating the foreseeable environmental effects, both beneficial and adverse, of public and private (development) activities and with the generation of alternatives and mitigating measures, aiming at eliminating or minimizing the negative and optimizing the positive impacts. In the following chapter the general procedure for Environmental Impact Assessment, as also followed in this study, is described.

According to the Netherlands policy for Development Cooperation, EIA has to be an integrated part of the project cycle of any development cooperation activity. The first step is the initial assessment of environmental impacts as part of the so-called 'D-screening,' in which possible implications of a project idea or proposal for poverty, woman in development and environment are looked into. It is also assessed whether or not the project will be carried out in an area which is vulnerable from an environmental point of view.

The next step in the procedure after the initial screening is the scoping, which concerns the determination of the most significant potential environmental impacts associated with the project and the identification of possible alternatives which would enable the project to be implemented in the most environmentally sound manner. Scoping is carried out by

experts and policy makers together in a meeting between donor agency, government officials and environmental experts, preferably during the preparation phase of the project. Scoping results in project specific guidelines for the EIA to be included in the TOR for the feasibility study. In the project cycle this results in an Environmental Impact Statement (EIS) to be drafted during the formulation stage. The EIS is defined as a report in which the effects of certain project, plan or policies on the physical, natural and social environment are presented, as well as an analysis of possible alternatives to avoid, limit or mitigate these negative environmental impacts. The EIS may contain detailed proposals for mitigating measures that are translated into concrete activities to be included in the project document, which forms the basis for the implementation of the project or programme.

According to the Indian legislation, minor irrigation projects do not require an Environmental Impact Assessment. For more details on the Indian legislation concerning the environment, reference is made to Annex 1.1.

The Andhra Pradesh Surface Water Lift Irrigation Project (APLIFT), for which this EIS has been prepared, has gone through a very long preparation period. Already in 1987 a first fact finding mission visited Andhra Pradesh. The DGIS policy objective of sustainable development, on the other hand, is of a recent date and is actually still in a stage of further development of the instruments for operationalisation. As a result, the above sketched procedure for inclusion of EIA in the project cycle was not completely followed in the APLIFT project. The EIA came in a fairly advanced stage of the project cycle: the project was already determined on the basis of its engineering, technical and economical feasibility. As such, alternatives to the project were left out of the scope of the study and efforts concentrated on identifying mitigating measures which can be incorporated in the implementation phase of the project.

The EIA study was carried out in the period November 1993- March 1994 by the Agricultural and Rural Development Area of the Administrative Staff College of India (ASCI) in Hyderabad. Subcontracts for the gathering of the baseline data were awarded to the Andhra Pradesh State Remote Sensing Application Centre (APSRAC) and VIMTA Labs Ltd., both located in Hyderabad as well. DELFT HYDRAULICS of the Netherlands supported and advised ASCI in defining, starting up and planning of the Environmental Impact Statement as well as in the methodology development.

1.2 Brief description of the APLIFT project

1.2.1 History of the project

As already mentioned in paragraph 1.1 the APLIFT project has already a long history. In 1987 the Government of India (GOI) submitted a proposal to the Government of the Netherlands (GON) for funding of a number of minor irrigation projects in Andhra Pradesh. A Netherlands fact finding mission expressed its preference for ground water irrigation through bore wells.

A revised project proposal was appraised by an Indo-Netherlands mission in 1990. The mission recommended that the mission report should pay explicit attention to the agro-economic and socio-economic aspects of the project as well as to irrigated agriculture extension, environmental impacts and the project's impact on woman. Comments of the GOI and the Government of Andhra Pradesh (GOAP) on the appraisal report were incorporated in a new proposal, which was submitted to the GON in 1991. In March 1992 a formulation mission fielded by GON prepared a project document for consideration by GOI and GON.

At the same time a proposal for a "Surface Water Lift Irrigation Schemes" project was prepared by the Andhra Pradesh State Irrigation Development Corporation (APSIDC). Also in March 1992 this proposal was discussed by an Indo- Netherlands fact finding mission and GOAP and APSIDC. On the basis of the mission's recommendations APSIDC forwarded a revised project document in April 1992. In May 1992 an appraisal mission was fielded to assess this revised project proposal.

In November-December 1992 a Dutch mission was fielded with the task to formulate the Andhra Pradesh State Lift Irrigation Schemes project (APLIFT) and further specify the APWELL project document on organisational arrangements and privatisation of the bore wells. Besides, the mission had to screen both project documents on contradictory approach and conflicting activities and requirements, as well as create conditions for the incorporation of the results of the EIA in the implementation phase.

Although the APLIFT and APWELL projects are closely related to each other, in the sense that the projects are located in the same area, are implemented by the same organisation, follow a similar approach and have the same target group and external funding, this report deals only with the environmental impacts of the APLIFT project. The environmental impacts of the APWELL project are discussed in a separate report.

1.3 Approach

1.3.1 A general procedure for environmental impact assessment

An environmental impact assessment usually starts with the collection and analysis of basic data, both on the project and possible project alternatives and on the environment as far as it is likely to be affected. The collection and analysis of environmental data serves to provide a so called baseline or bench-mark information. In arriving at the baseline conditions, the environmental effects of autonomous developments are taken into account. By combining the information on baseline conditions and the project activities, the potential environmental impacts are identified. Usually not all potential impacts are studied in detail. For the scoping of impacts to be analyzed in detail, the following criteria are used such as:

-magnitude (the quantum of change);
-extent (the affected area); and
-significance (with respect to effects).

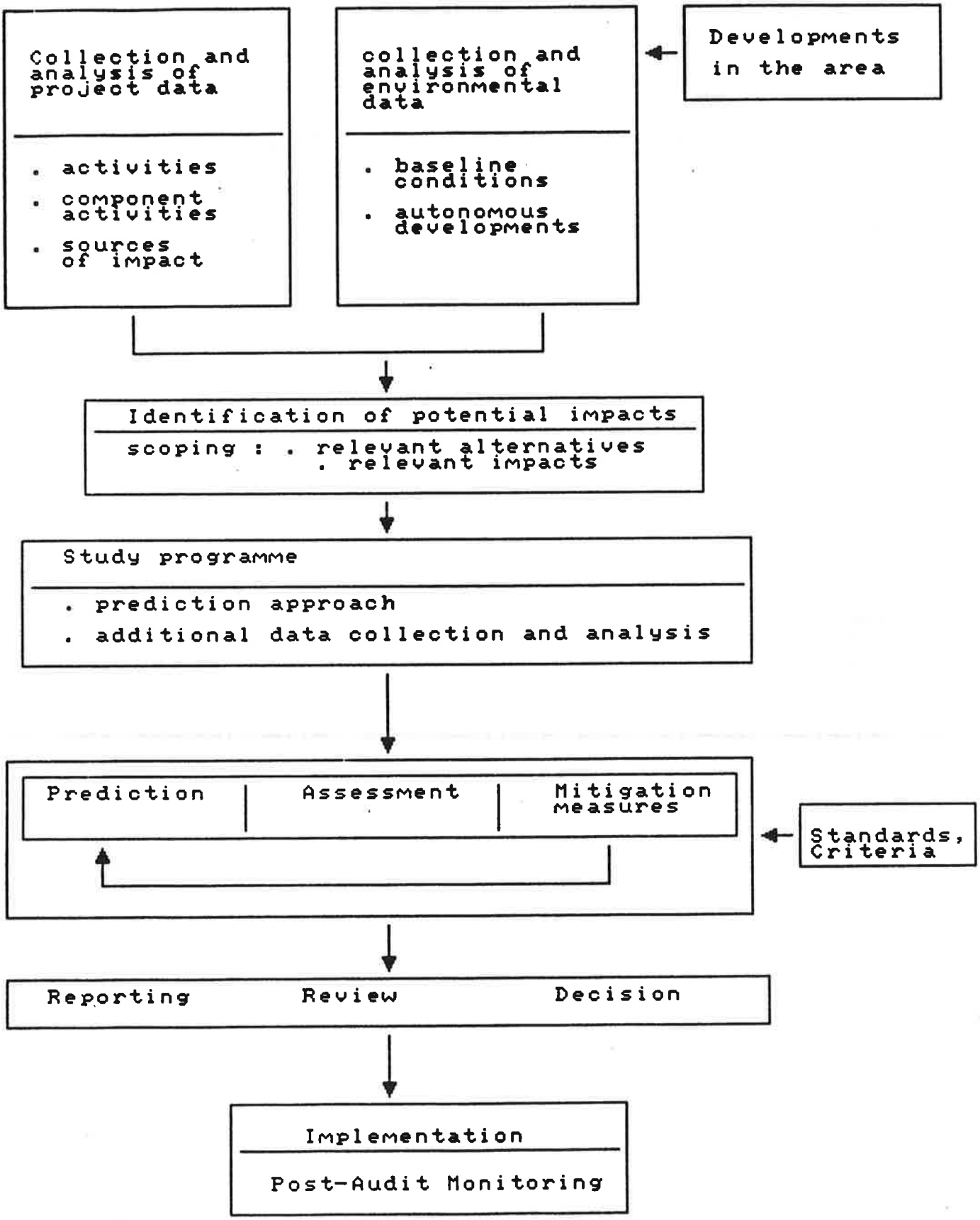
For the selected alternatives and impacts, an impact prediction and assessment is carried out, based on the available data and information. Measures to mitigate undesired, adverse impacts are defined, and a monitoring programme is developed. This monitoring programme, consisting of actual field measurements and studies carried out after the implementation of the project, provides data for the evaluation of the impact predictions.

The above given general outline of the environmental impact assessment (EIA) is illustrated in Figure 1.1, which shows the conceptual framework of EIA study. From this, the following objectives can be distinguished: To

-describe the project and the identified project alternatives, with special emphasis on (component) activities which are potential sources of impact. Commonly a distinction is made between activities carried out during the construction phase of the project and activities carried out during the operational phase. A description of the proposed project is usually available from the technical reports of a project;

-describe the physical, chemical, ecological and socio-economic environment and the natural resource use in the area directly affected by the project. This description is synthesized by field data, local knowledge and literature review;
-describe the autonomous developments in the area, in as far as these developments may be of importance for the

Fig 1.1 Conceptual Framework for an EIA Study



contents and the conclusions of the environmental impact study. Autonomous developments are human activities that presently take place and that will increase in intensity in the future, even without the project being executed. Most of these increased activities will be caused by the population growth and the expected growth in standard of living. Examples of autonomous developments are e.g. changes in water quality, increases in the use of High Yielding Varieties etc.;

-identify the environmental impacts which result directly from the execution of the project, but also those that may be expected as a result of developments which are induced by the project. Cause-effect networks (the relationships between project activities and impacts, as well as the interrelationships among impacts) are very useful in identifying environmental disturbances and impacts associated with a project. Environmental impacts can be categorized in several ways: e.g. positive versus negative, reversible versus irreversible, short-term versus long-term and a distinction can also be made between impacts occurring during the execution phase and those occurring after completion of the project;

-predict the environmental impacts of the proposed project by using expert judgements or computerized models or by comparison with analogous conditions;

-formulate mitigative measures for the identified adverse impacts. The applicability, effectiveness and costs and benefits of these mitigating measures are usually also described;

-assess the impacts of the project and project alternatives using the existing environmental quality, the autonomous developments and the effectiveness of the mitigating measures and national and international environmental standards and guidelines as a reference. From this assessment it should become clear which project alternative and which mitigative measures are preferable from an environmental point of view;and

-design a monitoring programme to check the impacts in reality and to be able to take remedial measures if impacts exceed anticipation.

Furthermore it is a common practice in EIA studies to give an overview of identified gaps in knowledge and information and to show how these gaps influence the decision-making process. Gaps in knowledge may be especially addressed in the monitoring programme. Identification of relationships between the project and existing plans and policies is also an important point. Equally important is to check whether existing

legislation is sufficient to provide regulations for the proper execution of the project activities and for controlling the developments which will take place as a result of the project.

1.3.2 Approach of the APLIFT Environmental Impact Assessment

The APLIFT Environmental Impact Assessment was basically carried out along the lines described above. Data on the project were derived from the APLIFT project Document (NEDWORG, 1993) and earlier Mission reports. Additional information was derived in discussions with officials of the Andhra Pradesh State Irrigation Development Corporation. The study being a pilot exercise in nature, concentrated on 2 Lift Irrigation Schemes - One located on the Krishna river, proposed to irrigate some 2,000 Ha spread across 5 villages in Nagnoor Mandal of Mahboobnagar District; and the other, on a drainage - Ogeru Vaagu - proposed to irrigate some 1,000 Ha spread across 3 villages in Parchur Mandal in Prakasam District.

The baseline information of the areas of the proposed lift irrigation development schemes was compiled by studying the relevant literature and by conducting a field survey and carrying out a air, soil and water sampling programme. The questionnaires used for this purpose, as well as an overview of the samples taken and the type of analysis carried out are presented in Annexures 1.2 through 1.4. Autonomous developments were thought to be of only marginal influence on the environmental parameters studied and were only treated in passing.

For the identification of the potential impacts a scoping workshop was organised at the beginning of the study. At this workshop representatives of the Andhra Pradesh State Irrigation Development Corporation (APSIDC, the implementing agency), the Andhra Pradesh Ground Water Department and various research institutes and NGOs active in the field of irrigation, agriculture and environment discussed the potential impacts of the project in small discipline oriented groups. The results of the group discussions were presented and discussed in more detail in plenary sessions. The outcome of the scoping workshop was a detailed list of potential impacts and environmental parameters to be measured, predicted and assessed. A checklist of environmental impacts of irrigation projects published by the Asian Development Bank (ADB, 1991) was used to complete the list.

Project alternatives, usually an important topic to be discussed in a scoping workshop received little attention because the project is already in a stage in

which real alternatives for the project can not be considered anymore. The more detailed project layout and execution, however, can still be adapted, according to the mitigating measures that will be proposed in this study to alleviate the possible negative impacts of the project.

For the prediction of the impacts a simple approach was followed: the environmental and socio-economical conditions in the area of the proposed project, the baseline conditions, were compared with the conditions in a nearby control area, in which ground water bore well irrigation had been established a number of years ago. It is assumed that changes in the proposed project area will be the same as the changes that took place in the control area. This assumption is of course only valid if the physical, chemical, biological and socio-economic conditions in the proposed project area are well comparable with those in the control area. This has been an important criterion in selecting the study areas. A review of the APSIDC's progress and functioning also gave insights into future prediction.

Besides comparison with already existing lift irrigation schemes, expert opinions and the literature reviews used to predict the impacts of the proposed project. For the assessment of the impacts an impact matrix has been constructed. This matrix is again based on the ADB checklists and distinguishes between impacts that are significant and non-significant, positive and negative, reversible and non-reversible and impacts that show immediately or that will only become apparent in the long run.

1.4 Organisation of the report

The report is organised following the general procedure for EIA as described in paragraph 1.3.1. as much as possible. The different components of the impact assessment are discussed in the consecutive chapters. In chapter 2 the proposed project is described in as much detail as presently available, in chapter 3 the physical, chemical, ecological and socio-economic setting of the overall APLIFT project are presented. In chapter 4 the base line conditions in the sites selected for this pilot EIA are discussed. This discussion concentrates on the socio-economic baseline data, the physical, chemical and ecological aspects receive attention in the chapters on impact assessment. Chapter 5 deals with the identification of environmental parameters that will be influenced by the project. The identified key environmental parameters are discussed separately in the chapters 6, 7, 8, 9, 10 and 11. In these six chapters, each of the parameters is described for the proposed and control sites and the impacts are assessed. The influence of missing and unreliable data

receives explicit attention. In chapter 12, while summarizing the impacts, both positive and negative, mitigating measures that can be taken to reduce the negative impacts are discussed. 'Monitoring' of the environmental aspects of the programme is not dealt with in the study, as per the directive from the sponsorers of the study, the Royal Netherlands Embassy, New Delhi.

To this main report, two more reports are appended. They are, one consisting of all the annexures to different chapters in the main report, and another prepared by the APSRAC.

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CHAPTER - 2

DESCRIPTION OF THE ANDHRA PRADESH SURFACE WATER LIFT IRRIGATION PROJECT (APLIFT)

2.1 Objective of the project

The APLIFT project aims at improving the living conditions of small and marginal farmers by increasing their agricultural production through the provision of surface water irrigation facilities. This is envisaged to be achieved by sustainable and environmentally sound intervention and in such a way that women farmers can become equal partners of male farmers in farm and other economic development related activities.

2.2 General description of the project

2.2.1 Main features

The Andhra Pradesh Surface Water Lift Irrigation (APLIFT) project comprises 107 lift irrigation schemes with a total command area of about 24,500 Ha benefiting about 75,000 poor people.

The sites for borewell development proposed by the project will be located in the following districts:

1) Kurnool
2) Mahboobnagar
3) Adilabad
4) Prakasam
5) Guntur
6) Khammam
7) Warangal

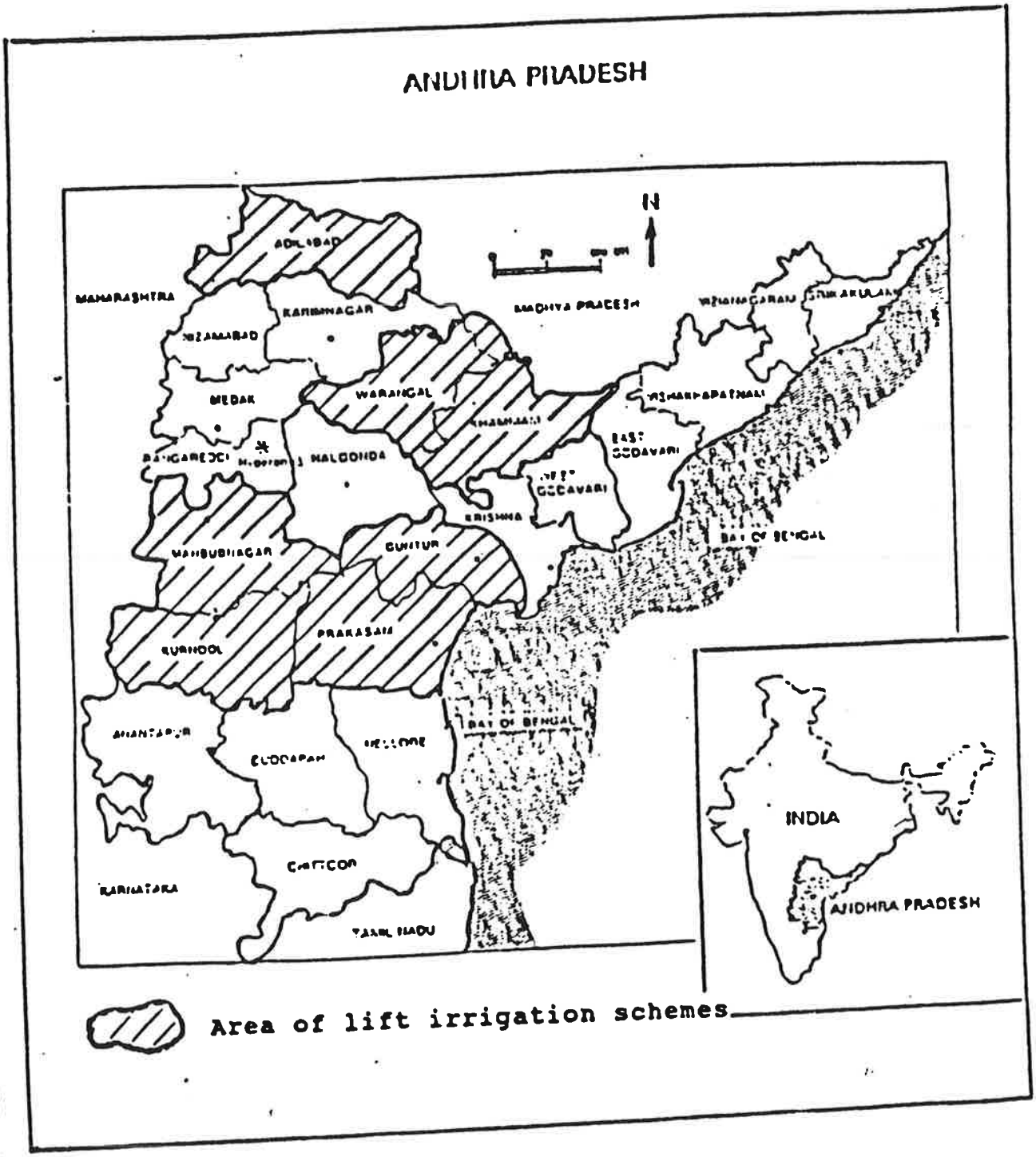
The project area is indicated in Figure 2.1.

The project is designed to improve the economic conditions of the poor, small and marginal farmers. Schemes are only drawn if at least 80% of the beneficiaries are marginal (less than 1 ha of land) or small farmers (1-2 ha of land). Together the marginal and small farmers must own at least 65% of the area to be irrigated. In the case of government assigned lands, the title of the lands has to be in the name of the woman. Special attention will be given to the vulnerable sections of society, Scheduled castes and Scheduled tribes, and to female headed households.

At present, the targeted group primarily make a living from rainfed agriculture. Not only are the yields of the crops very low, the production is also associated with a high degree of risks and uncertainty. Enhanced and stabilized levels of productivity are needed to improve

Fig.2.1

APLIFT project area



the economic conditions of these people, and provision of irrigation water is one means to reach this. Possibilities to provide irrigation water through gravity (surface sources) in vast stretches in the state is highly limited mainly for topographical reasons. Tapping groundwater is also not feasible in these areas, amongst others, for quality reasons. The areas under the project's purview are, despite the availability for water resources, not put to agricultural usage because development interventions are required. Hence, the APLIFT project as a development intervention to make water available for areas/people hitherto practicing rainfed agriculture.

The project is expected to produce the following benefits:

-marginal farmers with one Ha of land can increase their income from about Rs 8,000 to Rs 9,000, even after making allowance for repayment of the loan with the usual rate of interest and full payment of the charges for operation and maintenance; a small farmer will be able to increase his/her income from Rs 10,000 to Rs 12,000 during the period of loan repayment and to Rs 14,000 thereafter; and

-calculated in economic prices, the project produces an internal economic rate of 8.3% in case of one irrigation season and of 17% in case of two irrigation seasons. Rabi irrigation is particularly profitable but the result is sensitive to interruptions in power supply. It should be stressed that the calculations assume that water would be used fairly efficiently.

It is probable that women (who have lower daily wages), will be the first to give up some of their off-farm work and (cash) income in order to increase their work input, as an unpaid family member, on the farm. It is assumed that they will also be able to increase their share of farm earnings.

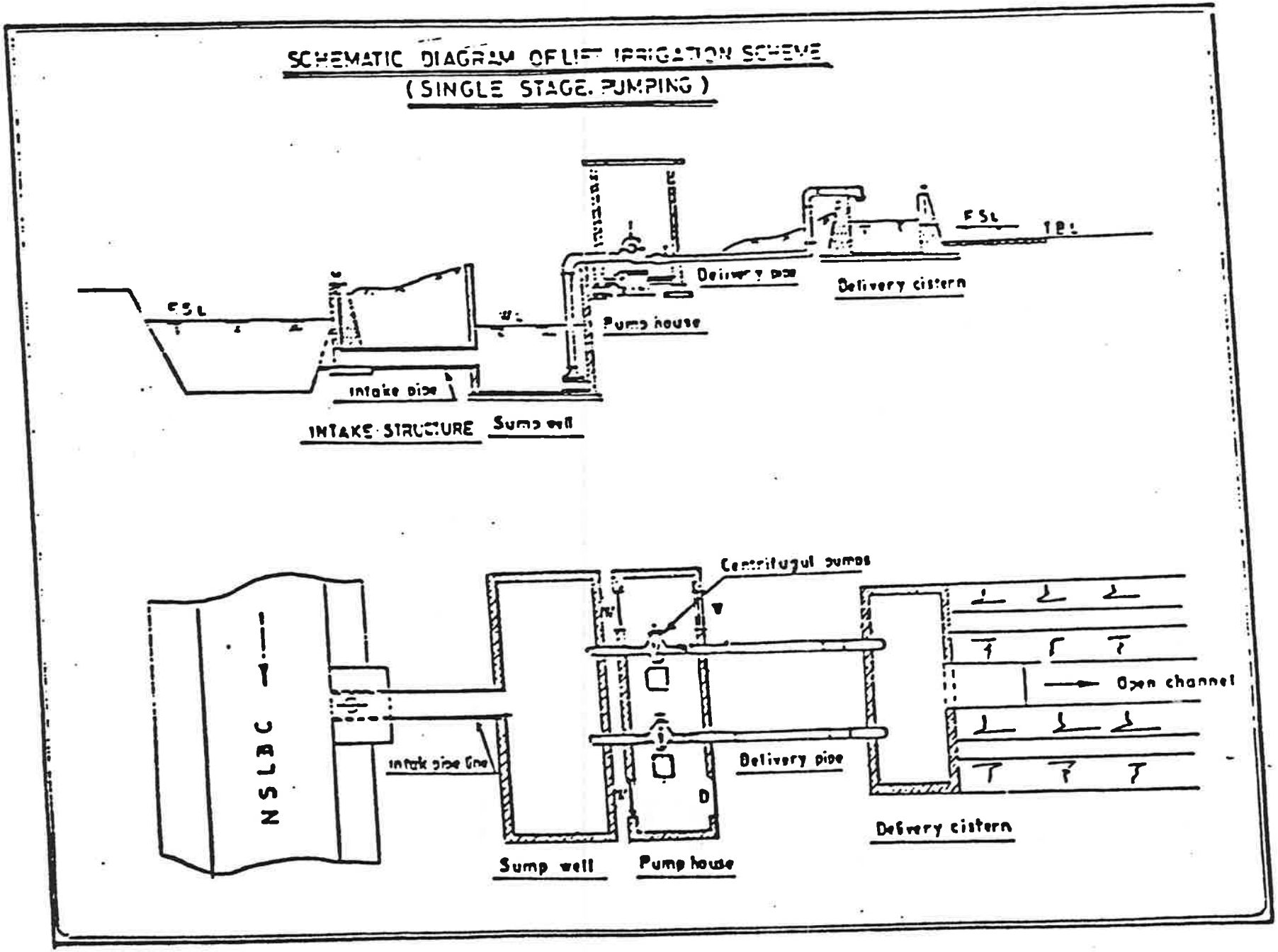
2.2.2. Project design

Through the project, 107 lift irrigation schemes will be constructed, covering a total net area of 24,480 Ha. The preliminary distribution of the schemes over the districts and the implementation schedule are presented in Annex 2.1.

The typical design of the irrigation infrastructure is shown in Fig 2.2 and includes :

-an intake structure, a pump station usually provided with three 40 hp electricity driven pumps (one for stand-by), abstracting water from a river, a canal or a drain;

Fig. 2.2
Design of the APLIFT irrigation infrastructure



-a conveying system, consisting of the main (concrete) pipe to the highest point in the command area, from where the water is distributed through earthen secondary and tertiary channels;
-diversion boxes, culverts and other structures made in masonry or in concrete.

A lift irrigation scheme will be established in four stages, namely:

Initiation stage (six months). This stage starts with the request for the scheme by the farmers. APSIDC will make preliminary investigations to secure the Hydrological Clearance (HC, both for the Kharif and Rabi seasons) and the supply of electricity at nearby distance.

Preparation stage (six months). APSIDC together with the AP Central Cooperative Agricultural Development Bank (APCCADB) will carry out standard feasibility studies assessing whether the scheme meets their socio-economic, economic and technical selection criteria. Simultaneously, farmers will mobilize and organize themselves, assisted by the NGOs. Farmers will be motivated to consider the schemes as their own and to accept ownership. Farmers will join APSIDC in choosing the location of the pump station and the conveyance system. Farmers' organisations will be registered to apply for a loan from the District Cooperative Central Bank or a Commercial Bank.

Construction stage (eighteen months). APSIDC will construct the scheme through contractors. Farmers will be trained in water management by NGOs and relevant Government departments. The scheme personnel will be trained in technical and financial management by APSIDC, the banks and the NGOs.

Initial operation stage (twelve months). APSIDC will commission the schemes and test the system during twelve months. If there are no defects, the ownership of the schemes will be transferred to the farmers. APSIDC will train them on-the-job, in the operation and maintenance of the scheme and will give them the O&M manual. Farmers will also be trained and supported by NGOs on matters such as awareness of other relevant developments or programmes, marketing, improvement of agricultural production, soil conservation, etc.

Including the after-care period of one year by NGOs, the entire establishment cycle of an APLIFT scheme will be about 4.5 years or 4 years after the Hydrological Clearance has been obtained.

2.2.3 Privatization and farmers' participation

Participation of the farmers in scheme management is an integral part of the design of the project. In the context of the project, it is a process which includes farmers organizing themselves, taking part in the planning and design of the scheme and in the selection of water users, participating in the construction of field channels as well as in the operation and maintenance of the scheme for which the farmers will ultimately assume entire responsibility. Training and support for the development of local technical, managerial and agricultural capabilities is part of the approach.

Assistance in setting up farmers organizations will be sought from local NGOs already existing in most of the districts. They know the farmers in the areas and in most cases have already worked with the target groups. As they are usually small and working in a limited geographical area, coordination of a number of organizations is required. This will be entrusted to some of the larger NGOs like IRDAS, PROGRESS, MYRADA, etc.
Encouragement and strengthening of farmer participation will focus on the following aspects:

- -participation is critical for ensuring that the needs of the community are taken into account and this can be achieved by giving priority to requests from the communities;
- -technical surveys for the selection of sites and for the layout of the pipes and drains will be undertaken in consultation with the community. Their knowledge of local conditions will be critical in planning the scheme;
- -selection of farmers according to the pre-determined selection criteria will be undertaken together with the farmers concerned;
- -farmers will participate in the actual construction of the scheme and contribute partially towards the cost of investment. The contribution can be in kind (land or labour) or in cash. The rules for tendering of construction contractors allow priority to be given to farmers' organizations working on their own land. Land development and field levelling will be undertaken by the farmers themselves (loans will be available to facilitate these activities); and
- -completed schemes will be handed over to the farmers as soon as possible and not later than one year after commissioning of the scheme; farmers will appoint pump operators and establish water rights and distribution procedures, including water charges and penalties in case of violation of the rules.

Through the project, assistance will be provided in the following matters:

-setting up of local associations or organisations;
-development of technical and financial capabilities in irrigation and watershed management, in operation, maintenance and repairs, agricultural extension, etc.; and
-technical assistance and advice from APSIDC.

2.2.4 Extension

Most of the extension will be provided by NGOs, many of which have already acquired substantial experience in this field; they will work in close cooperation with the extension staff of the Department of Agriculture.

An integrated approach will be adopted for the agricultural extension to farmers. The emphasis on the inter-relations between the physical processes of surface water flows and water storage, erosion, groundwater recharge, irrigation and drainage, is necessary if an optimum and sustainable functioning of the schemes and an equitable distribution of benefits is to be achieved. It includes, in addition to the standard irrigation (and drainage) facilities, various soil and water conservation measures such as bunding or terracing of fields, agro-forestry, farm ponds, wells, percolation tanks, farm roads, etc., depending on the needs and interests of the farmers and the requirements for conservation.

Only a few instances have been reported where farmers have spontaneously adopted soil and water conservation techniques and measures. The approach adopted by the project, is to rely on demonstration and voluntary participation without financial incentives for purposes of watershed management. Demonstration fields and farms, as well as a nursery, - all to be operated by farmers/animators under an agreement with the NGOs involved in implementing the project -will be established in each drainage basin and farmers will be invited to visit and discuss problems and issues. Training and extension will be centered around these 'model' farms and fields.

2.2.5 Training

NGOs will train farmers and their representatives. They will be trained on a variety of subjects related to crop, water and scheme management. Training will be done through on-field demonstrations, key-farmers, brief courses in Farmers' Training Centres, video and film presentations, radio programmes, etc.

NGOs will also train the trainers themselves in

technical subjects as well as issues like communication, farmers' participation and gender awareness. This training will also be extended to Government extension field staff and junior engineers in the districts. Additionally, APSIDC executives will be trained in farmers' organizational and participatory aspects, through one- week courses or seminars by the Irrigation Department's Training Institute, Water and Land Management Training and Research Institute (WALAMTARI), which will make use of the modules prepared by the Netherlands assisted Project Management Unit (PMU).

2.2.6 Environment

While aiming at productivity enhancements, the project is conscious of several environmental aspects to be addressed, such as conservation of soil and water, the quantity as well as quality of water lifted from the source, and inefficient use of water, often causing drainage and/or salinity problems. In other words, the project does recognize the importance of, and strive towards, achieving sustainability. As a first step to reach this objective, an Environmental Impact Assessment (EIA) of the project is undertaken on a pilot basis in two of the seven districts **Mahboobnagar** and **Prakasam**. A summary of the main project features is given in table 2.1.

2.3 Project activities

As described in chapter 1 activities carried out in the project area are potential sources of impact. It was also mentioned that generally a distinction between activities carried out during the construction phase and during the operational phase of a project is made. In the case of the APLIFT project the main activities during the construction phase are:

-construction of an intake structure, a pump station usually provided with 3 to 4 electricity driven pumps;
-construction of powerlines/electrification;
-construction of a conveying system to draw water from the source;
-construction of a water distribution system;
-construction of approach roads; and
-clearing and levelling of land in a total of 24,480 ha.

During the operational phase of the project the most important activities are:
-lifting of water from the source;
-distribution and application of irrigation water over 24,480 ha of crop land;
-cultivation of irrigated crops on 24,480 ha, at least once a year; and
-discharge of excess irrigation water.

Besides these direct, project related activities, some indirect activities and developments will take place. Examples of the indirect activities are watershed treatment and the application of fertilizers and pesticides. Related developments are for example the immigration of people and related population growth, an increase in trade and commerce, an increase in animal husbandry and an increase in agro-industrial activities and power consumption.

Table 2.1 Main features of the APLIFT project

Number of L.I. Schemes	107
Command area	
Total	24,480 Ha
Per scheme	230 Ha
Target group	13,500 small and marginal men and women farmers
Target area: districts	Prakasam Mahboobnagar Adilabad Guntur Khammam Warangal Kurnool
Implementing agencies	APSIDC, NGOs, and Programme Support Office
Long term objective	Improve living conditions of small and marginal farmers through sustainable and environmentally sound interventions
Immediate objective	Increased agricultural production of small and marginal farmers target area through provision of irrigation facilities
Project duration	6 years
Project cost	Dfl. 40.8 million (Rs 69.3 crores)

Whether or not the above described project activities and project related developments are likely to result in environmental impacts will be discussed in chapter 5, Impact Identification.

2.4 Project setting

2.4.1 Relationships with existing policies

In the "Approach Paper to the Eighth Five Year Plan (FYP, 1990-1995)", the National Planning Commission pays much attention to the importance of extension and improvement of irrigation facilities. Emphasis is given to the need to ensure that Plan investments will go primarily to the less developed areas and sectors and to the people who have not benefited sufficiently, so far. Furthermore, involvement of people is advocated through democratic decentralized bodies, in a bottom-up planning process.

The following broad strategies of the present FYP regarding irrigation are relevant to the project:

-improving the efficiency of irrigation by means of modernization and improvement of projects, including the improvement of irrigation management following the guidelines of the National Water Management Programme;
-encouraging new minor irrigation works, striking a better balance between various forms of irrigation works;
-conjunctive use of ground water and surface water;
-increased participation of people in operation and maintenance of irrigation projects;
-drainage planning for water-logged areas in irrigation schemes; and
-adequate water pricing policy.

In 1987, the Ministry of Water Resources drafted the National Water Policy, a few elements of this policy that apply to the project are the following:

-a standard national information system should be established with a network of data banks to collect information about resource availability and utilization of available resources;
-study of environmental and socio-economic impacts of the projects during implementation and later stages should be an essential component of project planning;
-there should be strict control on ground water exploitation to ensure social equity; and
-water rates should be such as to convey the scarcity value of the resources to the users and to foster the motivation for economy in water use.

The Planning Commission, Government of India, in its Eighth Five Year Plan Document (1992-1997) has expressed deep concern over the environmental impacts of irrigation and power projects which focuses on the rapid siltation of reservoirs, resulting from failures to check erosion in catchments; submergence of ecologically and economically valuable forests; large scale

displacement of people; dangers of over-exploitation of ground water; and damages to cultivated lands due to indiscriminate use of irrigation water. In the plan it is also mentioned that, despite growing awareness about the environmental aspects, a great deal remains to be done to ensure that preventive and corrective actions are given sufficient attention in design and implementation of projects. The need to plan crop and water use patterns with due care and taking into account potential adverse impacts is stressed.

From the above it may be concluded that the APLIFT project, being a minor irrigation project, aiming for sustainable resource use by means of an integrated development approach and focusing on small and marginal farmers that will own and manage the systems themselves, fits very well in the general policy concerning development of irrigated agriculture of the Indian Government. The same is valid for the special attention that the project pays to the assessment and mitigation of adverse environmental impacts.

2.4.2 Relationship with other developments in irrigated agriculture

The APLIFT project aims at developing 107 surface lift irrigation schemes to provide water for irrigated agriculture. To be able to place this development in perspective a short overview of other developments in irrigated agriculture will be presented here.

The total number of surface lift irrigation schemes in Andhra Pradesh is estimated at 15,000, 95% of which is in the private sector. The 107 surface lift irrigation schemes to be developed under the APLIFT project thus form a very small addition to the number of borewells already present (0.7%). For the two districts addressed in this study, the contribution of the APLIFT schemes to the total number of lift irrigation schemes is slightly higher - 1.3% and 2.3% for Mahboobnagar and Prakasam respectively (see table 2.2).

Table 2.2 **Number of existing and planned APLIFT schemes in Mahboobnagar and Prakasam**

	No of Schemes		Planned as
	Existing	Planned	% of total
Andhra Pradesh	15,000	107	0.7
Mahboobnagar	784	10	1.3
Prakasam	827	19	2.3

The share of APSIDC in the surface lift irrigation development (in total, 440 schemes) in the state has been relatively limited, overall a mere 4% of the surface lift irrigation schemes in Andhra Pradesh has been developed by APSIDC, implying that the vast majority of the schemes have been developed by the private sector. It is not likely that the ratio between private and APSIDC initiatives will change drastically in the near future.

Also the area to be irrigated with water from APLIFT surface lift irrigation schemes, 24,480 ha, is very limited compared to the total net area of irrigated lands in Andhra Pradesh: 5.7 million ha (Eighth Five Year Plan, 1992-1997), is 0.4% (see table 2.3). Districtwise these figures are 3.5% and 1.7% for the Mahboobnagar and Prakasam district respectively.

Table 2.3 **Existing net irrigated area and area planned to be irrigated by the APLIFT project (in Ha)**

	Total irrigated area	Planned APLIFT area	% to Total
Andhra Pradesh	5,700,000	16,000	0.4
Mahboobnagar	96,000	3,400	3.5
Prakasam	2,07,000	3,600	1.7

An indication of the order of magnitude of other developments in irrigated agriculture that are expected to take place in the near future can be derived from the Eighth Five Year Plan, 1992-1997. Table 2.4 summarises the ongoing major and medium irrigation projects in Andhra Pradesh. The total irrigation potential of these ongoing projects amounts to more than 2 million ha. This figure is only indicative since some of the projects are already (partly) finished and a fairly large part of the potential areas given in the table is probably already under irrigation, and some others are yet to be initiated.

As regards minor irrigation, the Eighth Five Year Plan mentions a target for development during the plan period of 500,000 ha in the state.

Table 2.4 Ongoing major and medium irrigation projects in Andhra Pradesh

No	Name of project	Ultimate potential (Ha)
1	Sriram Sagar	411,000
2	Srisailam RBC	77,000
3	Nagarjun Sagar	895,000
4	Somasila	65,000
5	T.B.P.H.L.C. Stage II	90,000
6	Vamsadhara Stage I	20,000
7	Jurala	88,000
8	Pulivendala Br. Canal	24,000
9	Telugu Ganga	233,000
10	Srisailam L.B.C.	121,000
11	Vamsadhara Stage II	24,000
	Total : major schemes	2,021,000
	medium schemes	146,000
	major and medium schemes	2,167,000

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Chapter 3

CHARACTERISTICS OF THE PROJECT AREA

3.1 Andhra Pradesh State

3.1.1 Geography

Andhra Pradesh, the fifth largest state in India, covers an area of 274,000 sq km and can be divided, on the basis of geographical, historical and ethnic reasons, into three parts: coastal Andhra, covering the nine north-eastern districts, Rayalaseema, comprising the south-western districts of Kurnool, Anantapur, Cuddapah and Chittoor and Telangana, covering the north-western districts around Hyderabad. Also on a physio-graphical basis a sub-division into three zones can be made: the Coastal Plains, covering a zone along the coast ranging in width from 4 to 70 km, the Eastern Ghats, running in NE to SW direction in a strip parallel to the coastal plain and the Western Peneplains, covering the remainder of the state. Each of these zones is characterised by a specific geomorphology and drainage pattern and a specific altitudinal range.

Soils in the coastal zone are formed in recent alluvial deposits. They are very fertile and intensively cultivated. The Eastern Ghats reach an altitude of 600-1200 m above sea level and have a strong influence on the climate. Orographic rainfall results rainfall totals that are much higher in the coastal zone and hills as compared to the peneplain. Population densities in the mostly forested hilly region are relatively low. Tribal people form the majority of the population. The peneplains have a rolling topography with flat areas between the hills, and rising gradually upto 600 m towards the west. Most of the plains are covered with red soils. In areas underlain by basaltic flows black soils are encountered. The peneplain area is characterised by the occurrence of large numbers of reservoirs (tanks), often constructed in chains along the rivers draining the area. Population densities are lower than in the coastal area.

The main rivers in Andhra Pradesh, Godavari and Krishna flow from west to east through all three physio-graphical zones.

3.1.2 Climate

The climate of Andhra Pradesh can be categorised as semi-arid tropical. It is characterised by a long dry period. As mentioned average annual rainfall is highest in the Coastal Zone and Eastern Ghats: more than 1000 mm. In the south-western part of the state rainfall total are less than 600 mm per year on average. In the

peneplain area most of the rains fall in the monsoon season, between June and September. This period is also characterised by lower temperatures. The hills and coastal plains receive most of their rainfall in the retreating monsoon or autumn season, between October and November. The winter season, December-February, is characterised by relatively low temperatures and very limited rainfall. Temperatures in the summer or pre-monsoon season are very high. In this period an occasional shower may fall.

3.1.3 Population

According to 1991 census, Andhra Pradesh has a population of about 66 million (an increase by 22% over 1981), of which 75% live in rural areas. The annual population growth rate is about 2.5%. The sex ratio, the ratio between female and male population is 0.980, indicating a lower life expectancy for women, compared to men. Most people live in one of the about 27,000 villages. The population density ranges from as high as 300 per sq.km in the coastal areas to about 100 per sq.km in the interior, where dry land agriculture and forests prevail.

3.1.4 Social and economic conditions

The economy of Andhra Pradesh is predominantly agrarian: agriculture contributes about 50% of the State's income and 70% of the population depends on agriculture. Population pressure on the agricultural land is high, and is ever increasing. The total cultivable area of 11.3 million ha is used by about 3 million farm families. The average operational holding appears to be on the decline and is less than 0.75 ha. Although sharecropping is officially abolished, the APLIFT Gender Impact Study (1993) indicated that sharecropping is widespread and on the increase.

The literacy rate for the rural areas of Andhra Pradesh was 30% in 1991, 20% for the female and 40% for the male population. Scheduled casts and scheduled tribes have relatively lower literacy rates.

Per capita income has risen from Rs. 1.384 in 1980-81 to Rs. 2,653 in 1986-87 in current prices; expressed in constant prices of 1980-81, this rise is just 8% (to Rs. 1,495 in 1986-1987). Since generally incomes in rural areas lag behind the urban, it can be assumed that the former have increased with perhaps 5%.

3.1.5 Forests and wastelands

Forests cover one fifth (21%) of Andhra Pradesh. As a result of over-exploitation, 50 % of this forest is seriously degraded. In fact the actual forest area is

only 75% of the recorded area. The areas that are affected by erosion, salinity or alkalinity problems, are designated as wastelands. They cover 7.7 million ha or 28% of the surface area of the state. This figure does not take into account the degraded forest areas.

3.1.6 Rainfed agriculture

Of the total geographical area of Andhra Pradesh of 27.4 million ha, 21% is covered with forests, 15% is fallow and 40% or 11.3 million ha is cultivated (1987-1988). The net area sown accounted for 10.4 million ha. The area which was sown more than once represented 1.7 million ha or 16% of the net sown area.

Most commonly one Kharif crop is grown during the rainy season, while in irrigated areas a second Rabi crop can be produced. Dry land Rabi crops are also grown as the only cultivation on black Vertisols in the coastal area. Sorghum and millet are favourite crops in the rainy season, so are groundnut, castor and sesame. The latter are mostly grown on red soils. Rain fed rice can be found in the coastal zone where rainfall is more than in the rest of the state.

3.1.7 Irrigated agriculture

Controlled irrigation in Andhra Pradesh started over 100 years ago in the deltas of Godavari and Krishna rivers. The ultimate irrigation potential in the state is estimated at 9.2 million ha, 62% of which has been developed so far. The average utilization of the irrigated area is 94%. The share of minor irrigation schemes (less than 20,000 ha) in the ultimate potential is about 46% or 4.2 million ha. The minor irrigation schemes developed to date cover 2.9 million ha or 69% of the potential. The utilization of the minor irrigation schemes is as high as 92%.

GOAP pays attention to the development of minor irrigation since small schemes play an important role in the development of agriculture in rural and backward areas. They also have the advantage, as compared to major and medium irrigation, of smaller investments, shorter gestation periods and easy mobilization of local labour.

Five agencies are involved in the development of minor irrigation in Andhra Pradesh:

-Department of Minor Irrigation: construction of schemes between 10 and 2,000 ha; maintenance of schemes between 40 and 2,000 ha;
-APSIDC: construction and maintenance of lift irrigation schemes (pumped surface water) and of ground water schemes;

-State Ground Water Department: investigation of ground water potential;
-Panchayati Raj Engineering Department: construction of schemes up to 10 ha; maintenance of schemes up to 40 ha; and
-Andhra Pradesh State Cooperative Rural Irrigation Corporation Ltd.: execution of in-well drilling and revitalization of existing dug wells for small scale irrigation purposes.

Irrigation water is obtained from shallow, medium and deep ground water aquifers and from surface water. Ground water is pumped from dugwells and tubewells in weak strata and borewells in hard rock areas. The surface water is obtained from rivers, streams and drains.

3.2 Mahboobnagar and Prakasam district

3.2.1 Mahboobnagar

Mahboobnagar is situated in Telangana region, the most backward region as far as agriculture is concerned. It has a feudal history, which finds its reflection in today's social dynamics. The district lies between 15 55′ and 17 20′ northern latitude and 77 15′ and 79 15′ eastern longitude. The location of the district as shown in figure 2.1. Most information pertaining to Mahboobnagar and Prakasam districts, in a comparative fashion, are summarised in tables 3.1 through 3.4. However, some basic information pertaining to climate, geology, and landuse are discussed in subsequent paragraphs.

Climate

Nearly the total district, over 80% of the area and affecting 80% of the population has been classified as drought prone. Overall rainfall is very poor and many dry spells occur. The average annual rainfall is 739 mm. Most of the rainfall (over 70%) falls during the south-west monsoon, the heaviest rainfall is received in July and August. Average maximum and minimum daily temperatures are 39 c and 15 c respectively.

Hydrology

Andhra pradesh is called a state of rivers as nearly 75% of its territory is covered by the basins of 3 big rivers - Godavari, Krishna, Pennar and their tributaries such as Kadam, Pranahita, Pedavagu, Indravati, Sabari, Manair, Manjira, Thungabhadra, Hundra, Musi, Wyra, Chandravanka, Erra Kalva, Tammileru, Budameru, Naguleru, Dindi, Papaghni, Chitravathi, Cheyyeru and Kunderu. Apart from these, there are seventeen more short rivers which includes some independent rivers like Gundlakamma and Swarnamukhi. Mahboobnagar District, too, is richly endowed with surface water resources, rivers Krishna, Thungabhadra, Dindi and Peddavagu flowing through the

district. All these rivers are in the purview of the Krishna basin, and flow from West to East. Krishna is the second largest river of the state, about 1,440 km long, and of which 620 km or 43% lies in Andhra Pradesh. Rising in Maharastra and traversing through Karnataka, it enters Andhra Pradesh near Tangadigi village in Mahboobnagar district, flows through Kurnool, Nalgonda, Guntur, Prakasam and Krishna districts before draining into Bay of Bengal. According to the Krishna water tribunal, the total available water of 2,000 TMC is allocated among the three states in this order: 500 TMC to Maharastra; 700 TMC to Karnataka; and 800 TMC to Andhra Pradesh. Currently, Karnataka and Maharastra are utilising a maximum of 60% of their allocations. The unutilised quantum is being utilised in Andhra Pradesh. Almost all the water available in the Krishna basin is being used or planned to be used, any further new development will be at the expense of current uses and commitments.

Land use and irrigation

Of the total area of the district of 18,25,849 ha, over 220,000 ha are covered with forests (12.4%). The net area sown amounts to 908,962 ha (50%), of which only a very limited percentage is double cropped. Of the total agricultural area just over a quarter (26%) is irrigated. Major sources of irrigation are tanks, canals, tube and borewells and open wells. Under major irrigation there is only one scheme: the Rajolibanda Diversion Scheme. The proposed Jurala project has not yet materialised. Besides there are three medium irrigation schemes, two of which across tributaries of the Krishna river. Minor irrigation schemes are numerous, deriving water from wells and tanks and lifting water from the Krishna and Bhima rivers. The principal crops are paddy and jowar, other commercial crops are groundnut, pulses, cotton, tobacco, chillies, castor and sesame.

3.2.2 Prakasam

Prakasam is situated in the coastal Andhra Region and is one of the newly formed districts in the state. It contains the most fertile tracts of land and is therefore the most developed and prosperous part of the state. The district lies between 14 57′ and 16 17′ northern latitude and 78 43′ and 80 25′ eastern longitude. Similar to Mahboobnagar, most information are summarised in tables 3.1 through 3.4. A brief discussion about climate, geology and landuse follows under.

Table - 3.1
Districts' Profile

Sl.No	Particulars	Mahboobnagar	Prakasam
1.	AREA (sq km)	17,247	17,626
2.	POPULATION	30,34,594	27,53,288
	-SCs (%)	18.6	13.5
	-STs (%)	8.2	3.0
	-OTHERS (%)	73.2	83.5
3.	RURAL POPULATION(%)	89.0	84.0
	URBAN POPULATION(%)	11.0	16.0
4.	SEX RATIO	1:1	1:1
5.	LITERACY (%)	18.0	35.0
6.	TEMPERATURE	$15^{o}c$ - $39^{o}c$ (Average $26^{o}c$)	$19^{o}c$ - $39^{o}c$ (Average $29^{o}c$)
7.	RAINFALL (mm)	738.7	1005.9
8.	CLIMATE	Semi-arid with dry days and pleasant evenings	Moderate both in winter and summer with sea breeze in the coastal areas. Summer is severe, especially in the tracts of upland areas.
9.	RIVERS	Major: Krishna, Tungabhadra Minor: Dindi, Peddavagu and Chinnavagu	Major : Gundlakamma and Musi Minor : Maneru and Paleru
10.	SOILS	Red soil is predominant. Black soil occurs in narrow strips along the banks of Krishna and Tungabhadra and natural streams only.	Red soil is predominant. Red Loamy, Black Soil and Sandy Loams, occur in small strips.
11.	MINERAL RESOURCES	Shahbad stone, Lime stone, Asbestos Glass Sands.	Slate, Iron Ore, Silican Sand, Lime-stone, Lime Kanker Barytes, Manganese.
12.	FLORA & FAUNA	Major Forest Produce: Timber, Nallamaddi (Terminalia Tumentosa), Eppa(Hardwickia-Binata), Teak, Ebony, Babul, Mango, Tamarind and other fuel bared trees. Wildlife: Tiger, Panther, Wilddog, Hyena and Slothbear. Herbivorous: Spotted Deer, Nilgai, Wild Goat, Sambhar, BlackBuck, Chinkara, Wild Boar, Porcupine are common. Birds: Spotted dove, Ringdove, Peafowl, Junglefowl, Brushquail, Greenpigeon, Grey duck, Partridge, Whistling teal, Mallard are common.	Major Forest Produce: Teak, Babul, Beedileaves, Casurina and Cashew plantations. Wildlife : Tiger, Cheetah Herbivorous : Nilgai (Manubothu), BlackBuck (NallaDuppi), Peafowl, Wild Buffalo and Grey Junglefowl.

Table - 3.2

Districts' profile - Land utilization

Sl.No	Particulars	Mahboobnagar (Ha)	(%)	Prakasam (Ha)	(%)
1.	GEOGRAPHICAL AREA	18,25,849		16,94,212	
2.	FORESTS	2,27,241	(12.4)	4,37,373	(26.0)
3.	BARREN AND UNCULTIVABLE LAND	1,01,354	(5.5)	1,56,421	(9.0)
4.	LAND PUT TO NON-AGRICULTURAL USES	73,176	(4.0)	1,40,681	(8.3)
5.	PERMANENT PASTURES AND OTHER GRAZING LAND	28,618	(1.5)	70,868	(4.0)
6.	MISCELLANEOUS TREES AND CROPS NOT AREA SOWN	6,866	(4.0)	9,900	(6.0)
7.	CULTIVABLE WASTE	12,806	(7.0)	77,621	(5.0)
8.	OTHER FALLOW LANDS	89,299	(5.0)	1,13,258	(6.5)
9.	CURRENT FALLOW LANDS	3,77,527	(21.0)	86,348	(5.0)
10.	NET AREA SOWN	9,08,962	(50.0)	6,01,736	(35.0)
11.	AREA SOWN MORE THAN ONCE	-		62,975	
12.	TOTAL CROPPED AREA	9,08,962		6,64,712	

Table - 3.3

Districts' profile - Irrigation

Sl.No	Particulars	Mahboobnagar (Ha)	(%)	Prakasam (Ha)	(%)
1.	NET AREA SOWN	9,08,962		6,64,712	
2.	AREA - RAINFED	6,68,927	(73.0)	3,77,997	(57.0)
3.	AREA UNDER IRRIGATION				
	-NET	2,40,035	(26.0)	1,95,279	(29.0)
	-GROSS	2,40,035		2,23,739	
4.	AREA IRRIGATED				
	-CANALS	16,875		93,198	
	-TANKS	89,251		37,247	
	-TUBE WELLS	6,047		68,295	
	-OTHER	1,24,273		62,246	
5.	LIFT IRRIGATED SCHEMES (No)	-		-	
6.	ELECTRIC MOTORS (No)	38,811		9,589	
7.	DIESEL PUMPSET (No)	36,189		97,886	

Table - 3.4

Districts' profile - Agriculture

Sl. No	Crop	Mahboobnagar			Prakasam		
		AREA (Ha)		ARRIVAL	AREA (Ha)		ARRIVAL
		KHARIF	RABI	(Qts)	KHARIF	RABI	(Qts)
1.	PADDY	2,91,722	1,09,599	17,71,359	2,76,968	69,380	3,48,000
2.	JOWAR	5,75,017	85,554	22,795	1,05,688	32,821	20,000
3.	BAJRA	41,023	120	214	80,304	1,683	35,000
4.	MAIZE	2,263	1,095	-	-	-	-
5.	RAGI	59,934	2,577	89,211	930	27,956	15,000
6.	HORSE GRAM	47,436	4,000	74,486	-	-	-
7.	GREEN GRAM	59,683	-	28,589	-	-	-
8.	RED GRAM	1,29,775	-	-	70,805	17	17,000
9.	SAMAI	3,714	65	-	-	-	-
10.	KORRA	14,306	-	-	-	-	-
11.	CHILLIES	15,870	2,937	-	44,452	19,812	17,000
12.	ONIONS	5,708	1,076	5,783	-	-	-
13.	COTTON	68,992	539	-	1,04,569	222	1,32,000
14.	TOBACCO	4,202	17,444	-	2,620	11,350	55,000
15.	GROUNDNUT	38,66,720	1,29,241	7,23,896	82,596	97,824	97,000
16.	CASTOR	2,96,432	-	1,05,618	86,294	856	13,000
17.	MANGOES	3,535	19	-	-	-	-
18.	SESAME	-	-	-	28,427	4,362	7,000
	TOTAL	54,86,332	3,54,266	28,21,951	8,83,653	2,66,283	7,56,000

Climate
The sea breeze renders the climate moderate both in winter and summer in the coastal areas of the district. However, in the upland areas (western part of the state), heat is sévere in summer. Average maximum and minimum daily temperatures are 39c and 19c respectively. The normal rainfall is 751 mm per annum with both south-west monsoon (June to September) and north-east monsoon (October to December) contributing equally.

Hydrology
The principal rivers of the district are the Gundlakamma, Maneru, Paleru and the Musi, all in the Krishna river basin. The Gundlakamma rises in Giddalur taluk, and flows a length of 220 km supplying drinking water (besides irrigation) to Ongole, the district head quarters. The Musi flows across the southern portion of Ongole taluk. Paleru and Maneru rivers flow across Kanigiri and Kandkur taluks. Apart from these rivers, the district enjoys irrigation from two major irrigation projects -
i) Nagarjuna Sagar Project with a command of 1,78,937 Ha and ii) Krishna Western Delta Canals with a command of 29,310 Ha -
and 6 medium irrigation projects irrigating about 37,000 Ha. The Nagarjuna Sagar project yields substantial regeneration flows upon which all the lift irrigation schemes are planned under the APLIFT project.

Landuse and Irrigation
Of the total area of the district of 16,94,212 Ha, over 400,000 Ha are covered with forests (26%). The net area sown amounts to 6,01,736 Ha (35% only), of which only a very limited percentage is double cropped. Of the total agricultural area, nearly 30% is irrigated. Major sources of irrigation are canals, tanks, tube and borewells and open wells. There are two major irrigation projects in the district - Nagarjunasagar Project irrigating 180,000 Ha and Krishna Western Delta Canals irrigating 29,000 Ha. There are 6 medium projects irrigating about 38,000 Ha. The principle crops are paddy, cotton, tobacco, chillies, Jowar, Grams, Sesamum and Castor.

3.3 Magnoor and Parchur mandals

In Andhra Pradesh a mandal represents the second level of decentralised administration, below the district. It usually comprises 5-6 villages covering a population of 15,000 - 20,000. Mandal level assessments of the ground water potential are reported here for the Mahboobnagar and Prakasam districts only.

3.3.1 Magnoor mandal (Mahboobnagar district)

Location : Magnoor mandal falls under Makthal Taluk. It consists of 34 villages. It is bounded on the north by Urkur mandal; on the south by Krishna river; on the west by Raichur district of Karnataka state; and in the east by Makthal taluk. The total geographical area of the mandal is 317.79 sq.km.

Village and Population : This mandal consists of 34 villages with a population of 28,919 . There are 536 scheduled castes and 245 scheduled tribes. The density of the population is 68 per sq km. The sex ratio is 1:1. Most of the villagers speak Kannada.

Climate and Rainfall : In this mandal, the north east monsoon starts from June and lasts till September with the average rainfall being 652.2 mm. In the winter, this mandal experiences occasional spells of rainfall owing to the south-west monsoon. There is very little rainfall during summer (Annex - 3.1).

Occupation : The major occupation in this mandal is agriculture with 13,772 farmers and 5,108 agricultural labourers. There are 457 Industrial workers and 2,154 other workers. Apart from this, there are also eighteen flour mills and six rice mills in this mandal.

Education : Out of a total population of 28,919, 4,270 or 15% are literates. Instructively, 78% of the literates are men.

Housing : There are about 5,308 houses: total population being 28,919, family size works out to about 5.

Land holdings : There are 6,449 holdings in the mandal of which 2,360 or 37% belongs to marginal and small farmers. Thus, more than half of the holdings are of the size more than 2 Ha and 18% of the holdings belong to SCs and STs (Annex 3.2).

Land Utilisation : The total geographical area is about 31,779 Ha (Table - 3.5). Net area sown is 11,690 Ha, about 37% of the total. Gross cropped area is about the same as that of net sown area.

Irrigation : Out of 11,690 Ha of net sown area, only 1,571 i.e. 10% is under irrigation (Table - 3.6). Major sources of irrigation are Streams and Dugwells.

Season and crop : A variety of crops such as paddy, jowar, bajra, ragi, grams, chilies, groundnut, castor and cotton are grown in this mandal (Annex 3.3). The main cropping season is Kharif, from April to October. paddy, jowar, bajra, ragi, korra, gram, groundnut and castor are the major crops grown in this season. Rabi

season is the second season from November to March. The major crops are paddy & groundnut.

3.3.2 Parchur mandal (Prakasam district)

Location : Parchur mandal consists of 14 villages. It is bounded on the north by Nandipadu, which is a part of Guntur district; on the south by Inkollu mandal; on the east by Karamchedu mandal; and on the west by Eddapadi mandal. The total geographical area of the mandal is 223.2 sq km.

Village and Population : This mandal consists of 14 villages with a population of 53,520. There are 5,795 scheduled castes and 2,225 scheduled tribes. The density of the population is 240 per square kilometer. The sex ratio is almost 1:1.

Climate and Rainfall : In this mandal, the north east monsoon starts from June and lasts till September with the average rainfall being 1163.5 mm. In the winter, the normal rainfall in this mandal is 7.5 mm. In summer, this mandal experiences rainfall from March to June with the normal rainfall being 105.9 mm (Annex - 3.4).

Occupation : The major occupation in this mandal is agriculture with 9,000 farmers and agricultural 14,928 agricultural labourers. There are 357 Industrial workers and 3,113 other workers are engaged in allied occupations such as carpentry and small-scale industries. There are 11 cotton spinning mills, 5 tobacco breeding centres and 11 rice mills in this mandal.

Education : Out of a total population of 53,520, 21,615 or 40% are literates. Instructively, 65% of the literates are men.

Housing : There are about 11,744 houses. Total population being 53,520, family size works out to about 5.

Land utilization : The total geographical area is about 22,320 Ha (Table -3.7). Net area sown is 19,243 about 86% of the total. Gross cropped area is 21,149 or 96% of that of total geographical area.

Irrigation : Out of 19,243 Ha of net sown area, only 4,963 Ha i.e., 26% is under irrigation. The major source of irrigation is canal.

Season and Crop : Rice and cotton are the major crops grown in this mandal (Annex 3.5). The main cropping season is Kharif, from April to October. Rice and

Cotton are grown in this season. Other minor crops are grown in Rabi season.

3.4 Conclusions

From the state/district/mandal descriptions some general conclusions can be drawn. These are given below:

-the economy in the area is predominantly agriculture-based;

-at the minimum, half the population makes a living as small or marginal farmers and have a holding smaller than 2 ha;

-about 70% of the agriculture is rain-fed;

-in **Mahboobnagar district**, small holdings and the absence of an assured water supply not only results in low productivity and income, but also a high degree of risk and uncertainty for the farmers. Small farmers are not able to save some money and hence private investments for development are impossible. Furthermore, given these high risks and uncertainties, formal financial institutions are not very willing to extend credit facilities;

-in **Prakasam district**, cotton/tobacco based cropping pattern has become highly risky and large scale application of petrochemicals has polluted the environment. Farmers are looking forward towards an eco-friendly crop systems which ensure them stabilised returns;

-a considerable part of the state is rich in natural resources and has ample potential for surface water irrigation development; and

-irrigation will result in enhanced agricultural productivity/returns and welfare for the small and marginal farmers.

Table - 3.5

Land utilization

Particulars	Area (Ha)
1) Geographical area	31779
2) Forests	-
3) Barren and uncultivable land	2937
4) Land put to Non Agricultural uses	4330
5) Permanent Pastures and other grazing land	1745
6) Miscellaneous tree crops and groves not included in net area sown	510
7) Cultivable waste	1031
8) Current fallow lands	5405
9) Other fallow land	4131
10) Net area sown	11690
11) Area sown more than once	521
12) Total cropped area	12211

Table - 3.6

Irrigation

Sources	**Ha**
Canals	-
Streams	251
Tube wells	-
Dug wells	1188
Other(ponds,small streams)	28
Land irrigated more than once	104
Total Irrigated land	1571

Table - 3.7

Land utilization

Particulars	Area(Ha)
1) Geographical area	22320
2) Forests	-
3) Barren and uncultivable land	100
4) Land put to Non Agricultural uses	1038
5) Permanent Pastures and other grazing land	-
6) Miscellaneous tree crops and groves not included in net area sown	108
7) Cultivate waste	100
8) Current fallow lands	1223
9) Other fallow lands	510
10) Net area sown	19243
11) Area sown more than once	1906
12) Total cropped area	21149

ooOOoo

Chapter 4

BASELINE SOCIO-ECONOMIC INFORMATION

4.1 Introduction

For the purpose of this pilot EIA, the study has selected two schemes proposed by the APSIDC for the development of surface lift irrigation, one each in the Mahboobnagar and Prakasam district. In Mahboobnagar, the proposed scheme is located in the Mudmal village of the Magnoor mandal in the Makthal taluk. It is proposed to irrigate about 2,000 Ha spread across 6 villages. In Prakasam, the scheme is located in Adasumalli village of the Parchur Mandal in Chirala taluk. This scheme is proposed to irrigate about 1,000 Ha spread across 3 villages. In this chapter the baseline socio-economic information pertaining to these schemes is presented. The baseline information pertaining to the physical, chemical and biotic environment is presented parameter-wise in the chapters 6 through 11.

To be able to identify and predict the possible adverse impacts of the project intervention by comparing a 'with project' and a 'without project" situation, two control sites, one in each district, with existing APSIDC surface lift irrigation schemes were selected as well. Since comparison of an existing scheme with a proposed scheme to predict possible environmental impacts at the proposed site is only meaningful if the physical, chemical, ecological and socio-economic conditions at the control site are comparable with that of the proposed site, selection of schemes are to be done carefully. Besides, environmental impacts may only become apparent a number of years after the scheme become functional. Therefore the control scheme must already be stabilised, i.e. running for a number of years. Information on the selected 'control' schemes is also presented in this chapter.

4.2 Proposed site selection

The APSIDC is quite opportunistic, in the sense, it has always some 'on the shelf' schemes, ready to be grounded no sooner the funds become available. Normally, all the schemes of APSIDC are located in complex and diverse environ predominantly inhabited by poor people. Yet, considerations and criteria for selection differ from scheme to scheme. The task before us, initially, was to select two (one each in Mahboobnagar and Prakasam district) of the several 'on the shelf' (proposed) schemes. A brief write-up about the schemes considered for the EIA study and the criteria on which a particular scheme (both proposed and control) is selected would be apt for the current pilot EIA study.

4.2.1 Mahboobnagar, proposed schemes

Muslaipally Scheme
The proposed scheme covers an area of about 1,000 Ha spread across 3 villages benefiting about 600 families. The area is sandwiched between two existing lift irrigation schemes (partly illegal, but very well organised) and is quite well developed. The area is totally cultivated; groundnut being an important crop. It is intended to provide irrigation for 2 seasons. It is expected that paddy will become a very important crop as it is already existing in the surrounding schemes.

Water will be lifted from the Krishna river and will be piped in-land. Open channels can not be used because the water has to pass the already existing schemes. The scheme is mentioned in APLIFT appraisal report as Muslaipally I and Muslaipally II, each having an area of 400 Ha.

Chityal Scheme
This was avoided as the same had been chosen for the gender impact assessment and the residents expressed suffering from a 'Survey Fatigue'.

Mudmal Scheme
This scheme covers an area of 2,000 Ha spread across 6 very poor villages with around 2,500 families. Developments in the area are minimal.

The water is to be lifted from Krishna river over an elevation of about 45 meters. The water is envisaged to be lifted in two stages and the horizontal distance is about 2 Km. The scheme will provide water for two crops in an year. At present, a variety of Irrigated Dry (ID) crops are grown. Large parts of the area are not cultivated at present and are covered with a sparse vegetation of grasses and bushes. Irrigated agriculture is expected to be predominantly paddy based crop pattern. Soil erosion may be a serious problem. Some private illegal lift irrigation also exists along the river.

The scheme is not mentioned in the APLIFT appraisal report and strictly spoken too large to be considered in the APLIFT project. However, the scheme will be subdivided into 4 smaller schemes.

Of the proposed schemes, the Mudmal scheme seems the most suitable one for a pilot environmental impact assessment for the following reasons :

- the area is backward;

- since the area is more or less virgin, no delineation problems exist i.e., not interspersed with the

existing schemes, and pre-project conditions are not influenced too much by ongoing activities in the area;

- illegal water intrusion is minimal;

- the area is fairly large and thus offers relatively diverse physical conditions implying that a larger range of Environmental Impacts may be encountered; and

- since no definite system lay-out has been established, various alternatives can be taken into consideration.

4.2.2 Mahboobnagar - Control Schemes

Gudepallur Schemes
An existing scheme commissioned in 1987. It covers an area of about 800 Ha spread across four villages. The major crops grown are paddy and groundnut, though some Jowar is also seen. The irrigation water is extracted from Krishna river, the same source as that of the proposed, Mudmal, and physical conditions are comparable. The scheme is quite far away from Mudmal (Proposed) scheme and accessibility is poor.

Murardoddi Scheme
An existing scheme (on the upstream of proposed scheme) planned to irrigate lands spread across 3 villages, and was commissioned in 1987. Water is drawn from Krishna river, same as that of Mudmal (proposed) scheme. Some 670 families are to be benefited. As against 1,240 Ha planned for irrigation, only 738 Ha have been developed so far. Major crops grown are groundnut and paddy. Irrigation channels are not lined. System is characterized by water logging (in the upper reaches) and inadequate water availability in the lower reaches.

Pasupal Scheme
An existing scheme (on the down stream of the proposed scheme) planned to irrigate lands spread across 4 villages, and was commissioned in 1987. Water is drawn from Krishna river, as is the case with the Mudmal (Proposed) scheme. Designed command is of the order of about 1,380 Ha. So far, 1,000 Ha has been developed. Major crops grown are Paddy and groundnut. Irrigation channels are lined.

All these schemes are comparable in term of (a) source of water and (b) physical conditions. But, based on accessibility, nearness to the proposed scheme, and the type of channels - lined and/or unlined, we decided to select 2 schemes - Murardoddi and Pasupal- to serve as 'Control'. Characteristically, Murardoddi channels are unlined and that of pasupal are lined.

4.3 Prakasam

4.3.1 proposed Schemes

Garlapadu lift irrigation scheme
This scheme was earlier chosen to conduct the Gender Impact Assessment. Purposefully, this scheme was avoided as we feared over residents suffering from 'survey fatigue'.

Adasumalli Lift Irrigation Scheme
A proposed scheme, covers an area of 1,040 Ha spread across 3 villages benefiting some 1,270 families. The source of irrigation is the Ogeru Vagu, a drainage canal. Ogeru is the naturally existing water course converted into manmade (also called Nallamada) drainage-canal. The drainage and 320 Ha of land bordering it are located in Guntur district. The command area, was initially envisaged to be exclusively located in Prakasam district which implied water has to cross a non-irrigated area either piped or in an open channel.

Now, it is decided to take the water through underground pipes. In return, 80 Ha of Guntur district will also be irrigated. The total distance over which the water will have to be carried is about 2 Km. Most of the surrounding area is very well developed. At present, cotton, tobacco and some grams are grown in the proposed area. With irrigation, farmers are expected to grow paddy. Irrigation will be provided for one season - late Kharif. A second crop, a short duration crop, can be grown using the residual soil moisture.

Adasumalli Scheme, among others, was chosen as the other proposed schemes in the area are very limited in acreage and therefore less suitable for EIA purpose.

4.3.2 Prakasam - Control Schemes

Motupally lift irrigation scheme
An existing APSIDC scheme commissioned in 1984, is planned to irrigate 1,320 Ha. Water source is from a straight cut drainage. Area irrigated so far is 480 Ha, less than 40% of the planned command. Soils are sandy and only tree crops such as casuarina, cashew are possible. But farmers want to grow paddy. The water source is 1 Km from the sea and saline intrusion is common affecting the quality of water. Corrosion has been a common problem. This is a situation - difficult and fragile - where everything is against all odds, and the APSIDC, normally, is to develop such areas.

Adasumalli has black soils and the water source is 30 km awaya from the sea, whereas this scheme has sandy soils and 1 Km awaya from sea. Hence, the schemes are not comparable.

Chinna Ganjam Scheme
An existing APSIDC scheme commissioned in 1991-92 with an intention of irrigating 960 Ha. So far only 400 Ha have been developed. Major crop grown is Paddy. APSIDC had to bring soil from outside to construct the irrigation channels as the available soils were not suitable. The terrain is almost flat, and layout formation is quite difficult. The water source, an irrigation drainage, is 8 Km away from Sea. Saline water intrusion particularly during the months March through June is quite common. Constructing a check dam in the down stream (to prevent saline water intrusion) would result in flooding in the upstream.

The scheme is not comparable with that of the proposed (Adasumalli) scheme.

Peddanandipadu
An existing APSIDC scheme commissioned in 1992-93, is planned to irrigate some 160 Ha, benefiting 150 farmers. This scheme is in the downstream of Adasumalli (Proposed) scheme, drawing water from the same drain. The scheme is hardly one season old, and hence do not serve our purpose of comparison/prediction.

Our efforts to select an APSIDC scheme to serve as 'Control' for the prediction of likely adverse environmental impacts, proved futile as no scheme was comparable to the proposed scheme. Hence, we were compelled to choose a private Lift Irrigation Scheme - Srinivasa Lift Irrigation Society, situated in the down stream of Adasumalli Scheme.

Srinivasa Lift Irrigation Scheme
An existing scheme developed and managed by the farmers themselves. Designed command is 1,200 Ha and 50% of it is developed so far. Situated in the down stream of Adasumalli scheme, it has a long and interesting history.

Historically, till the late 60s and early 70s, farmers of the Srinivasa Lift Irrigation scheme area, like other farmers in the coastal area, used to grow tobacco. The quality of tobacco particularly in some areas gradually became too poor to be acceptable in the market, due to the development of high salinity in the soils. Infact, we are given to understand that some pockets were black listed by tobacco traders. Farmers decided to switch over to paddy. Thus, Srinivasa Lift Irrigation Scheme came into existence during 1974, with people mobilizing themselves into a Society. Funds were raised from financial institutions to meet the initial investment. Simultaneously, there was a break-through in the development of high yielding varieties of cotton, and favourable markets emerged. Srinivasa farmers gave up the idea of growing paddy, and switched over to cotton.

Came the 90s, cotton cultivation has become very risky due to large fluctuation in yield and price. Farmers, in response revived the earlier established Lift Irrigation Scheme to grow Paddy.

This behaviour of farmers being highly responsive to the market, is true not only of 'Srinivasa', but also of 'Adasumalli' and the entire coastal area in the district.

Srinivasa L.I. Scheme is comparable with Adasumalli in most aspects, and hence, is chosen as a 'control'.

4.4 Baseline socio-economic information

4.4.1 Mudmal scheme - Mahboobnagar

Location: Mudmal Scheme is situated 100 Km south of Mahboobnagar town and is located between 77 25' and 77 35' Eastern longitude and 16 20' and 16 27' Northern latitude, falling in 56 H/7 and 56 H/11 of Survey of India Toposheets (Fig 4.1). The scheme is situated on the banks of krishna river in the borders of Andhra Pradesh and Karnataka State.

Spread Scheme is proposed to irrigate about 2,000 Ha spread across 6 villages. The village-wise details are given in table 4.1.

Physiography and drainage
The area is a gently sloping terrain with small rock outcrops on the north and the Krishna river on the south. The command area falls in between Peddavagu (a stream) and Krishna river. The elevation is around 350 m above mean sea level. The Krishna is a perennial river. The drainage map is presented in Fig 4.2.

Geology
The study area is underlain by Archaean gneisses and granites. Entire area is occupied by the granites as relict hills, pediments and weathered pediplains. The present study area had undergone intensive tectonic disturbances during Proterozoic era. The fractures and joints developed in the area are the results of tectonic deformation. The fractures/lineaments are mapped through remote sensing techniques and they are trending N-S, NE-SW, NW-SE and E-W.

Hydrogeomorphology
The study area can be divided into seven hydrogeomorphological units based on landform, genesis, lithology, soils, ground water prospects, etc.,. The seven units are alluvial plain, moderately weathered pediplain, shallow weathered pediplain, pediment, tor complex and residual hill. The detailed mapping is presented in Fig 4.3. A brief writeup of the same

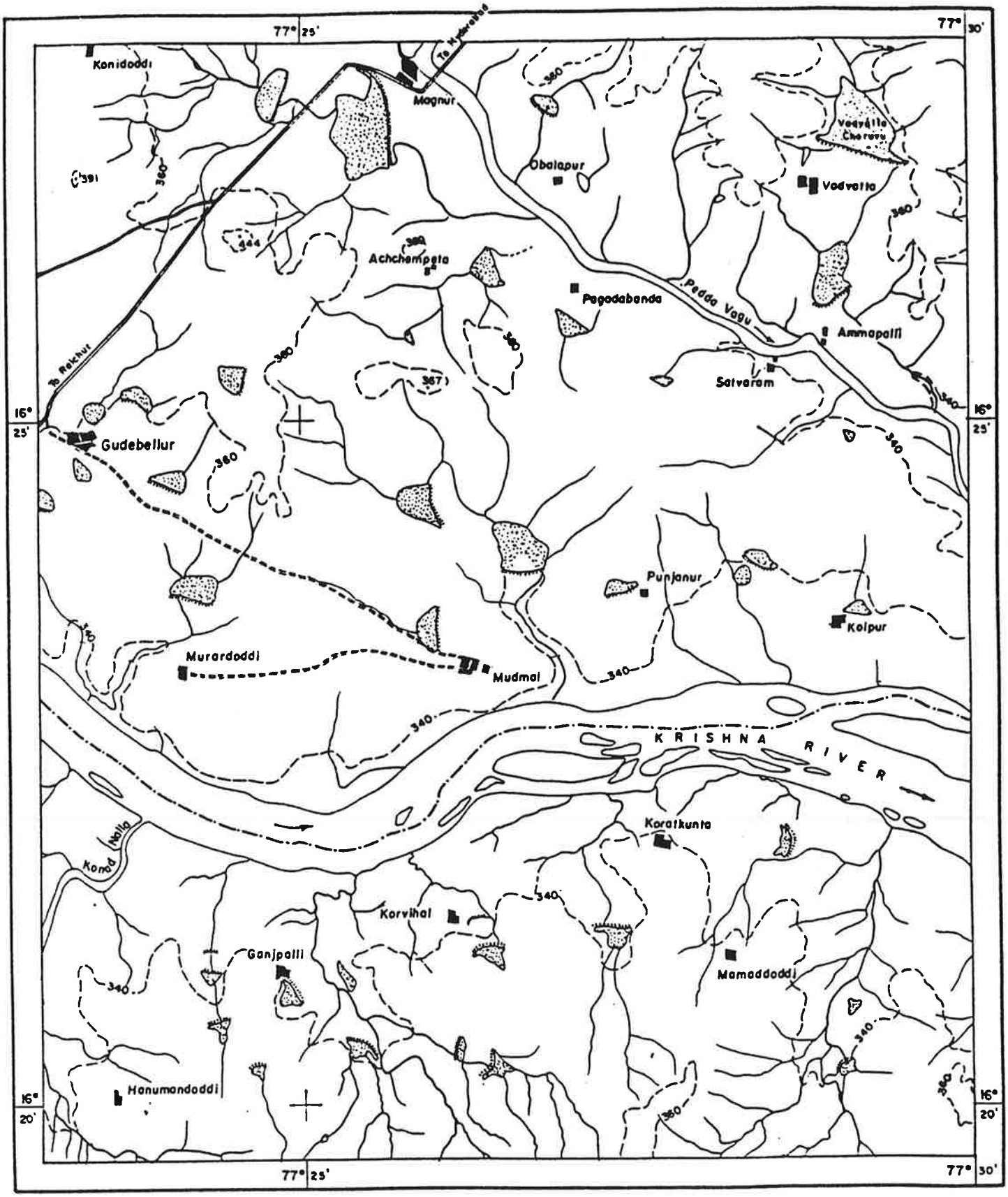


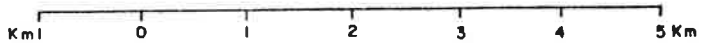
FIG 4.1 LOCATION OF MUDMAL SCHEME

Fig 4.2

INDO-DUTCH IRRIGATION PROJECT (EIA)
DRINAGE MAP

A.P. LIFT: MUDMAL VILLAGE, MAHBUBNAGAR DISTRICT.

SCALE 1:50,000



R E F E R E N C E

SETTLEMENT	□
ROAD	———
RIVER	
STREAM	
TANK	

APSRAC

Fig 4.2

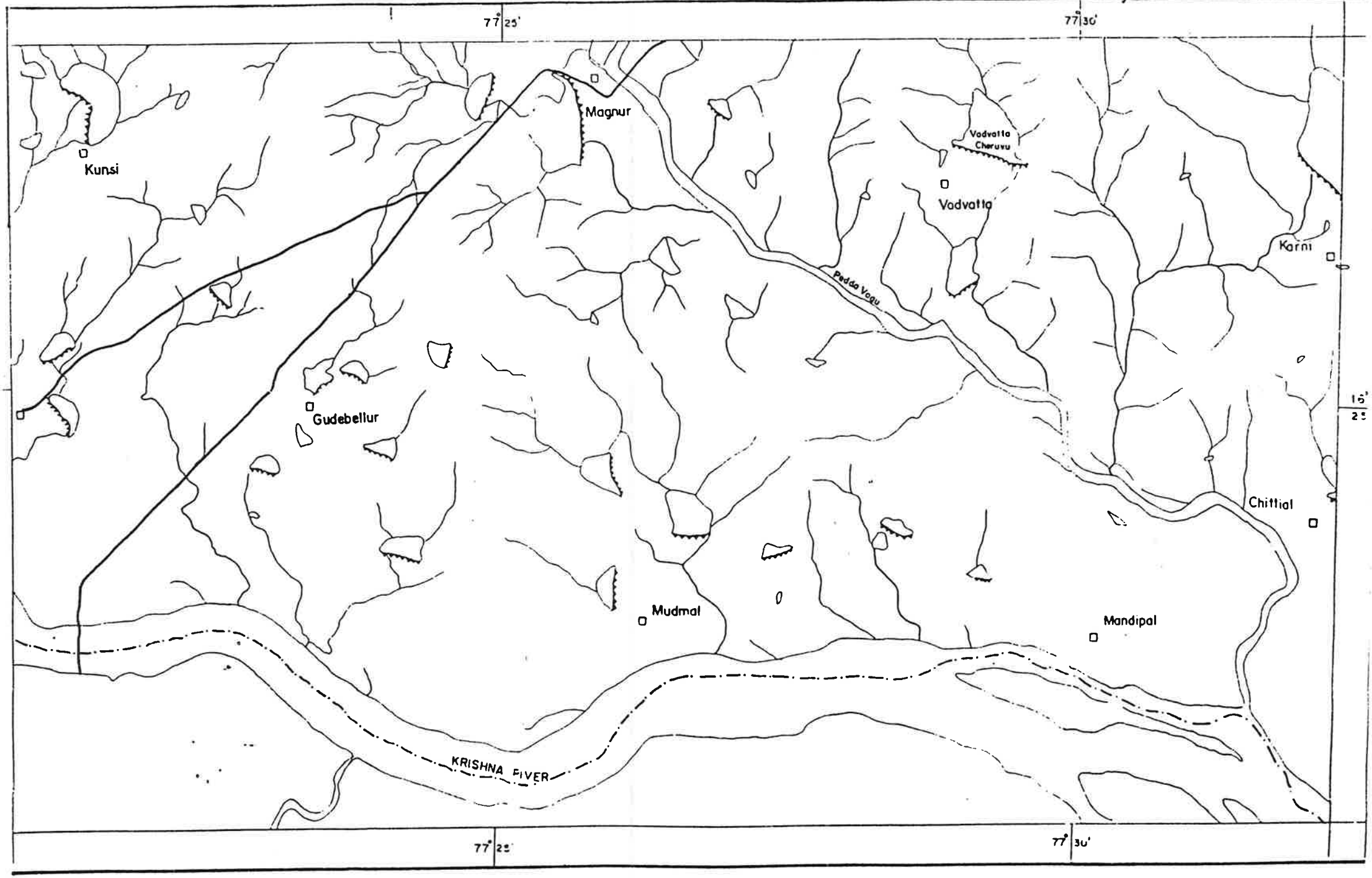
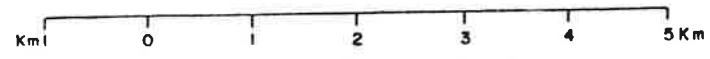

77° 25'
77° 30'
Kunsi
Magnur
Vadvatta Cheruvu
Vadvatta
Karni
Pedda Vagu
Gudebellur
Chittial
Mudmal
Mandipal
KRISHNA RIVER
77° 25'
77° 30'

Fig 4.3

INDO-DUTCH IRRIGATION PROJECT (EIA)
HYDROGEOMORPHOLOGICAL MAP
A.P.LIFT: MUDMAL VILLAGE, MAHBUBNAGAR DISTRICT

SCALE: 1:50,000



REFERENCE

MAP UNIT	GEOMORPHIC UNIT	DESCRIPTION	GROUND WATER PROSPECTS
AP	Alluvial plain	Flat Surface adjacent to stream, composed of unconsolidated fluvial sediments like gravel,sand and silt deposited by river action.	Good to very good yield ranges from 2 to 3 LPS.
PPM (Gr)	Moderately weathered	Flat and smooth surface with 5-15 mts.thick weathered material.	Moderate to good. Good yields are expected along fracture/lineament. Yields reges from 2 to 3 LPS.
BPPS (Gr)	Shallow weathered/ buried pediplain	Flat and smooth surface of weathered pediplain with 0-5 m thick weathered material covered with black soil.	Poor to moderate. Moderate yields are expected along fracture/lineament. Normally not suitable for agriculture & drinking purposes.
PPS (Gr)	Shallow weathered pediplain	Flat and smooth surface of weathered pediplain with 0-5m thick weathered material.	Poor to moderate. Moderate yields are expected along fracture/lineament. Yields ranges from 1 to 2 LPS.
P (Gr)	Pediplain	Gently sloping smooth surface of erosional bed rock between hill and plain with thin veneer of detritus.	Negligible to nil. Poor yields are expected along fracture/lineament.
TC (Gr)	Tor complex	Group of spheroidally weathered boulders rooted in bed rock which are exposed as sheet rock surfaces.	Poor
RH (Gr)	Residual Hill	Isolated hill occupying considerably small area.	Poor

OTHERS : Settlement □, Road ——, River, Stream, Tank.

APSRAC

Fig 4.3

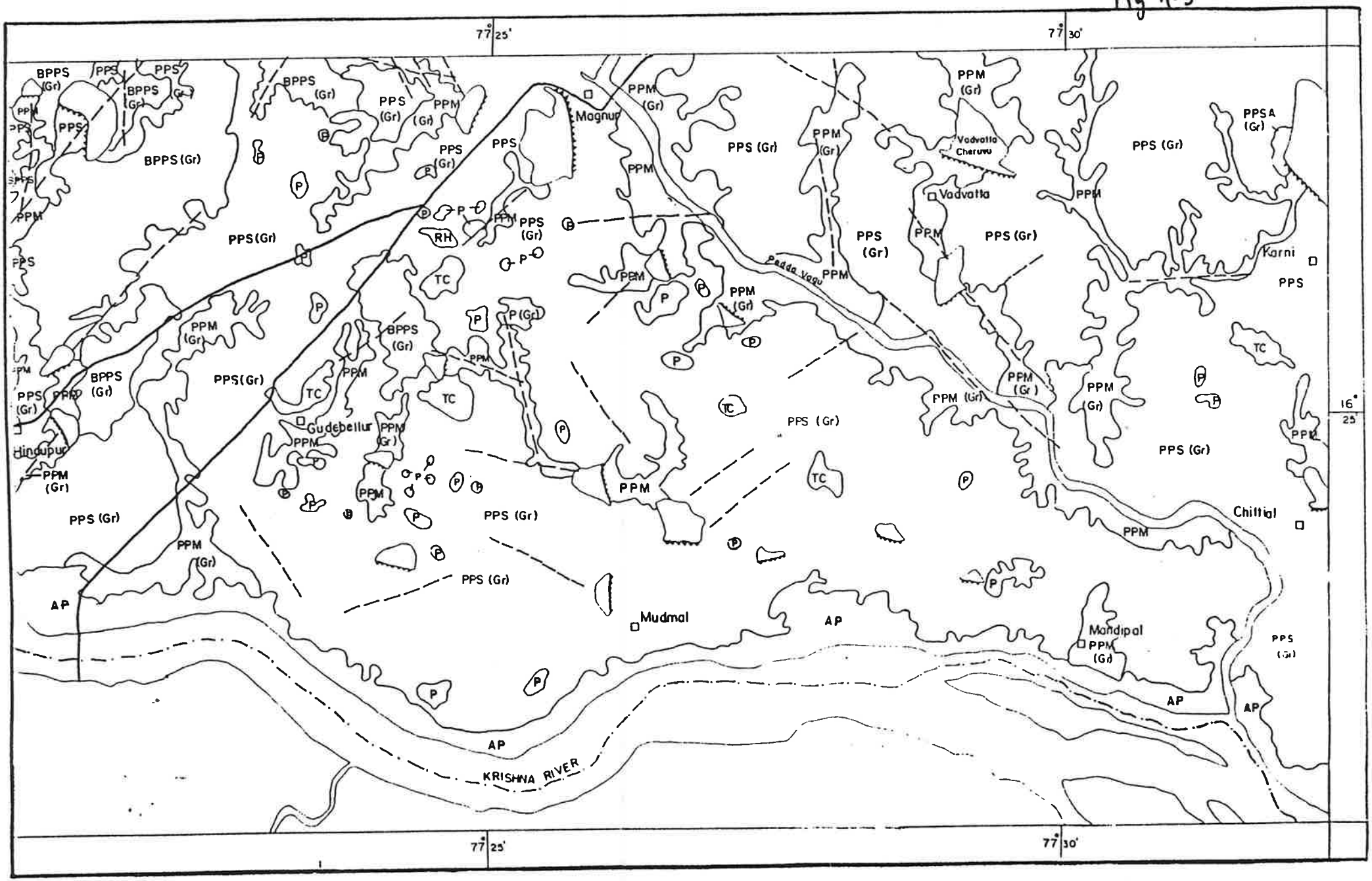
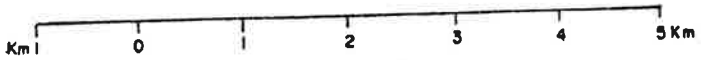

77° 25'
77° 30'
16° 25'
BPPS (Gr)
PPS (Gr)
PPM (Gr)
PPSA (Gr)
Magnur
Vadvatla
Vadvatla Cheruvu
Padda Vagu
Karni
Gudebellur
Hindupur
Chittial
Mudmal
Mandipal
RH
TC
P
AP
KRISHNA RIVER

Fig 4.4

INDO-DUTCH IRRIGATION PROJECT (EIA)
LAND USE / LAND COVER MAP
A.P.LIFT: MUDMAL VILLAGE, MAHBUBNAGAR DISTRICT.

SCALE: 1:50,000

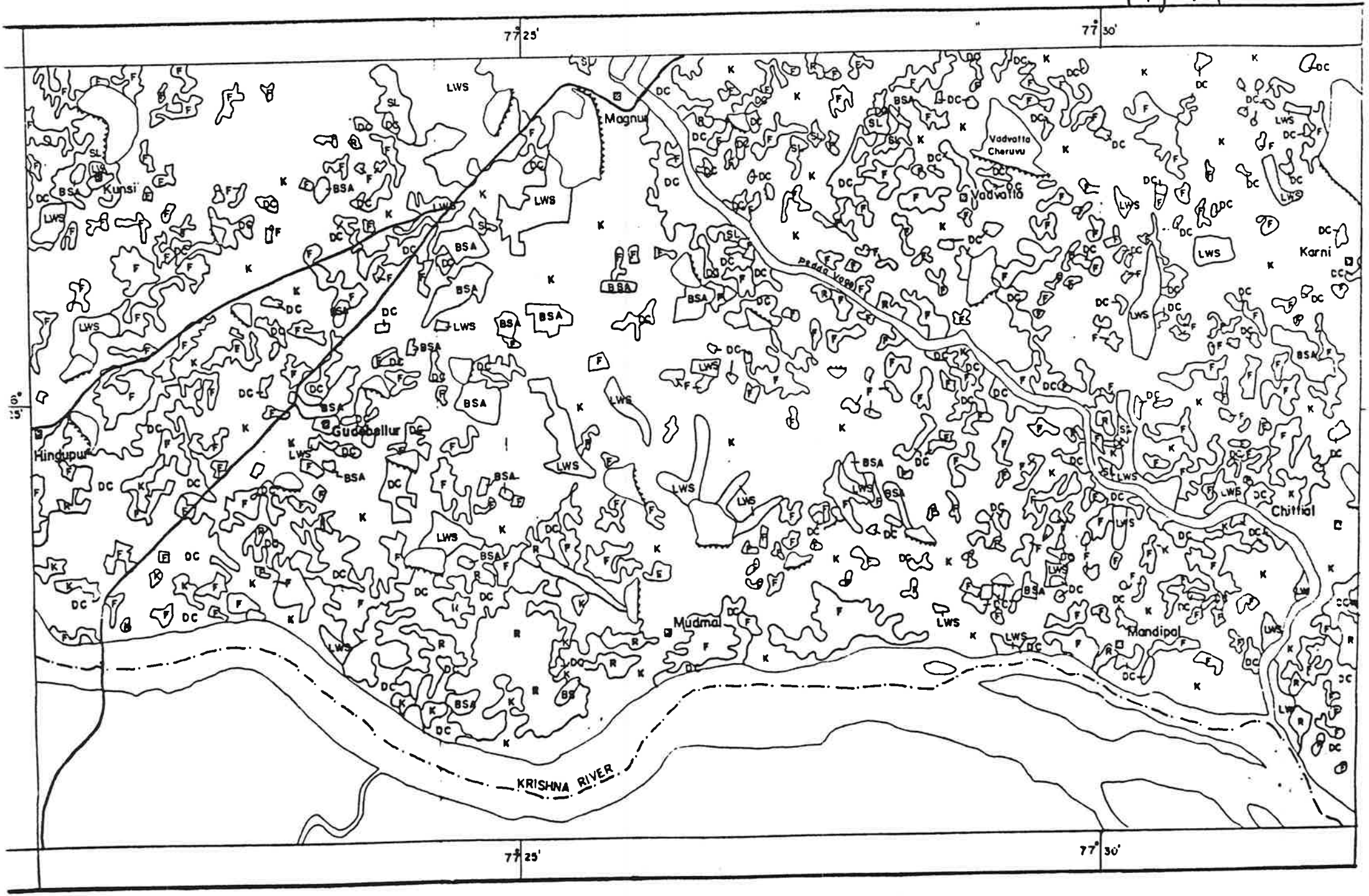


R E F E R E N C E

VILLAGE	V
KHARIF	K
RABI	R
DOUBLE CROP	DC
FALLOW	F
SALT AFFECTED LAND	SL
LAND WITH OR WITHOUT SCRUB	LWS
STONY WASTE / BARREN ROCK	BSA
RIVER	
STREAM	
TANK	
ROAD	

APSRAC

Fig H-H


77° 25'
77° 30'
15° 10'
Kunsi
Magnur
Vadvalla Cheruvu
Vadvalla
Karni
Pedda Vagu
Gudiballur
Hindupur
Chittial
Mudmal
Mandipal
KRISHNA RIVER
LWS
BSA
DC
SL
F
K
R

follows hereunder.

- Alluvial Plain
It is a flat surface adjacent to Krishna river and composed of unconsolidated fluvial sediments (gravel, sand and silt) deposited mainly by the river action.

- Moderately Weathered Pediplain (Gr)
It is a flat and smooth surface of weathered pediplain with 5-15 m thick weathered material of Archaean gneissic and granitic formations. Fractures are found in different directions.

- Shallow Weathered / Buried Pediplain (Gr)
It is a flat and smooth surface of weathered pediplain with 0-5 m thick weathered material generally covered with black soils.

- Shallow Weathered Pediplains (Gr)
This is a flat and smooth surface of weathered pediplain with 0-5 m. thick weathered material covered with red soils. Most part of the area is covered under this discription.

- Pediment (Gr)
This is a gently sloping smooth surface of erosional bedrock between hill and plain with thin veneer of detritus.

- Tor Complex
It is a group of spherically weathered boulders rooted in bedrock which are exposed as sheet rock surfaces.

Residual Hill (Gr)
This unit is normally composed of hard massive hills which are standing as residual hills, occupying considerably small area.

Land use
Nearly 80% of the area is under agriculture. Area under forests is nil. And 80% of the area is under rainfed agriculture (Fig 4.4).

Population
Total population is 5,049, with a sex ratio of 1,026. About 23% of the population are SC/STs. There are 3 fishermen families in the scheme. Number of houses are 700, family size works out to 7.

Table 4.1

Village-wise area under Mudmal scheme

Village	Total Geog Area (Ha)	Area in the Comm-and (Ha)	%	% to Total
1. Gajaramdoddi	201	119	59	6
2. Adavisathyaram	556	280	50	14
3. Punjanoor	460	222	48	11
4. Kolpur	1182	800	68	40
5. Mandipally	696	462	66	23
6. Mudmal	1841	117	6	6
Total	4,936	2000	49	100

Irrigation
Less than 20% of the area is under irrigation. Sources of irrigation are wells and streams. There are 18 borewells and 5 opens wells in the scheme area.

Potable Water
The scheme has no protected water supply service.

Expected cropping pattern
The project contemplates only ID crops. In contrast, with the advent of irrigation, paddy will be grown to the extent of 30 to 50%. Beside paddy, groundnut will be the major crop.

Socio-economics
Socio-economic information are presented comparatively with that of the control scheme in the Tables 4.2 through 4.5.

4.4.2 Mahboobnagar - Control Scheme

To facilitate identify and predict the likely adverse impacts due to the project intervention, we have drawn information from two existing schemes, Murardoddi and Pasupal LI schemes of APSIDC. These schemes are already discussed in the section 4.1.1. Further details are presented in the Tables 4.2 through 4.5.

Table 4.2

Demography and cropping pattern

(based on the information from sample respondents only)

Sl.no.	Particulars	Mahboobnagar		Prakasam	
		Proposed	Control	Proposed	Control
1.	Family size	7	6	6	6.5
2.	Sex Ratio	1356	1267	981	1017
3.	Literacy (%)	38.0	41	43.5	43
4.	Active work force (%)	57	58	49	52
5.	Labourers * (%)	30	12	26	24
6.	Holding size (Ha)	2.3	4.3	2.2	2.5
7.	Crops Grown				
	- Kharif	Groundnut, jowar, sunflower, pulses	Paddy, groundnut, sunflower chillies	Cotton, tobacco, redgram, jowar	Paddy, tobacco, cotton
	- Rabi	Nil	Onion Chillies	--	green-gram,

* in addition to owning land and raising crops

Table 4.3
Crop yield and income

Sl.No	Crop	Mahboobnagar		Prakasam	
		Proposed	Control	Proposed	Control
1.	Paddy				
	Yield	750	3750	--	7250
	Net Income	F.C.	6250	--	16000
2.	Ground Nut				
	Yield	1000	2750	--	--
	Net Income	8000	16250	--	--
3.	Jowar				
	Yield	500	--	--	--
	Net Income	1500	--	--	--
4.	Sunflower				
	Yield	500	1250	--	--
	Net Income	1250	3125	--	--
5.	Chillies				
	Yield	--	--	3000	--
	Net Income	--	--	2750	--
6.	Cotton				
	Yield	--	--	1750	3000
	Net Income	--	--	5800	13000
7.	Tobacco				
	Yield	--	--	2000	2500
	Net Income	--	--	9420	15000
8.	Pulses				
	Yield	375	--	--	--
	Net Income	2500	--	--	--
9.	Onion				
	Yield	--	3750	--	--
	Net Income	--	5000	--	--

Yield : Kgs/Hectare
Income : Rupees/Hectare

F.C.: Family consumption, & not marketed

Table 4.4
Family income

Sl.No.	Parameter	Mahboobnagar		Prakasam	
		proposed	Control	Proposed	Control
1.	Family Income (Rs)	12,400	55,700	21,448	30,600
2.	% of income due to wages	20	10	63	40
3.	Per capita per month income (Rs)	148	773*	298	392

* High value is due to larger holding size, almost double that of the other schemes. Partialling out the effect of holding size, the per capita per month income works out to Rs. 450.

Table 4.5

Fertilizer application

Sl.No.	Parameter	Mahboobnagar		Prakasam	
		Proposed	Control	Proposed	Control
1.	Normally applied fertilizers	DAP, Urea	Urea, DAP SuperPhos-phate,Complex	Urea, DAP, 20:20:20,	Urea, DAP, 20:20:20, Potash,
2.	% of farmers applying fertilizers	30	100	100	100
3.	Level of Application (Kgs/Ha)				
	Ground Nut				
	- Nitrogen	--	43	--	--
	- Phosphorous	--	43	--	--
	- Potassium	--	43	--	--
	Paddy				
	- Nitrogen	--	138	--	138
	- Phosphorous	--	48	--	118
	- Potassium	--	33	--	10
	Chillies				
	- Nitrogen	--	--	267	--
	- Phosphorous	--	--	165	--
	- Potassium	--	--	50	--
	Cotton				
	- Nitrogen	--	--	200	285
	- Phosphorous	--	--	138	288
	- Potassium	--	--	50	--
	Tobacco				
	- Nitrogen	--	--	163	193
	- Phosphorous	--	--	115	193
	- Potassium	--	--	--	--

4.5 Prakasam

4.5.1 Proposed - Adasumalli Scheme

Location
Adasumalli scheme is situated about 75 Km east of Ongole town; and is located between 80 15′ - 80 23′ Eastern longitude and 16 0′ - 16 5′ Northern latitude, covered in 65 D/8 Survey of India Toposheet (Fig. 4.5).

Physiography & Drainage
The area is a flat terrain with extensive black soil cover. The elevation is 10 m above mean sea level. The area is drained by Nallamada Vagu, a perennial stream carrying the NSP regeneration flows. It indicates that the assured irrigation is possible from the Nallamada Vagu. The drainage map of the area is presented in Fig 4.2.

Geology
The study area is underlined by Archaean gneissic complex and deltaic plain of marine sediments. The entire area is covered by black cotton soils. The alluvium is observed along the Nallamada Vagu and its palaeo courses.

Hydrogeomorphology
Hydrogeomorphologically, the study area can be divided into six units, based on landform, genesis, lithology, soils. While the detailed description of the same are available in Fig 4.6. A short writeup of the six classes - flood plain, alluvial plain, deltaic plain, shallow weathered pediplain, paleo channel and ox-bow lake - follows hereunder.

- Flood Plain
It is a flat and smooth surface and flooding occurs periodically. The area contains unconsolidated sediments like sand, clay, and silt, which are deposited by fluvial action.

- Alluvial Plain
It is also flat plain adjacent to flood plain but periodical flooding do not occur. And it contains unconsolidated sediments like sand, silt and clay, which are deposited by the fluvial action.

- Deltaic Plain
It is a gently sloping plain along the coast formed by marine action. It contains the unconsolidated clayey sandstone with shells.

- Shallow Weathered / Buried Pediplain
It is a gently sloping pediplain with 0-5 m thick weathered material covered with black cotton soils. Most part of the area is covered under this description.

Fig 4.5

INDO-DUTCH IRRIGATION PROJECT (EIA)

DRAINAGE MAP

A.P. LIFT : ADUSUMALLI VILLAGE, PRAKASAM DIST.

REFERENCE

SETTLEMENT	□
ROAD	———
RIVER, STREAM	~~~
TANK	⌓
CANAL	——•—•—•——
DISTRICT BOUNDARY	– – – –

APSRAC

Fig 4.5

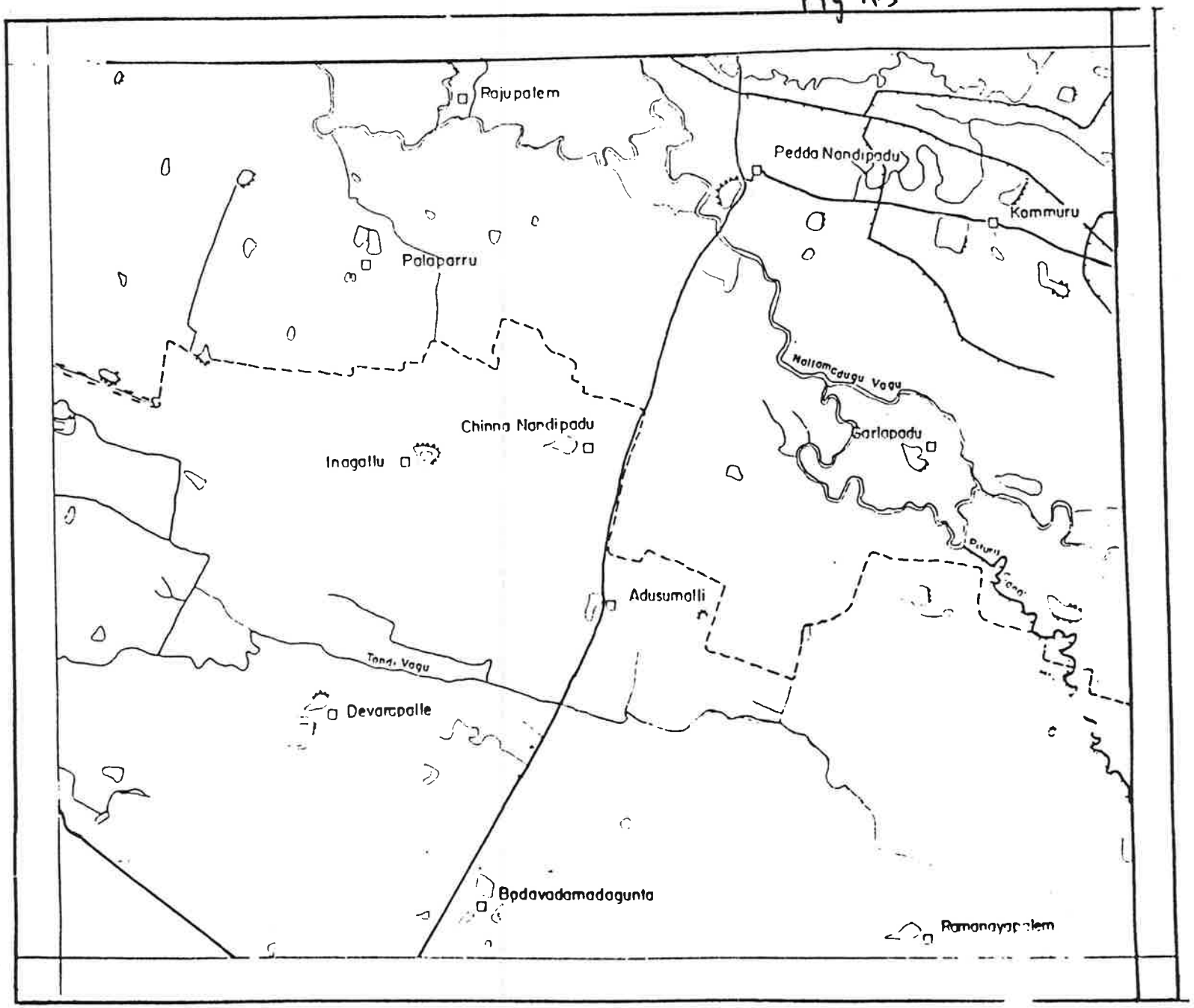

Rajupalem
Pedda Nandipadu
Kammuru
Palaparru
Nallamcdugu Vagu
Chinna Nandipadu
Inagallu
Garlapadu
Adusumalli
Tondi Vagu
Devarapalle
Bodavadamadagunta
Ramanayapalem

Fig 4.6

INDO-DUTCH IRRIGATION PROJECT (EIA)
HYDROGEOMORPHOLOGICAL MAP
A.P. LIFT : ADUSUMALLI VILLAGE, PRAKASAM DIST.

Km 1 0 1 2 3 4 Km.

REFERENCE

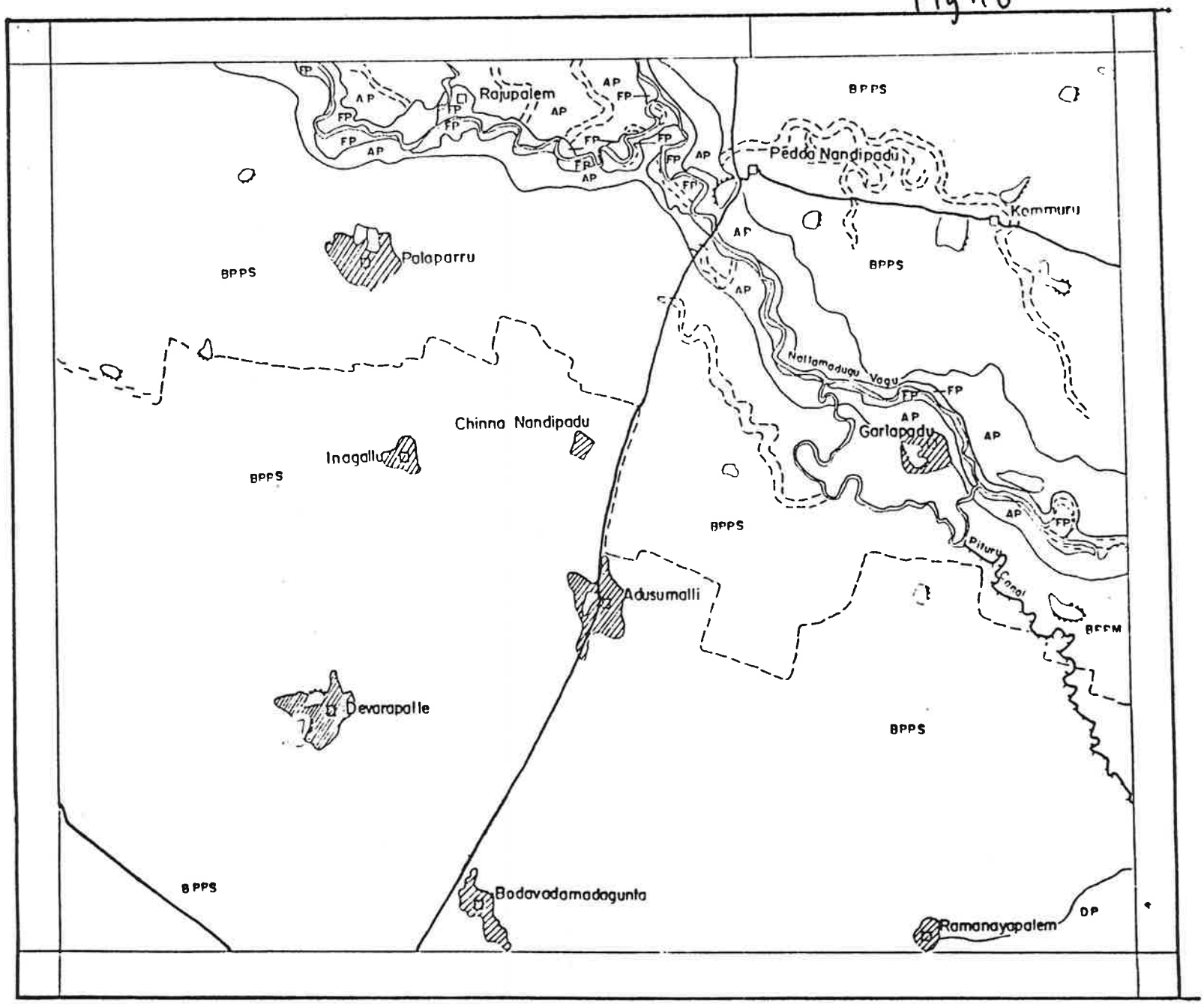
MAP UNIT	GEOMORPHIC UNIT	DESCRIPTION	GROUND WATER PROSPECTS
FP	Flood plain	Flat Surface adjacent to stream, composed of unconsolidated fluvial sediments like gravel, sand and silt deposited by river action.	Good to very good yields range from 2 to 3 LPS.
AP	Alluvial plain	Flat Surface adjacent to stream/river composed of unconsolidated material (sand, silt and clay), 5-20 m. deep.	Good to very good yields range from 2 to 3 LPS.
DP	Deltaic plain	Gently sloping plain along the const formed by marine action. Semi consolidated clayey sand stone with shells.	Good to very good. Shallow fresh water pockets are available. Suitable for filter points and ring wells.
BPPS	Shallow weathered/ buried pediplain	Flat and smooth surface of weathered pediplain with 0-5 m thick weathered material covered with black soil.	Poor to moderate. Moderate yields are expected along fracture/lineament. Normally not suitable for agriculture & drinking purposes.
	Paleo channel	Comprises fluvial deposits of varying grain size.	Excellent
	Ox bow lake	Composed of gravels, pebbels, sand and clay.	Excellent

FRCTURE/LINEAMENT

SETTLEMENT ROAD RIVER STREAM TANK

APSRAC

Fig 4.6


Rajupalem
Pedda Nandipadu
Kommuru
Palaparru
Nallamadugu Vagu
Chinna Nandipadu
Inagallu
Garlapadu
Pituru
Vagu
Adusumalli
Devarapalle
Bodavadamadagunta
Ramanayapalem
BPPS
AP
FP
DP

- Palaeo-Channel
It is a old river course of Nallamada Vagu, which is gradually changing its main course. These old course comprises fluvial deposits of varying grain size.

- Ox-Bow Lake
It is a lake located in an abandoned meandering channel and hence on a flood plain with lunate shape and composed of gravels, pebbles, sand and clay.

Land use
The entire area is under 'agriculture'. Area under forests is nil. Area under irrigation is almost nil (Fig 4.7).

Population
Total population is 11,250 with a sex ratio of 981. While 81% of the farmers are small/marginal farmers, 20% belong to the SC/STs.

Irrigation
Currently, farmers are growing cotton, tobacco and chilies, which we understand would get adversely affected if the lands are irrigated. Hence no irrigation is practiced in the area. In any case, the only possible source of irrigation is surface water lifts as ground water is highly saline.

Potable water
The villages are covered under a Dutch assisted protected water supply scheme.

Season and crop pattern
Water is to be drawn from an irrigation drainage. In addition to some water from its own independent catchment, the drainage receives substantial quantum of water from the regeneration flows of Nagarjuna Sagar project (NSP). Fresh regeneration from the NSP becomes available from August (irrigation in the upstream is May june onwards). The drain, it is natural to expect, will be carrying residual agro-chemicals, notably nitrates and pesticides. We also expect water to be polluted otherwise too, due to some 10 cotton solvent extract units (manufacturing cotton oil and cake) letting their affluents into the drainage. These units are situated in chilakaluripeta about 20 km upstream of the proposed LI scheme. Municipal waste of Chilakaluripeta town also flows into the drain. So long as water is afresh and flowing, till February March (when the Nagarjuna Sagar Project stops the issue of water), quality of water pose no problem due to the dilution effects. The moment flow stagnates, water is no longer suitable for domestic and agricultural purposes. Hence the crop season depends on the availability of good quality water.

Fig - 4.7

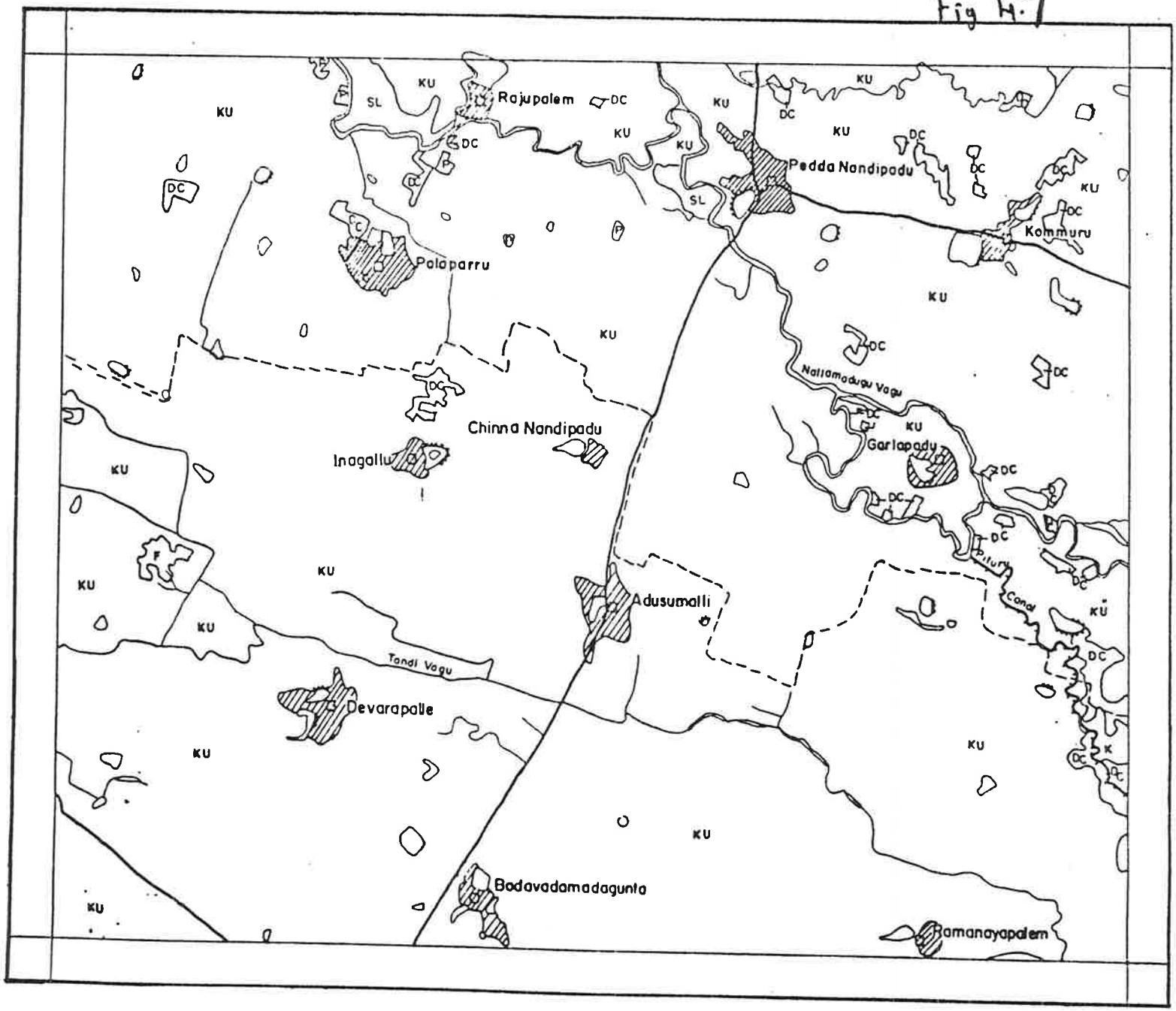
INDO-DUTCH IRRIGATION PROJECT (EIA)
LAND USE / LAND COVER MAP
A.P. LIFT : ADUSUMALLI VILLAGE, PRAKASAM DIST.

R E F E R E N C E

Built-up land	
Kharif Unirrigated	KU
Double Crop	DC
Plantation	P
Fallow	F
Salt affected Land	SL

APSRAC

Fig 4.7


KU
SL
Rajupalem
DC
Pedda Nandipadu
Kommuru
Palaparru
Chinna Nandipadu
Inagallu
Nallamadugu Vagu
Garlapadu
Adusumalli
Tandi Vagu
Devarapalle
Bodavadamadagunta
Ramanayapalem

Drinking Water
When the water is flowing from August-September through January February, villages pump out water into the tanks (using historically laid out water channels) which serves as surface storage. Water so stored is used throughout the year.

However, during february through july, villagers have no option but to the stagnated water particularly for washing. With the result likelihood of cattle catching diseases are quite high.

Tobacco
The proposed scheme was designed (about 20 years ago) to be irrigated under the Nagarjuna Sagar Project. At that time, farmers refused to avail of the irrigation facility as the same would affect adversely the cultivation of tobacco. The tobacco companies, in order to protect their interests, advised, supported and encouraged the farmers to confine to tobacco. A variety of incentives too were provided. Came the 90s, with the collapse of USSR, the export scenario changed drastically. Tobacco is no longer a profitable crop.

Cotton
Cotton occupied prominence some time during the mid 70s as a result of a good number of high yielding varieties of cotton developed by the Indian scientists. Cotton proved to be better crop than tobacco. A mix of cotton and tobacco based cropping pattern emerged. Cotton varieties, particularly the hybrid ones require not only high levels of fertilizer application, but are also highly susceptible to diseases and pests. Agro chemical manufacturers and traders took unfair advantage of the situation. The Government, on its part was not vigilant. Pesticides supplied were too much adulterated to make any impact. Consequently, over time, pests and diseases developed immunity. Today, the cotton cultivation is associated with a high degree of risks and uncertainties.

Remarks
The above described cotton scenario reflects in poor shade the R&D status in the country. The agriculture R&D which made wonders the late 60s, and mid - 70s, today is dormant. Coupled with this is the Government's apathy towards enforcing quality control measures.

Expected crop pattern
Given the tobacco and cotton scenario, farmers would like to grow paddy with the 'project'.

We would like to caution that these farmers are highly market responsive. No sooner tobacco/cotton situation improves, farmers are sure to give up paddy and switch back. In the event of which, the entire investment

under APLIFT Project would be a waste (as happened in the case of Srinivasa Lift during 70s).

4.5.2 'Control' - Srinivasa Lift Irrigation Scheme'

Most aspects of this scheme are already discussed, particularly how the scheme got grounded, later abandoned, and then revived. At the time of revival, each farmer contributed Rs. 3,750 per Ha - Rs 3,000 as a deposit towards lay out development and Rs. 750 as water charges. Currently, as against a proposed area of 1,200 Ha, only 1,600 Ha of land is availing irrigation. Other farmers are closely watching and they are not still decided about the crop - to continue cotton or switch over to paddy. But for the high risk, cotton is much more profitable than paddy.

In case 50% of the farmers decide to continue cotton, and refuse irrigation, paddy farmers will have to pay at least Rs 2,000 per Ha towards water charges. Thus, water charges in a private Lift Irrigation scheme is not only dynamic i.e., varies from time to time, being a function of the 'overall costs,' but also that it is determined to a large extent by the area under irrigation. Water charges are likely to reduce with an increase in the area, till some point, later on it reaches an asymptotic. Beyond this asymptotic reach, command will become too large to be managed effectively. Given this relationship between water rates and area, it is possible to work out the size of a scheme which is 'optimum'.

ooOOoo

Chapter - 5

Identification of impacts

5.1 Introduction

Identification of impacts is an important step in the EIA procedure. It is a first rough judgement of potential impacts of the project and should result in a list of environmental parameters that require a more detailed study. Whether or not an environmental change is serious enough to warrant detailed study depends on a number criteria such as the magnitude of the impact, i.e., the expected quantum of change, the extent of the impact, or the area that is likely to be affected, and the significance of the impact, the extent to which the expected change in the parameter will really have an effect on the biotic or abiotic environment. In other words, if the expected change in a certain parameter is very small area this parameter may be discarded from further, detailed study. In this way the number of impacts to be studied and assessed can be reduced and the impact assessment can concentrate on the relevant issues.

Potential impacts of the APLIFT project have been identified based on the information on the baseline conditions and the project activities or sources of impact. A two step approach has been followed : firstly a number of checklist have been applied to construct a gross list of impacts related to irrigation and agricultural development, secondly a scoping workshop was organised with experts in the field who discussed the gross list and narrowed down the number of potential impacts to be studied.

5.2 Impact identification using checklist

Checklists, in general, are strong in impact identification and are capable to bring the complete range of potential impacts to the attention and awareness of the researcher carrying out the impact assessment. A number of checklists and guidelines have been consulted for our purposes. Guidelines used are, a.o., the Guideline for Environmental Impact Assessment of River Valley Projects of the Ministry of Environment of the Government of India (GOI Ministry of Environment, 1985), the Guideline for Environmental Impact Assessment for water Resources Development of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP, 1990) and the Environmental Guidelines for Selected Agricultural and Natural Resource Development Projects of the Asian Development Bank (ADB, 1991). The checklists in these guidelines were consulted as well as the Leopold Matrix of Actions and Environmental Items (Leopold, 1971) and the Battelle Environmental

Evaluation System, developed by Battelle Pacific Northwest Laboratories for the United States Bureau of Reclamation (Battelle Pacific Northwest Laboratories, 1974). Most suitable for our purpose turned out to the ADB checklists, which is designed for Initial Environmental Examination (IEE) of irrigation projects. This checklist, reproduced in Annexure 5.1 served as a starting point for the discussions in the scoping workshop (see paragraph 5.3).

5.3 **The Scoping Workshop**

A scoping workshop was organised at the beginning of the project to identify the potential impacts. Besides identifying potential impacts, the workshop also served to define the scope of the EIA, including agreement on the contents and requirements of the impact statement. The workshop was also very instrumental in starting a dialogue between the various stakeholders in the project : the decision maker, the proponent/implementor, research institutes, the consultant drafting the EIA and the NGOs involved. Present at the workshop were representatives of :

- The Andhra Pradesh Irrigation Development Corporation (the implementing agency);
- The Andhra Pradesh Ground Water Department;
- The Central Research Institute for Dryland Agriculture;
- Water and Land Management Training and Research Institute (WALAMTARI);
- The International Crops Research Institute for Semi Arid Tropics (ICRISAT);
- The Rural Development and Self Employment Training Institute;
- The Maheswaram Watershed Development Project;
- The Indo-German Watershed Project;
- The Sadguru Water & Development foundation (NGO);
- The Institute for Resource Development and Social Management (NGO);
- The Administrative Staff College of India, the agency carrying out the EIA;
- VIMTA Labs (associated with ASCI in drafting the EIA); and
- The Andhra Pradesh State Remote Sensing Application Centre (associated with ASCI in drafting the EIA);

The decision maker authority of the project, the Directorate General for International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs, was represented at the workshop in the persons of the Environmental and Land and Water Sector Specialists of the Netherlands Embassy in New Delhi and the DGIS appointed advisor to the EIA study. A complete list of participants of the workshop is given in Annex 5.2

The ADB checklist was discussed in the workshop and a list of significant environmental impacts was drafted. Each of these impacts was discussed in small working groups and environmental parameters to be measured in the field were assessed.

5.4 Conclusions

At the scoping workshop it was concluded that the following potential environmental impacts of the APLIFT project required further study. The key environmental parameters related to those impacts are given as well :

- impacts on the hydrology (water quantity)
- over/under pumping of surface water
- exploitation at the expense of current/committed usages
- suspended sediments
- salinity
- nutrients
- heavy metals and pesticides
- fluoride
- pathogens
- Impacts on the soil physical and chemical status and the soil productivity
- water logging
- salinization
- alkalinization
- nutrient leaching
- soil texture
- soil permeability
- soil erosion
- impacts on the air quality
- out door air quality
- impacts on the public health; and
- impacts on the biotic environment (flora and fauna)
- encroachment into forests and swamplands
- movement of wildlife
- flora and fauna (rare and endangered species)
- downstream ecology.

In fig 5.1 the relationship between the project activities, as discussed in chapter 3, the environmental impacts mentioned above the key environmental parameters identified and the public interests that may be affected by the project are displayed. An overview of the variables that have been measured in the field and laboratory to assess the geo-hydrological conditions, the water and air quality, the soil properties, the characteristic of flora and fauna and at the public health conditions in the proposed project sites and in the control areas is presented in Annex 1. The various environmental impacts will be discussed in the order given above in the next chapters.

Fig. 5.1

PROJECT ACTIVITIES, ENVIRONMENTAL PARAMETERS AND PUBLIC INTERESTS

CAUSE AND EFFECT RELATIONSHIPS

PROJECT ACTIVITIES		KEY ENVIRONMENTAL PARAMETERS		PUBLIC INTERESTS
Before Construction		Hydrology (Water Quantity)		
- Assessment of the surface water potential at regional/ local level		- Over/under pumping of surface water		1- AGRICULTURAL PRODUCTION
- Assessment of the Surface Water potential in a particular area	-->	- Exploitation at the expense of current/commited usages		
- Check for the interference with the current usages viz.,down stream/upstream: agriculture/industry/domestic/ navigation/fishery/recreation/ waste disposal		- Disruption of hydrology		
During Construction		Water Quality		
- Construction of pumphouse and related facilities/drilling of bore wells		- Total Dissolved solids	-->	2- SOCIOECONOMIC DEVELOPMENT
- Construction of power lines/ electrification	-->	- Suspended sediments		
- Construction of channels		- Salinity		
- Lining of channels		- Nutrients		
- Land clearing and levelling		- Heavy metals		
- Watershed treatment		- Pesticides		
		- Pathogens		3- LINKAGES -FORWARD & BACKWARD
		- Fluoride		
		Air Quality		
		- Indoor air quality		
		- Outdoor quality		4- PUBLIC HEALTH
		Soils		
During Operation		- Adverse soil modifications		
- Lifting of water		Water Logging		
- Distribution of water	-->	Salinization		5- DRINKING WATER
- Cultivation of irrigated crops		Alkanization		
- Application of fertilizers and other agro-chemicals		Nutrient leaching		
- Application of irrigationwater		Soil texture		
- Discharge of drainage water channel and infrastructure maintenance		Soil fertility		
		Soil permeability from excessive sodium		
		- Soil erosion	-->	6- NATURAL RESOURCES MANAGEMENT
		Biotic environment		
Related developments		- Encroachment into forests		
- Population growth		- Movement of wildlife		
- Trade/commerce	-->	- Flora and Fauna		
- Agro-industries		- Downstream ecology		7- SOCIOCULTURAL VALUES
- Navigation				
- Fishery				

The scoping workshop participants also agreed to adopt the general impact review criteria as presented in the ADB guidelines (ADB, 1991). They are reproduced below:

-will the project cause unwarranted losses in precious/irreplaceable natural or other resources?;
-will the project make unwarranted accelerated use of scarce resources in favour of short than long term gains?;
-will the project adversely affect the national energy/foreign exchange situation?;
-will the project result in unwarranted hazards to endangered species?;
-will the project tend to decrease undesirable migration?; and
-will the project enhance the welfare of the poor and vulnerable sectors of society?

Chapter - 6

WATER QUANTITY

6.1 Introduction

In this chapter the surface water availability aspects of the APLIFT project are discussed. Special attention will be given to how far the assumptions made in the project hold good in reality, its implications on the design and thence functioning of the system as a whole. To be able to answer this question, the procedures and the management practices currently followed/adopted by the APSIDC in the development of lift irrigation schemes will be discussed. Based on this, a series of issues/questions are raised. Attempts towards resolving the same are made subsequently, with specific reference to the proposed schemes - Mudmal and Adasumalli in Mahboobnagar and Prakasam districts respectively.

6.2 APSIDC's lift irrigation development

6.2.1 APSIDC's market share

Andhra Pradesh State has an estimated number of 15,000 lift irrigation schemes. Nearly 95 percent of them are owned by the private societies. The APSIDC's share (1993-94) in the total number of lift irrigation schemes is 440 or a mere 4 percent. The irrigation potential (of 440 Schemes) is of the order of about 80,000 Ha., about 3% of the total minor irrigation acreage (see, section 2.4.2). Thus, the APSIDC's share in the irrigation market is too low to be a market leader. Given the Charter (to be confined to schemes less than 2,000 Ha.), it is difficult to be a market leader.

6.2.2 Selection and Investigation

The prospective beneficiaries have to apply for the development of a lift irrigation scheme furnishing a list with names, certificates stating their status as small/marginal or scheduled castes/scheduled tribe farmers, extent of area to be irrigated, in a preliminary agreement form, and certified by the revenue authorities, with a fee of Rs.25/Ha.

Applications are entertained subject to the scheme/command proposed for development being adjacent to a river or canal or drain in a contiguous block and the same should not have been already registered under any other irrigation source of the government.

Detailed investigations are initiated subject to the according of hydrological clearance (HC) from the Department of Minor Irrigation and that, the

beneficiaries pay an initiation fee of Rs 250 per Ha.

Beneficiaries should agree to make available free of cost the land required for the scheme. Schemes accorded hydrological clearance with no limits on season and/or duration is preferred over the conditional clearances.

The schemes are designed considering the following:

- Extent of area to be irrigated
- Crop & season, which determines the duration; and
- Pumping hours of 16 hours per day.

Normally, a duty of 40 Ha/cusec for ID crops and 20 Ha/cusec for paddy crop is adopted. The computation of which takes into the account actual crop-water requirement and duly partialling out the effect of rainfall. After the construction, maintenance rests with the APSIDC.

6.2.3 Water rates

Water rates per Ha fixed are as follows :

Kharif (paddy)	:	Rs. 1,250
Rabi (ID Crops)	:	Rs. 1,888

Water rates per Ha, a farmer has to pay to the APSIDC:

Kharif/Rabi paddy	:	Rs. 188
Rabi ID/groundnut	:	Rs. 125
Other Commercial Crops (except sugarcane)	:	Rs. 188

The difference between water rates fixed and water rates levied is reimbursed by the Government of Andhra Pradesh as subsidy.

6.2.4 Key issues/questions

Whether or not sufficient water will be available for development of a lift irrigation scheme at a certain point along the water source (river/stream/drain) depends both on the river (the supply) and the present as well as future competing demands made on the water. Demand and supply, however, are to be worked out not on a local, but at a river basin scale. In effect, this should get reflected in the Master Plan for water resources development made on the basis of intra-and inter- basin-linkage computations. A simple evaluation of surface water availability for regional/national boundary-use can be based on the total river water quantity. It provides a direct measure of water quantity and hence the availability of this for specific uses. Provided good data are available, it is easier to compute the expected volumes of water per year or per

month, and the usage allocations thereof.

It is often necessary to establish short and long term fluctuations in water quantity in relation to basin characteristics and climate, probably designing the system on a 10% dry year. The probability distribution of the run-off data, the standard deviation of calculated means and the occurrence of extreme values have to be taken into account explicitly. If run-off data are few, but long-period rainfall data are available, rainfall-run-off models may be applied. In the absence of both run-off and rainfall data, remote sensing images or opinions of local farmers may give a very rough estimate of water availability.

In assessing water availability it is very important to take also into account future developments considering the water use in the river upstream of the proposed intake point. Large reservoirs and associated off takes, either planned or under construction, may considerably change the river hydrology, as expected in the case of the Upper Krishna reservoirs. Increasing population and related drinking water demands as well as an increase of water extraction for irrigated agriculture in the upstream reach should be accounted for as well. Finally, an increase in the groundwater extraction in the upland areas will decrease the river's base flow.

Time horizons to be taken into account to estimate future development should at least cover the project's lifetime (15 years ?); from the point of view of sustainable development a longer period (50 years) is preferred.

For the calculation of the water requirements not only the requirements of the proposed scheme have to be taken into account, but also the requirements (demands) of other users and uses in the river reach downstream of the proposed scheme. These comprise demands for irrigation, drinking water, industrial water and ecology (e.g. some rest flows may be needed to prevent saline water intrusion). Again, a time horizon of at lest 15 years, but preferably more, should be taken into account.

Questions related to water availability:

- what is the exact procedure followed to obtain hydrological clearance? Is this procedure adequate for our purpose? If not, what modifications are required?
- are water resources development master plans available?
- are upstream water use developments taken into account, both regarding surface water use and

groundwater extraction, how are the demands assessed?
- are downstream water demands taken into account, if so which users/uses are dealt with and how are they assessed?
- what are the time horizons applied ?
- are existing and possible future private (illegal) abstractions taken into account? If not how can these abstractions be estimated?
- what will be the impacts if irrigation water (in a lift irrigation scheme) demands are not met in 5, 10, 15, or 20 years?

In the following sections, we attempt to answer the above questions with specific reference, but separately, to the lift irrigation schemes in Mahboobnagar and Prakasam.

6.3 Water availability at source

6.3.1 Proposed Lift Irrigation Scheme - Mahboobnagar

As mentioned earlier, for the EIA, we chose Mudmal Scheme, on the banks of the river Krishna, proposed to irrigate some 2,500 Ha spread across 5 villages. This scheme has hydrological clearance (HC) accorded by the Minor Irrigation (MI) Department. However, no guarantee on quantity or quality of the available water is given (Annex-6.1). Regarding the data used and the procedure adopted in giving the HC, the Chief Engineer, MI office (HC - issuing authorities) directed us to their District office in Mahboobnagar. After being made to shuttle between the Head and the district offices, we were advised to approach the Central Water Commission (CWC), Government of India. They, we understand, monitor the flows in all major rivers including Krishna. The CWC demanded an official letter of request from the APSIDC who readily complied (Annex-6.2). In response, the CWC wrote back (Annex-6.3) that the river data compiled annually, in 'Water-year books', are regularly sent to the Minor Irrigation Department, and we should approach them only. Efforts to lay our hands on the 'Water-year' book in the M.I department proved futile. Andhra Pradesh government's decision to not part with the data is not without reasons. The Krishna water is to be shared by the states of Maharashtra, Karnataka and Andhra Pradesh. At present, sharing of water is governed by a Water Tribunal Award which, however, lapses by 2000 A.D. Currently, the upper riparian states of Maharashtra and Karnataka are able to utilise upto a maximum of 60% of their allocations. The unutilised water is being enjoyed by Andhra Pradesh. That the new allocations are expected to be worked out in 2000 A.D., each of the three state governments is maintaining secrecy as regards water flows and utilisation.
At every step, the message conveyed was that Krishna is

a perennial river and that the proposed lift irrigation scheme would account for a tiny fraction of the river flows. But, the fact that 10 lift irrigation schemes are envisaged to be developed in the district, urged further enquiry. The salient points of which are:

i) Andhra Pradesh has Maharashtra and Karnataka as the Upper riparian states so far as Krishna river is concerned. According to the basin-wise allocation (1993 estimates), Maharashtra is to utilise 500 TMC and Karnataka 700 TMC of water. Against this, current utilizations are of the order of about 300 TMC and 450 TMC or about 60% only. The remaining (40%) unutilized allocation is currently being utilized by Andhra Pradesh. Completion of the irrigation projects particularly in Karnataka, hence, will certainly result in the reduced availability of water to Andhra Pradesh. Given the pace of development in Karnataka (project construction started in early 60s), we do not expect it to be completed before 2025 AD. The likelihood of Mudmal lift irrigation scheme affected adversely, hence, is not envisaged.

ii) It is instructive to know that the APLIFT Project Document states :

"Surface water for lift irrigation schemes is available mainly from the river Godavari and its tributaries, some irrigation canals and drains. In the Krishna basin, water availability for irrigation is critical, as water lifted from this river will be at the expense of downstream uses and commitments. In the Pennar basin there is no water available any more for new irrigation."

Yet, the lift irrigation schemes are proposed on Krishna river.

iii) In response to the above, we are informed that APSIDC contemplates further development of lift irrigation schemes not on the river, but on the drain and the foreshore of reservoirs. Moreover these schemes would be designed for one season irrigation only. Lifts designed on the fore shore of reservoirs should not be located near the Full Reservoir Level, but on realistic estimate of Water levels. Consequently the entire machinery should be able to with stand flooding.

Judging on the above discussions, we do not envisage any likelihood of lift irrigation schemes in Mahboobnagar being affected adversely as a result of insufficient availability of water.

6.3.2 Proposed lift irrigation scheme - Prakasam

Adasumalli scheme in Prakasam draws water from a drainage (Ogeru villages. The water source is mostly due to regeneration flows from the Nagarjuna Sagar Project (NSP) which has an irrigation potential of about 800,000 Ha. The Adasumalli scheme and the adjoining areas were earlier (15-20 year back) envisaged to be irrigated under the NSP. But during that period, farmers refused irrigation for it would have affected cultivation of tobacco, the then most profitable crop. Taking advantage of the earlier plan, the APSIDC has proposed several lift irrigation schemes on this drain. Being in the purview of a command area of a Major Project, detailed information about the water availability are available. And based on the same, HC is accorded. The water budgeting computations are furnished in the Table 6.1.

Thus, currently, sufficient water is available for Adasumalli lift irrigation scheme. But, the estimates depend heavily on rainfall and regeneration flows. Particularly, the latter is critical as NSP is on the Krishna river, and is bound to be affected by the pattern of Water utilization in the upper riparian states. But, we understand that plans are afoot to interlink Krishna and Godavari (Polavaram barrage) rivers, and the same will off-set reduction in Krishna.

If the APSIDC follows the above procedure for other proposed lift irrigation schemes as well, water availability can be ensured fairly accurately in the Prakasam district. 'Water availability', however, is more like a potential, and its realization depends upon the point(s) of water intake, system design and the usage of water.

6.4 Water Lifting

6.4.1 Proposed lift irrigation scheme - Mahboobnagar

Water lifting or intake point(s) should be such that maximum water can be lifted for most months in an year at the lowest cost. For this, the intake point should be chosen such that i) water should be hugging towards the point; ii) length of the main pipeline should be minimum; iii) the main pipeline should end in the highest command point so that water can flow freely by gravity; and iv) that the entire command receives water. Given these requirements, this section is devoted to assess the (merits and/or demerits) of alternative water intake points(s).

The APSIDC proposed the following intake points (Fig 6.1) to lift Water such as to irrigate 2,000 Ha of land:

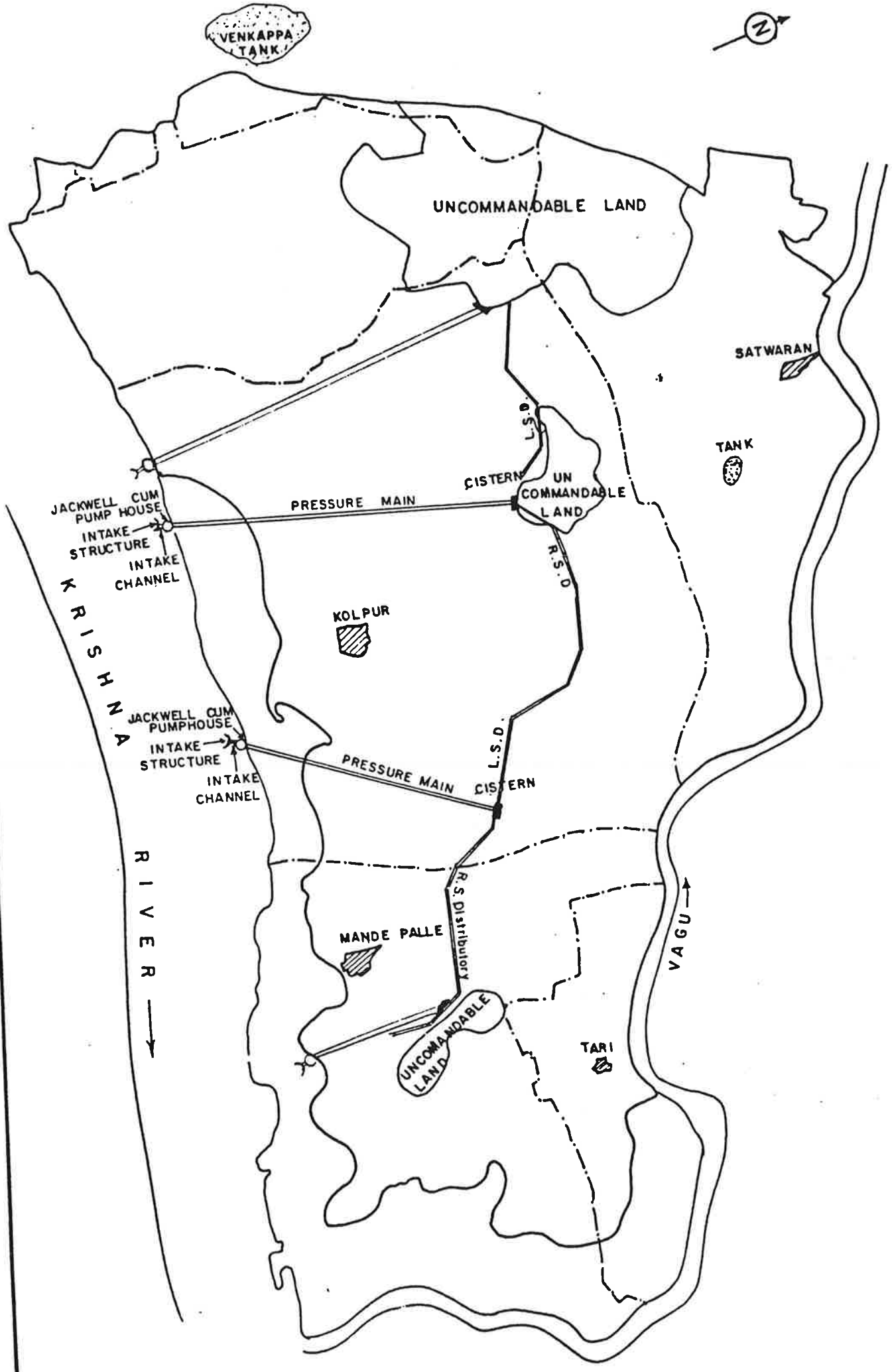

VENKAPPA TANK
N
UNCOMMANDABLE LAND
SATWARAN
TANK
L.S.D.
CISTERN
UN COMMANDABLE LAND
JACKWELL CUM PUMP HOUSE
INTAKE STRUCTURE
INTAKE CHANNEL
PRESSURE MAIN
R.S.D.
KOLPUR
KRISHNA RIVER
JACKWELL CUM PUMPHOUSE
INTAKE STRUCTURE
INTAKE CHANNEL
PRESSURE MAIN
L.S.D.
CISTERN
R.S. Distributory
MANDE PALLE
VAGU
UNCOMMANDABLE LAND
TARI

Table 6.1

Adasumalli water budgeting

Water demand from APSIDC		
HC accorded for :		Cusec
i) Inagallu Scheme	: water to irrigate 660 Ha of paddy; and	39.6
ii) Adasumalli Scheme	: water to irrigate 1,040 Ha of paddy	62.4
		102.0

Water Supply	
a) Total Catchment area of Ogeru Vagu of the of the proposed site at Adasumalli (sq km)	465
b) Discharge available at the proposed site from the catchment (Cusec)	374
c) Discharge available from regeneration flows (Cusec)	108
Total	482

Competing demands	
Upstream - (upto 1989)	Cusec
a) N.S.P - 18 Schemes	63
b) Minor Irrigation Dept Schemes	84
c) Telugu Grameen Kranti Patham	14
d) APSIDC	145
e) Private L.I. Schemes [after 1989]	12
f) N.S.P	50
g) Down stream demands	70
Total	338
Surplus of supply over demand	144

Intake I: Could be called **Punjanoor** intake as it is nearer to Punjanoor village. The flow is such that water is available throughout the year, except probably for 3 months in summer - March, April and May. Depth of water is quite high. Water is ensured even in a drought year.

Intake II: Could be called **Kolpur-I** intake as it is nearer to Kolpur village. Flow is similar to that of intake-I. Water availability is not adequate during drought years

Intake III: Could be called **Kolpur-II** intake as it is also nearer to Kolpur village. Water availability is not adequate particularly during the lean season i.e. January onwards. Some investments to the extent of Rs 1 Lakh towards river training is necessary to ensure adequate flows during the lean season

Intake IV : Could be called **Mundpally** intake as it is nearer to the Mundapally village. Water availability during the months January through May is not possible due to the presence of some sort of an island. This calls for substantial investments to blast the whole island and train the river for about 2 km. and the investment would be about Rs. 10. Lakh

As a first step, 9 alternative intake points were considered for further appraisal. The list of alternatives are presented in Table 6.2. It can be seen from the table that the alternative intake point(s) are appraised in terms of the following parameters.

* Water flow in the river [at the point (s)];
* Sufficiency in water availability, so as to ; irrigate 2,000 Ha; and
* Initial Investment

Net requirement of water is 50 cusec or the duty is 40 Ha/cusec. The gross requirement would be 15-35% higher depending on the extent of loss in water conveyance/distribution, Conveyance loss will vary between 15-25% if channels are lined and 28 to 35% if channels are unlined. In extreme cases, the loss could be as high as 40%. The gross requirement, accordingly varies. A comparison of the initial investment among the points which offer sufficient water, led us narrow down ourselves to two alternatives:

(i) Intakes I, II & III; and
(ii) Intakes II & III.

These alternatives were further subjected to a comparative appraisal (Table 6.3) in terms of

* Capacity of the pump (expressed in HP),
* Consequently, initial investment,
* Power consumption,
* O & M expenses, and
* Water loss.

Table 6.2

Intake point alternatives - First stage

Parameter	I	II	III	IV	I&II	I&II &III	I&III	I&II III&IV	II&III
1) Water availability of in the river	***	***	**	*	***	***	***	***	***
2) Sufficiently to cover 2,0005 Ha	***	***	**	*	***	***	**	***	***
3) Net requirement (Cusecs)	50	50	50	50	50	50	50	50	50
4) Loss (Conveyance)									
- Lined	25%	25%	NC	NC	20%	15%	20%	15%	20%
- Unlined	35% (40%)	35%	NC	NC	33% (35%)	28% (33%)	35% (40%)	25% (30%)	30% (35%)
5) Gross requirement									
- Lined	62.50	62.50	NC	NC	60.0	57.5	60.0	57.5	60.0
- Unlined	67.50	67.50	NC	NC	66.5	64.0	67.0	62.5	65.0
6) Initial Investment (Rs)									
- Lined	NC	NC	NC	NC	NC	35 million	NC	40 million	30 million
- Unlined									

*** : Very Good ** : Good * : Poor
Figures in the brackets refer to the maximum values
NC : Not Considered for insufficient Water availability.

Based on the above, Intake combination of II & III scores over I, II & III.

Table 6.3

Alternate intake points - Final stage

Parameter	ALTERNATIVES	
	I II & III	II & III
1. Capacity of the pump (HP)	1100	1050
2. Initial investment (Rs. Million)	35	35
3. Power consumption	No Difference	
4. O & M expenses	* *	*
5. Water loss Lining Vs Unlined	*	* *
6. Differnce in conveyance loss	6.5%	6.5%
-consequently reduction in HP	120 (980)	100 (950)
-reduction in investment (Rs.million)	6	5
-additional cost due to lining (Rs.million)	3.5	4
7. Net Investment (Rs.million)	32.5	29

** : More * : Less
Figures in the brackets : Net Capacity (HP)

Lined Vs Unlined Channels
Lining the irrigation channels will result in the reduction of water loss to the extent of 5 to 6.5 percent. Consequently, the system can be designed for lesser capacity motor, and hence a reduction in initial investment. Additional cost, due to lining however, should be considered.

Ultimately, we zeroed down to the intake combination of II &III with lined channel. However, if the central objective is 'People's' Participation', then it is better to have more number of intake points so that area and hence the number of farmers to be served by a point is less, thereby facilitating easy mobilisation. In such a case, cost implications are obvious.

The above exercise indicates the need and the importance for formulating alternative water intake points and appraise the same to arrive at technically feasible, cost effective and socially acceptable intake point(s). Further, wherever possible the irrigation channels should be lined as it will not only save the scarce water resources but also prove cost effective in the long run. This exercise is entirely done by the APSIDC with a catalytic input from the ASCI.

6.4.2 **Water lifting - Prakasam**

Given that the command is rather longish in shape (Fig - 6.2), and that the head is low (less than 12 meters), it is more draining out water than lifting. Purely from technical considerations, a single intake point is sufficient to irrigate 1,040 Ha. But, from a cost perspective it is altogether different.

The Andhra Pradesh State Electricity Board (APSEB) power tariff is fixed depending on the capacity of the motor (HP). Farmers/societies with a motor of capacity of less than 70 HP are to pay power tariff on a fixed basis i.e., Rs.400/HP/annum, irrespective of the power consumed. If the capacity is more than 70 HP, tariff is @ Rs 1.10 per unit of consumption. If the farmers are to manage the system themselves, as envisaged in the project, it is always advisable to have a cost effective system. Hence, the two alternatives based on the power tariff differentials are:

Alt I : One society with 4 motors of 125 HP each (normal/traditional); and
Alt II : Eight societies with a motor of 70 HP each. The design should be such as to project 8 Societies, though, for practical purposes it is still a single scheme.

Power tariff per annum in the case of Alternative I (16 hours of pumping/day for 120 days) would be about Rs 10 lakh. The same for Alternative II is Rs.400 x 560 = Rs 2.24 lakh. Also, subject to water availability, even a second crop can be planned at zero power cost. On the other hand, raising a second crop under Alternative II would mean an expenditure of another Rs. 10 Lakh. Initial investment remains the same in both cases. We understand that the APSIDC has already toyed with this idea else where in the state. Large scale application is constrained for want of lower capacity motors but with higher discharges.

6.5 **System design, crops** and **water utilization**

In this section, we discuss how far the assumptions made in the project hold good in reality and its implications on the design of the system.

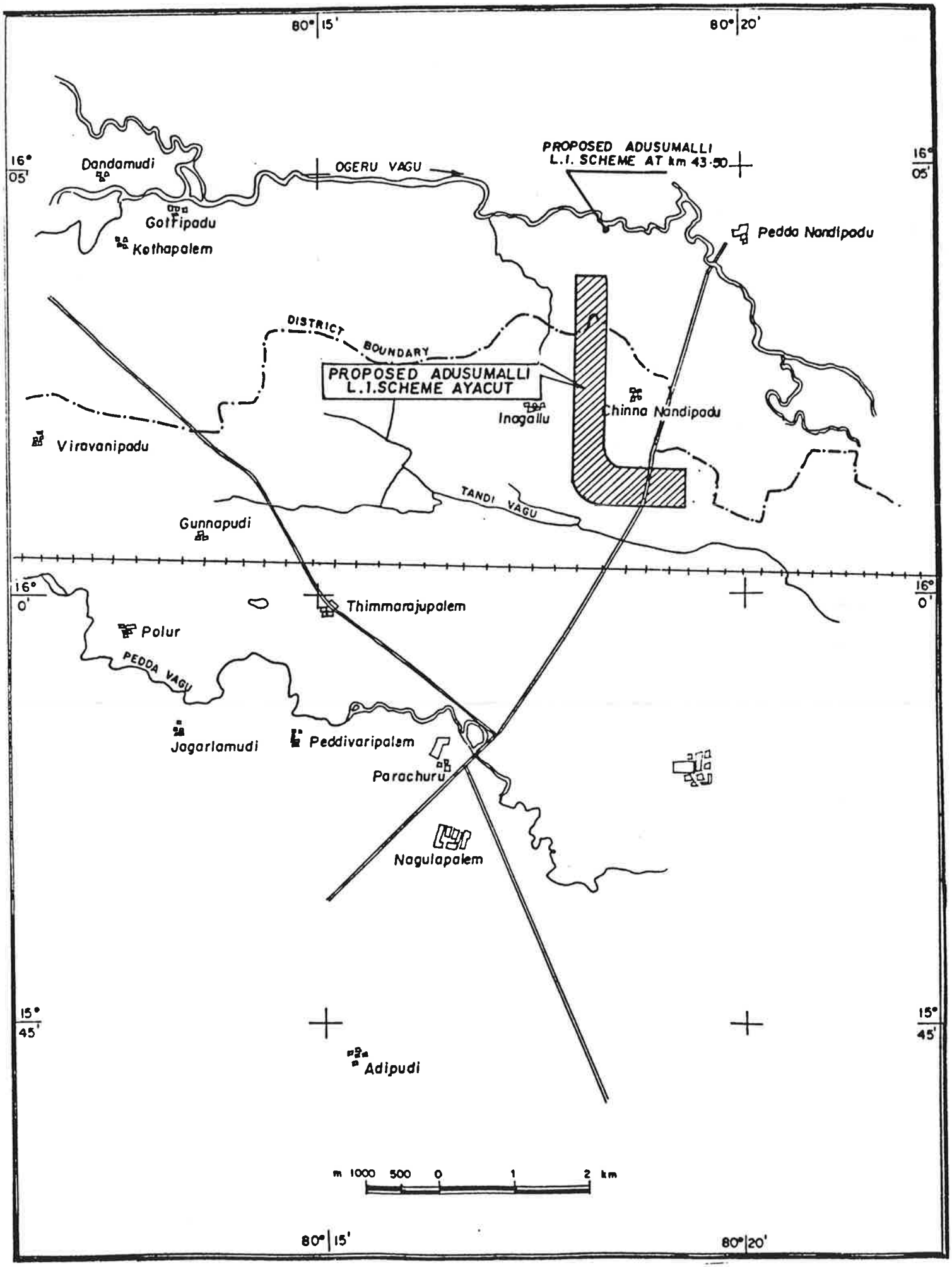


FIG.6.2 ADUSUMALLI INDEX MAP OF L.I SCHEME

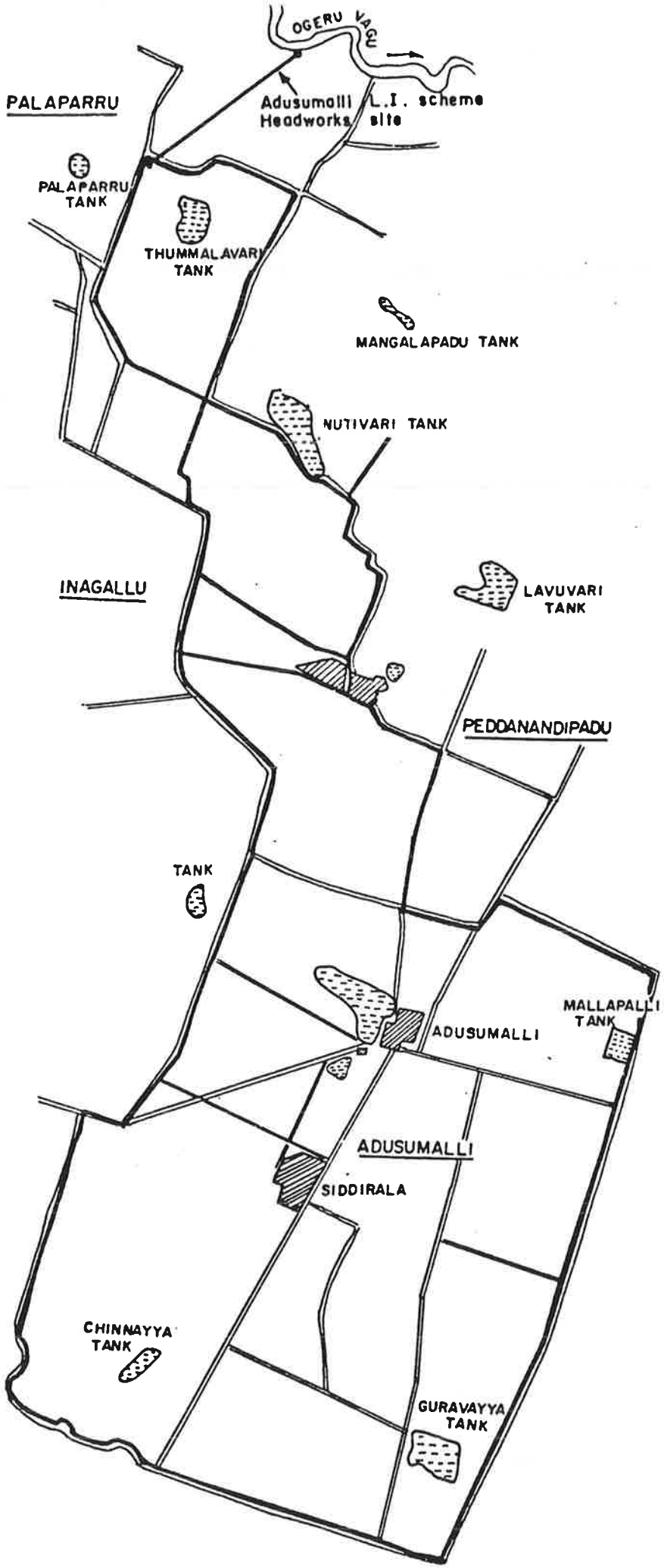


FIG 6.2 SCHEMATIC MAP OF ADUSUMALLI ROUTINE

6.5.1 Proposed lift irrigation scheme - Mahboobnagar

A major assumption on which the entire water budgeting, and hence the system design, is dependent, is on the 'crops' likely to be grown by the farmers under irrigated agriculture. The project assumes and, infact, the hydrological clearance is given only for the cultivation of ID crops like jowar, groundnut, sunflower, pulses etc, which require at the most 8 Ha Cm of water. However much the desire may be on the part of the farmers to grow ID crops, particularly groundnut (commercially good proposition), in reality they will start to grow paddy, initially with an intention to meet the home-consumption needs. Water table around the paddy fields rise and renders the cultivation of ID crops impossible. As a result, the paddy area spreads out and commonly 30 to 50% of the irrigated area is under paddy after 5-6 years. Paddy requires normally about 24 Ha Cm of water (more in this area as water holding capacity of the soils are poor), and hence uses nearly all the water (meant to irrigate the entire command). Thus, some 20% of the area will not receive water at all, resulting in conflicts between farmers.

Seepage is another problem related to paddy cultivation, in the studied (control) schemes, some 30% of the area had become water logged and return flows, in the form of small streams are very high (up to 30%). Furthermore, illegal lifts, currently operated with diesel pumps cannot be excluded from drawing water from the APLIFT scheme. Diesel costs being very high, farmers would draw water from the APLIFT scheme rather than operating on their own.

Taking all the above into account, water would be required for 2,800 Ha (based on ID norms) as against the proposed 2,000 Ha, an increase of 40%. This is not taken into account in the system design.

Other reasons for the waterlogging and distribution problems are related to the fact that distributory canals are not lined, resulting in seepage into the fields along the canals. Blocking of the canals due to sedimentation and excessive aquatic weed growth (AAP) is also common. The water flow stagnates and water sweeps into the adjacent fields. Sedimentation is mainly a result of trampling of the unlined canals. Unlined channels have a natural tendency to depreciate very fast (unless maintained properly and regularly) widening/changing the water flows.

Social differences/problems coupled with poor design of the layout of the system are also mentioned as reasons for tail-end and water-logging problems.

Poor performance of the irrigation schemes, in the sense

that, not only large amount of water are lost, but also that average yields are low, is attributed to complete lack of irrigation and agricultural extension.

6.5.2 System design, crop and water utilization proposed lift irrigation scheme - Prakasam

Adasumalli Lift Irrigation scheme, proposed to irrigate 1,040 Ha spread across 3 villages, is to draw water from Ogeru drain. The expected cropping pattern is paddy. And the hydrological clearance is accorded for paddy. Duty is worked out following the norm, of 20 Ha per cusec with a 20% provision for losses. Scheme has black soils and hence possess high water holding capacity. Accordingly, the system is designed for a discharge of 25 Ha per cusec. Well laid out distribution channels linking the tanks in the scheme area with the drainage, developed for drinking purpose (many years ago) already exists. The same is now not utilized as the villages are already covered under a Dutch assisted Drinking Water Programme. The APSIDC plans to utilize the same for the Project. Growing paddy, characteristically, on black soils my result in water logging unless drainage is planned properly which, we understand, is being taken care of.

Conclusions

A system, designed considering the sufficiency in water availability at source, crops expected to be grown and a realistic delineation of the command, will function effectively. The system design is infact the basic prerequisite for the well-functioning of the system. Moreover hydrological clearance should be in conformity with the system design. Any divergence or mis-matching would eventually result in the collapse of the system, as noticed in the case of control sites in Mahboobnagar.

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Chapter 7

WATER QUALITY

7.1 Introduction

In this chapter the water quality aspects of the APLIFT project will be discussed. From an environmental point of view two topics should receive attention: the suitability of the surface water for irrigation and the quality of the water draining the irrigated areas, which may influence the downstream ecology and water use. Besides, attention is paid to the suitability of the surface water for domestic purposes, since it is to be expected that the surface water will, at least on some occasions, also be used for drinking purposes.

Water quality primarily refers to the presence of inorganic and organic constituents in the water as well as its bacteriological condition. Water quality data are required to assess the suitability of the water for a particular use, and, in the case the water is used for irrigation, to design the required drainage infrastructure. Water quality is dependent on the hydrological characteristics and the pattern of upstream usages. Besides, drainage conditions, coastal saline water intrusions and human activities, like the application of fertilizers and pesticides and bathing and washing of laundry, influence the water quality.

Suitability for irrigation
The characteristics of the water which determine its suitability for irrigation are the total concentration of soluble salts (TDS), the relative proportion of sodium to other cations (the Sodium Absorption Ratio, SAR) and the concentration of boron and other elements which may be toxic.

According to the US Salinity Laboratory, irrigation water salinity can be classified into six conductivity classes (see table 7.1). Whether or not water with a certain salinity is suitable for irrigation also depends on the nature of the soil and the crops to be grown. Sandy soils for example can be irrigated with more saline water than clayey soils, because the salts are leached easier. Besides salinity, the sodium hazard, the probable extent to which a soil will absorb sodium from the applied irrigation water, is of importance. The relative activity of sodium ions in exchange reactions with the soil is expressed in the Sodium Exchange Ratio (SAR), which not only depends on the sodium content of the water, but also of the calcium and magnesium concentrations. The sodium hazard increases with increasing levels of salinity.

High SAR values have a negative impact on the soil's physical condition. The classification of irrigation water on the basis of SAR values is based on these

Table 7.1 **Irrigation water salinity classification (Source: Agricultural Compendium, ILACO, 1985)**

Class	EC.10^6	Characteristics
C1	<250	low salinity hazard, water can be used for most crops on most soils
C2	250-750	moderate salinity hazard, water can be used with moderate leaching for most crops
C3	750-2,250	medium-high salinity, water for use on soils with moderate/poor permeability and crops with moderate/good salt tolerance, leaching is required
C4	2,250-4,000	high salinity hazard, water for use on well permeable soils with salt tolerant crops, special leaching required
C5	4,000-6,000	very high salinity, water generally undesirable for irrigation, to be used only on highly permeable soils with frequent leaching and highly salt tolerant crops
C6	>6,000	excessive salinity water, unsuitable for irrigation

Table 7.2 **Sodium hazard classification (Source: Agricultural Compendium, ILACO, 1985)**

Class	Description
S1	low sodium water that can be used on virtually all soils. The risk of soil structure deterioration is low, Sodium sensitive plants may suffer from sodium accumulation
S2	medium sodium water, can be applied on coarse textured or organic soils, but may give problems on fine textured soils, especially under low leaching conditions
S3	high sodium water, only to be used in combination with high leaching, good drainage and chemical and organic soil improvement
S4	very high sodium waters, generally unsuitable for irrigation

impacts on the soil structure and is given in table 7.2.

Of importance to determine the suitability of the water for irrigation are also the content of boron and iron and aluminium sulphates. Boron is essential to the normal growth of all plants, but the quantity required is very small. Too high quantities may prove toxic to certain species.

Normally, river/drain/stream waters from which the APLIFT project contemplates lifting water, are reported to be suitable for both irrigation and drinking purposes.

Suitability for domestic purposes
Indian national and international water quality standards, as given by the World Health Organisation (WHO), are given in table 7.3 and 7.4.

Table 7.3

Maximum allowable concentrations of selected water quality variables for drinking purposes
(INDIAN STANDARDS - IS10500 : 1991)

Sl No.	Substance or Characteristics	Requirement (Desirable limit)	Permissible limit in the absence of alternate source
i	Dissolved solids	500	2000
ii	Turbidity	5	10
iii	pH value	6.5 to 8.5	---
iv	Total hardness	300	600
v	Nitrate	45	100
vi	Chlorides	250	1000
vii	Sulphate	200	400
viii	Boron,	1	5
ix	Fluoride	1	1.5
x	Calcium (as Ca)	75	200
xi	Iron (as Fe)	0.3	1.0

All values are in mg/l, except turbidity, hardness & pH

7.2 Mahboobnagar district

In total, 83 water samples - 43 from the proposed scheme and 40 from the control schemes - were analyzed for their physio-chemical and bacteriological characteristics. At the proposed site, 14 samples from the river i.e. the water source, upstream and downstream of intake points, are drawn. From the villages, 29 samples of which 23 surface water and 6 ground water samples are drawn. At the control sites, 14 from the river i.e. from the water source, upstream and

downstream of the intake points, are drawn. From the villages, 26 samples - 10 from the canals; 3 open wells; 6 ground water drinking sources; 1 tank; and 6 agricultural runoffs are drawn. The samples were stored, pre treated and analyzed according to standard procedures by VIMTA Labs. Ltd. Detailed results are presented in Annex 7. An overview of the assessed water quality parameters and the range within which they fluctuate at the proposed and the existing project site is presented in table 7.5.

7.2.1 Water quality at the proposed site

Suitability for irrigation

In a lift irrigation scheme, water is drawn from the river for use in the villages. Accordingly, quality characteristics of water can be differentiated into two: one, that of the river, and two, villages. Quality characteristics of the river water are presented in Table 7.5 which indicate that all of them are within the prescribed limits for irrigation. The total dissolved solids content (TDS) of the ground water and so the electrical conductivity (EC) are within the prescribed limits of suitability for irrigation. The actual electrical conductivity of the water ranges between 738 and 930 units. As such the water can be classified as C-2/C-3 according to the U.S Salinity Classification (USDA, 1954), indicating a medium high salinity hazard which requires leaching (see table 7.1).

Table 7.4

Maximum allowable concentrations of selected water quality variables

Use	Drinking water				
Variable	WHO	EC	Canada	USA	USSR
Total dissolved solids (mg/L)	1,000	-	500	500	-
Total suspended solids (mg/L)	-	-	-	-	-
Turbidity (NTU)	5	4JTU	5	1-5	-
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	-
Hardness (mg/l CaCO3)	500	-	-	-	-
Nitrate (mg/l)	-	50	-	-	10
Sodium (mg/l)	200	150-175	-	-	-
Chloride (mg/l)	250	25	250	250	350
Sulphate (mg/l)	400	25	500	250	500
Fluoride (mg/l)	1.5	1.5-0.7	1.5	2.0	1.5
Boron (mg/l)	-	1.0	5.0	-	-
Microbiological variables	-	-	-	-	-
Faecal coliforms (No.per 100 ml)	-	-	-	-	-
Coliforms (No.per 100 ml)	0.13	-	10	1	-

The Sodium Adsorption Ratio ranges from 2.2 to 3.1 and is classified as S-1, low sodium water.

The total suspended solid levels of the water are permissible for irrigation and boron levels in the water samples are well within the prescribed limit.

Suitability for domestic use

None of the quality parameters of the river water as given in annex 7 and summarised in table 7.5 exceeds the national standards for drinking water (see table 7.3). International water quality standards as given by the World Health Organisation (WHO) (table 7.4) are not completely met.

Fluoride levels do not pose any problem, but nitrate levels in the water samples are slightly high - 16 to 55mg/l. Though all the samples are well within the prescribed national limit of 100mg/l, 14% of the samples (2 out of 14) exceed the international limits. While this may be favourable from an agricultural point of view (a high fertilizing value) excess nitrates can cause or contribute to excessive growth of algae, slimes, aquatic weeds and other organisms. As regards public health, high nitrate concentrations in the drinking water can cause serious health problems in infants.

Table 7.5

Water quality characteristics (Mahboobnagar district)

Parameters	Proposed site		Control	
	River	Village-site	River	Village-site
PH	7 - 8	7 - 8.2	7 - 8	7 - 9
EC	738 - 795	210 - 1350	723 - 818	815 - 2923
TSS	23 - 129	12 - 94	31 - 44	8 - 138
TDS	365 - 405	125 - 756	385 - 421	410 - 880
Hardness	188 - 215	24 - 840	191 - 231	134 - 600
Magnesium	10 - 20	2 - 35	9 - 28	12 - 67
Calcium	34 - 69	6 - 152	48 - 70	29 - 128
Sodium	74 - 100	18 - 92	75 - 105	48 - 230
Potassium	1 - 3.4	1 - 10	1 - 3.4	2 - 17
Chloride	54 - 90	12 - 52	55 - 96	64 - 215
Fluoride	0.8 - 0.9	0.8 - 0.9	0.8 - 0.9	0.8 - 0.9
Nitrate	16 - 55	6 - 60	17 - 55	10 - 162
Sulphate	89 - 131	5 - 41	101 - 134	39 - 180
SAR	2.2 - 3.1	1.0 - 10	2.2 - 2.9	1.0 - 4.0
Boron	0.04 - 0.15	0.04 - 0.9	0.03 - 0.12	0.13 - 0.14
Iron	0.09 - 0.28	0.07 - 0.32	0.09 - 0.27	0.02 - 0.06
Coliforms	12 - 27	9 - 30	7 - 22	9 - 32
E-Coli	3 - 10	2 - 10	3 - 8	2 - 9

Isolated cases of extreme values are not considered

Water quality at the village site
At the village site, both ground water and surface water samples were drawn for the analysis. While the surface water quality characteristics fully meet the national drinking water limits, ground water samples surpass the maximum allowable limits rendering it unsuitable for drinking purposes. The values (maximum) of some quality characteristics of ground water given below confirms the same.

	Maximum
EC	: 4100
TSS	: 2894
TDS	: 3017
SODIUM	: 555
CHLORIDE	: 884
NITRATE	: 175
SULPHATE	: 384

Based on coliform and E-coli counts it is concluded that nearly all samples are bacterially contaminated. This may be caused by poor sanitary conditions prevailing at and near the areas adjoining the wells.

Residual pesticides (organo-phosphorous and organo-chlorine) were not traceable in the samples, which is attributed to the very low level of pesticide use at this moment.

7.2.2 Water quality at the control site

Suitability for irrigation
Again, we have made a differentiation between the quality of river water and that at the village site. The quality characteristics of river water fully meet the national standards for drinking, similar to that in the proposed scheme. The water at the village sites, particularly, the ground water and agricultural runoffs seem to be somewhat polluted. The maximum values of some selected quality characteristics of ground water and runoffs are given below.

	Maximum
EC	: 2923
TSS	: 1049
TDS	: 1515
POTASSIUM	: 140
CHLORIDE	: 500
SULFATE	: 275
SAR	: 16

The ground water quality characteristics are comparable with that of the proposed site, and hence it is inferred that the ground water quality is independent of the irrigated agriculture intervention. Slightly higher parameter values in respect of agricultural runoffs

indicate nutrient leaching and salinization. The same, however, gets diluted and becomes normal no sooner it drains into the river back. This is evident by the fact that quality of water in the down stream of the intake point is free from pollution. Shannon-Weavers index, a measure of diversity of plankton, is above 3 (Annex.7) all along the river indicating that water bodies are not affected by irrigated agriculture.

Suitability for domestic use
The remarks made for the proposed site also apply to the water quality at the control site, since the values of the water quality parameters at the control site are in the same range as those observed at the proposed site.

Proposed Vs Existing Sites
No significant differences in the water quality characteristics between the proposed and existing project site is observed. This indicates that the introduction of irrigated agriculture does not adversely affect the quality of the resource.

7.3 Prakasam district

In total 27 water samples - 14 from proposed scheme and 13 from the control schemes - were analysed for their physio-chemical and bacteriological characteristics. At the proposed site, 4 samples from the river i.e., the water source, upstream and downstream of intake points, are drawn. From the villages, 10 samples, both surface and groundwater, are drawn. At the control site, 3 samples from the river i.e. from the water source, upstream and downstream of the intake points, are drawn. From the villages, 10 samples - from the canals; open wells; drinking water sources; tank; and agricultural runoffs are drawn. The samples were stored, pre treated and analyzed according to standard procedures by VIMTA Labs. Ltd. Detailed results are presented in Annex 7. An overview of the assessed water quality parameters and the range within which they fluctuate at the proposed and the existing project site is presented in table 7.6.

7.3.1 Water quality at the proposed site

Suitability for irrigation
In a lift irrigation scheme, water is drawn from the river/drain/stream for use in the villages. Accordingly, quality characteristics can be differentiated into two: one, that of the drain, and two, villages. Quality characteristics of the drain water are presented in Table 7.6 which indicate that all of them are within the prescribed limits for irrigation. The total dissolved solids content (TDS) and so the electrical conductivity (EC) are within the prescribed limits of suitability for irrigation. The actual electrical conductivity of the water ranges between 738 and 930 units. As such the

water can be classified as C-2/C-3 according to the U.S Salinity Classification (USDA, 1954), indicating a medium high salinity hazard which requires leaching (see table 7.1). The sodium absorption ratio ranges from 3.3 to 4.2 and is classified as S-1, low sodium water.

The total suspended solid levels of the water are permissible for irrigation and boron levels in the water samples are well within the prescribed limit.

Suitability for domestic use

None of the quality parameters of the river water as given in annex 7 and summarised in table 7.6 exceeds the national standards for drinking water (see table 7.3). International water quality standards as given by the World Health Organisation (WHO) (table 7.4) are not completely met.

Fluoride and nitrate levels do not pose any problem. As regards nitrates, though all the samples are well within the prescribed national limit of 100mg/l, many samples exceed the international limit (Table 7.4). While this may be favourable from an agricultural point of view (a high fertilizing value) excess nitrates can cause or contribute to excessive growth of algae, slimes, aquatic weeds and other organisms. As regards public health, high nitrate concentrations in the drinking water can cause serious health problems in infants.

Water quality at the village site

At the village site, surface water samples (open wells and tanks) were drawn for the analyses. Mention may be made of the fact that there are no bore wells in this area. The quality characteristics of all water bodies, particularly that of the open wells seems to be highly polluted (Table 7.6) surpassing the maximum allowable limits rendering it unsuitable for domestic purposes. A lot of limitations do exists for its applicability for irrigation purpose. The values (maximum) of some quality characteristics of surface water given below confirms the same.

		Maximum
EC	:	5400
TDS	:	4090
SODIUM	:	540
CHLORIDE	:	1035
NITRATE	:	330
SULPHATE	:	352
POTASSIUM	:	650
SAR	:	15

Based on coliform and E-coli counts it is concluded that nearly all samples are bacterially contaminated. This may be caused by poor sanitary conditions prevailing at and near the areas adjoining the wells.

Residual pesticides (organo-phosphorous and organo-chlorine) were not traceable in the samples, which is attributed to the very low level of pesticide use at this moment.

7.3.2 Water quality at the control site

Suitability for irrigation
Again, we have made a differentiation between the quality of drainage water and that at the village site.

Table 7.6

Water quality characteristics

(Prakasam district)

Parameters	Proposed site		Control	
	Drainage	Village-site	Drainage	Village-site
PH	8.1 - 8.5	7.3 - 8.5	8.2 - 8.5	7.6 - 8.2
EC	738 - 930	304 - 5400	745 - 930	1675 - 2980
TSS	126 - 318	15 - 205	172 - 185	83 - 105
TDS	596 - 745	257 - 4090	612 - 775	980 - 2370
Hardness	120 - 230	50 - 1095	135 - 180	144 - 530
Magnesium	9 - 30	1 - 92	14 - 23	18 - 100
Calcium	32 - 54	17 - 286	33 - 36	16 - 42
Sodium	100 - 116	42 - 540	126 - 400	196 - 510
Potassium	7 - 12	6 - 650	6 - 96	7 - 96
Chloride	55 - 85	25 - 1035	55 - 85	250 - 460
Fluoride	0.8 - 0.9	0.8 - 0.9	0.8 - 0.9	0.8 - 0.9
Nitrate	2 - 12	0.5 - 330	2 - 12	7 - 398
Sulphate	18 - 61	28 - 352	18 - 61	5 - 178
SAR	3.3 - 4.2	2.5 - 10	3.3 - 4.2	4 - 15
Boron	0.17 - 0.18	0.07 - 0.8	0.17 - 0.18	0.16 - 0.57
Iron	0.03 - 0.08	0.03 - 0.13	0.03 - 0.08	0.01 - 0.03
Coliforms	12 - 17	4 - 8	12 - 16	7 - 10
E-COLI	6 - 9	3 - 6	6 - 9	3 - 6

The quality characteristics of drainage water fully meet the national standards for drinking, similar to that in the proposed scheme. The water at the village site, particularly, the surface water and agricultural runoffs are highly polluted. The maximum values of some selected quality characteristics of surface water and runoffs are given below.

	Maximum
EC	2980
TDS	2370
POTASSIUM	96
CHLORIDE	460
SULFATE	178
SAR	15
NITRATE	398

The polluted surface water reflect very high levels of fertiliser application. Drainage must have been poor (as normally expected in the coastal areas) resulting in water logging, salinisation and nutrient leaching into the surface water storages.

Suitability for domestic use
The remarks made for the proposed site also apply to the water quality at the control site, since the values of the water quality parameters at the control site are in the same range as those observed at the proposed site.

Proposed Vs Existing Sites
Both the proposed and existing sites, till recently and even now are growing cotton, the cultivation of which is normally associated with high levels of fertilizer application. With the result, no significant differences in the water quality characteristics between the proposed and existing project site is observed. Moreover, irrigated agriculture (paddy cultivation) is just two seasons old in the Srinivasa lift irrigation scheme and their experience is too limited to draw inferences as to what would happen in future. However, the normal expectation is that paddy requires much less of fertilizers than cotton and hence there may be a reduction in pollution levels in the surface water bodies. But, unless the drainage is properly planned, paddy cultivation on black soils (found in the scheme area) will lead to water logging and salinization.

ooOOoo

Chapter 8

SOIL CHARACTERISTICS

8.1 Introduction

Soil, defined as a thin layer of earth's crust, serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to, and influenced by, genetic and environment factors - parent material, climate, organisms and topography, all acting over a period of time. Soil differs from the parent material (igneous, sedimentary and metamorphic rocks) in the morphological, physical, chemical and biological properties. Among themselves, too, soils differ in some or all properties, depending on the differences in the genetic and/or environmental factors. Soil serves as a reservoir of nutrients and water for crops, besides providing mechanical anchorage and favourable tilth. The components of the soils are mineral material, organic matter, water and air, the proportions of which vary, and which together form a system for plant growth. From an environmental point of view, a study of the soils, based on i) its inherent characteristics ii) the external land features, iii) the current/expected usage pattern and iv) water (quantity & quality) likely to be used, would enable in assessing:

- the potentiality, or otherwise, for irrigation;
- nutrient supplying ability; and
- hazards or modifications such as waterlogging, salinization, alkalinization, nutrient leaching, texture, fertility, permeability and erosion likely to occur as a result of irrigated agriculture.

This Chapter on soil characteristics is particularly aimed to discuss the above mentioned aspects.

8.1.1 Suitability for irrigated agriculture

Apart from the physical, chemical and biological properties, surface and sub surface characteristics and qualities, such as depth, drainage and soil moisture relationships determine the suitability or otherwise for irrigation. Hence, the terms 'soil' and 'land' are used rather synonymously in the study. The physical properties - water holding capacity, permeability to water, aeration, plasticity and nutrient supplying ability - influenced by the size, proportion, arrangement and mineral composition of soil particles- largely determine the manner in which the soils can be used. The chemical properties indicate the soil fertility viz., potential of the soil to supply/make available mineral elements essential for the plant growth. On the biological front, soil microorganisms are essential to decompose the raw organic matter into

humus and other simpler products to enable utilization by plants.

From an environmental impact point of view, viz., in assessing the potential for irrigability, nutrient supplying ability, and predicting future adverse soil modifications, the following characteristic are of special significance

8.1.2. Physical

Physical characteristics include texture, structure, soil depth, moisture holding capacity, drainage and permeability. Measures like bulk density and hydraulic conductivity help in assessing some of them.

8.1.3 Physico chemical

Soil reaction i.e., degree of acidity or alkalinity, indicated by the hydrogen-ion concentration in the soil moisture, is measured and presented as pH value. The classification of soils based on pH values is presented in Table 8.1

Table 8.1 Rating of soil reaction

Rating	pH
Extremely acid	below 4.5
Very strongly acid	4.5 - 5.0
Strongly acid	5.1 - 5.5
Medium acid	5.6 - 6.0
Slightly acid	6.1 - 6.5
Very slightly acid	6.6 - 6.9
Neutral	7.0
Very mildly alkaline	7.1 - 7.3
Mildly alkaline	7.4 - 7.8
Moderately alkaline	7.9 - 8.4
Strongly alkaline	8.5 - 9.0
Very strongly alkaline	above 9.0

Most plants and soil microorganisms thrive best in soils of a pH = 6 to 7.5. However, plant species (and even varieties) differ in the degree to which they favour or tolerate pH values beyond this range. Crops like potato, rice, sorghum, millet, cotton, cowpea, maize, tobacco, groundnut, tomato and cabbage do well in soils with low (acid) pH limits 4.5 to 5.5. Soil reaction affects the availability of various plant nutritive elements. A pH range of 6-7 promotes the most ready availability of plant nutrients. Extreme pH values result in toxicity. Extreme acidity cause Aluminum and/or Manganese toxicity, and high pH causes ammonia fertilizers to produce ammonia gas which is specially toxic to germinating seeds.

Cation exchange capacity (CEC) is the sum total of exchangeable cations that a soil can absorb which, in effect, reflects the soil's ability to retain and exchange ions in the soils, particularly calcium, magnesium, potassium sodium and ammonium. Given a particular CEC value i.e., exchange capacity, nutrient uptake is largely determined by the organic matter content particularly in the top soil, specially in light textured soils. This is even more essential for irrigated conditions. A general appraisal of CEC is given Table 8.2. The individual values for exchangeable Calcium, Magnesium and Potassium give certain indications of the fertility status of the soil. The exchangeable sodium percentage (ESP) is an important criterion in assessing the soil salinity.

Table 8.2

Ratings of exchangeable bases (exchangeable cations in m.e %)

Rating	Cation exchange capacity	Total exchangeable cations	Exchangeable			
			Ca	Mg	K	Na
Very high	> 40	> 30	> 20	> 8	> 1.2	> 2.0
High	26 - 40	15 - 30	10 - 20	3 - 8	0.6 - 1.2	0.7 - 2.0
Medium	13 - 25	8 - 15	5 - 10	1.5 - 3.0	0.3 - 0.6	0.3 - 0.7
Low	6 - 12	3 - 8	2 - 5	0.5 - 0.3	0.1 - 0.3	0.1 - 0.3
Very low	< 6	< 2	< 0.5		< 0.1	< 0.1

Electrical conductivity (EC), the generally accepted parameter of salinity gives the best correlation with cropping possibilities and crop yields in relation to soil moisture characteristics. Table 8.3 gives the limits of salinity classes.

Table 8.3

Limits of salinity classes

Class	Salt(%)	EC (mmhos.cm)
Class 0 - free	0.0 -15	0.4
Class 1 - slightly affected	0.15-0.35	4-8
Class 2 - moderately affected	0.35-0.65	8-15
Class 3 - strongly affected	>0.65	>15

Exchangeable sodium percentage (ESP), an indicator of the extent of alkalinity in the soils is obtained as a ratio between exchangeable sodium and CEC. EC, ESP and sodium adsorption ratio (SAR) - a relation between exchangeable sodium and that of calcium and magnesium - together enable classifying, particularly the problematic soils. The same is given in Table 8.4.

A saline soil suffers form its inability to absorb water from the salty solution in the soil, with the result, plant cells lose water to the soils and eventually die-off. In the case of non-saline alkali soils. Movement of water and air is greatly impeded. The roots will be unable to penetrate and hence the nutrient uptake suffers.

Table 8.4

Saline and alkaline soils

Category	EC.ESP m.mhos/cm. at 25 c	ESP	pH	SAR
Normal	< 1	--	6.0-7.5	
1-2	Critical for germination			
2-4	Critical for the growth of sensitive crops			
>4	Injurious to most crops			
Saline	> 4	> 15	7.5 - 8.5	10-14
Saline-Alkali	> 4	> 15	7.5 - 8.5	20-74
Non-saline alkali	> 4	> 15	8.5 - 10.5	14-40

8.1.4 Soil / Land Irrigability Classification

Based on physical and physio-chemical characteristics, lands can be classified for its irrigation suitability. Details pertaining to the same are presented in Table 8.5.

8.1.5 Soil nutrients

Plants require interlia the following essential nutrients for their normal development:

Carbon	Nitrogen	Calcium
Hydrogen	Phosphorous	Magnesium
Oxygen	Potassium	Sulfur
Iron	Zinc	Chlorine
Manganese	Boron	
Copper	Molybdenum	

Nitrogen, phosphorous and potassium are known as primary plant nutrients; calcium, magnesium and sulfur as secondary; and the remaining as micro or trace elements. The primary and secondary nutrient elements are also

known as major elements. The classification is based on their relative abundance, and not on their relative importance, and all are equally important for the normal growth. The role and significance of different nutrients are given in Table 8.6. Rating chart for the nitrogen, phosphorous and potassium nutrients is given in Table 8.7.

An analyses of the soil samples help in arriving at appropriate fertilizer doze recommendations.

Table - 8.5

Criteria for land irrigability classification

Sl No	Soil/land Characteristics	Irrigability Classification				
		I	II	III	IV	V
1.	Effective soil depth	> 90	45-90	22.5-45	7.5-22.5	<7.5
2.	Texture	SL,L,Scl, Sil & CL	LS,SC Sicl	Sic Clay	Sand Clay	Any texture
3.	Available Moisture holding capacity (90 cm depth) cm.	> 12	9-12	6-9	2-6	< 2
4.	Structure	Granular	Blocky crumb	Platy	Columnar prismatic	Single grain massive
5.	Permeability(mm/cm) of least permeable layer	5-50	50-130 1.3-5	130-150 0.3-1.3	More than 250, less than 0.3	Not applica ble
6.	Salinity (mmhos/cm)	< 4	4-8	8-12	12-16	> 16
7.	Alkali hazard	< 15	< 15	15-40	15-40	> 40
8.	Coarse fragments	< 15	15-35	35-55	55-70	> 70
9.	Rock out crops	> 40	20	15	5	< 5
10.	Slope %	< 1	1-3	3-5	5-10	> 10
11.	Erosion	Slight	Moderate	Severe	Very severe	----
12.	Depth of Ground water table(mt.)	> 5	3-5	1.5-5	< 1.5	----
13.	Drainage	Well drained	Modera- tely drained	Imper- fectly drained	poorly drained	very poorly or excessi- vely drained

8.2 Mahboobnagar district

In total, 100 soil samples, 50 each form the proposed and control sites were analyzed for their physical, chemical and biological characteristics. Of the 50 samples from the proposed site, 33 (66%) were drawn from the cultivated lands and the remaining 17 (34%) from uncultivated lands. In the control site, there were no barren/uncultivated lands to draw soil samples. The samples were stored, pretreated and analyzed according to standard procedures by VIMTA Labs Ltd. Detailed

results are presented in Annex 8. An overview of the assessed soil characteristics and the range within which they fluctuate at the proposed and control project sites is presented in table 8.8.

8.2.1 Soil characteristics at the proposed site

Soil Inventory
An inventory of the soil resources of the proposed site is developed using satellite imagery supported by field data. Geologically, the scheme area exhibits homogenity i.e. Archaean granite/gneiss and recent alluvium. The study area is classified into three major physiographic units based on geology and geomorphology: (i) granite/gneisses landscape, (ii) buried pediplains and (iii) tank command areas. Each landscape is further subdivided into different mapping units based on physiography, slope, salt infestation, soil erosion, drainage, soil depth, soil texture, etc so as to enable arrive at land capability classification. The study area is classified into 16 soil mapping units, the details of which are presented in Fig 8.1. Most part of the area is classified into G2.1 and G2.2 mapping units and class IIIce and class IIIc land capability classification. G2.1 soils are gently sloping to middle pediplains, moderately deep to deep, light yellowish red to reddish, brown, sandy loams at surface, sandy clay loams at subsurface, well drained, slight to moderate erosion. G2.2 gently sloping to nearly levelled lower pediplains, deep to very deep, dark reddish brown, fine sandy loams at surface, clay loams to clay at subsurface, well drained, slight erosion.

Physical Characteristics
The soils in the area are sandy loams. These soils appear to be the product of disintegration and decomposition of Gneissic composition or quartzites supplemented by infiltration of clay from shale formation. Structure of the soils are spheroidal, including blocky crumb type. Soil depth varies from about 35 to 80 cm.

The hydraulic conductivity i.e., a measure of the extent of permeability, in the soil samples can be classified as moderate to high. The sandy-loam and sandy soils will be loose, have good aeration and drainage and easy tillage characteristics. However such soils may lack capacity to absorb and hold sufficient moisture and nutrients as compared to fine textured soils. The soil is likely to be droughty and lack fertility.

The bulk density observed in the soils of study regions are in the range 1.17 to 1.70 units. These values fall in the lower range of coarse textured soils which indicate good porosity in the soils.

Fig 8.1

INDO-DUTCH IRRIGATION PROJECT (EIA)
SOIL MAP
A.P. LIFT: MUDMAL VILLAGE, MAHABUBNAGAR DIST

SCALE: 1:50,000

Km 0 1 2 3 4 5 Km

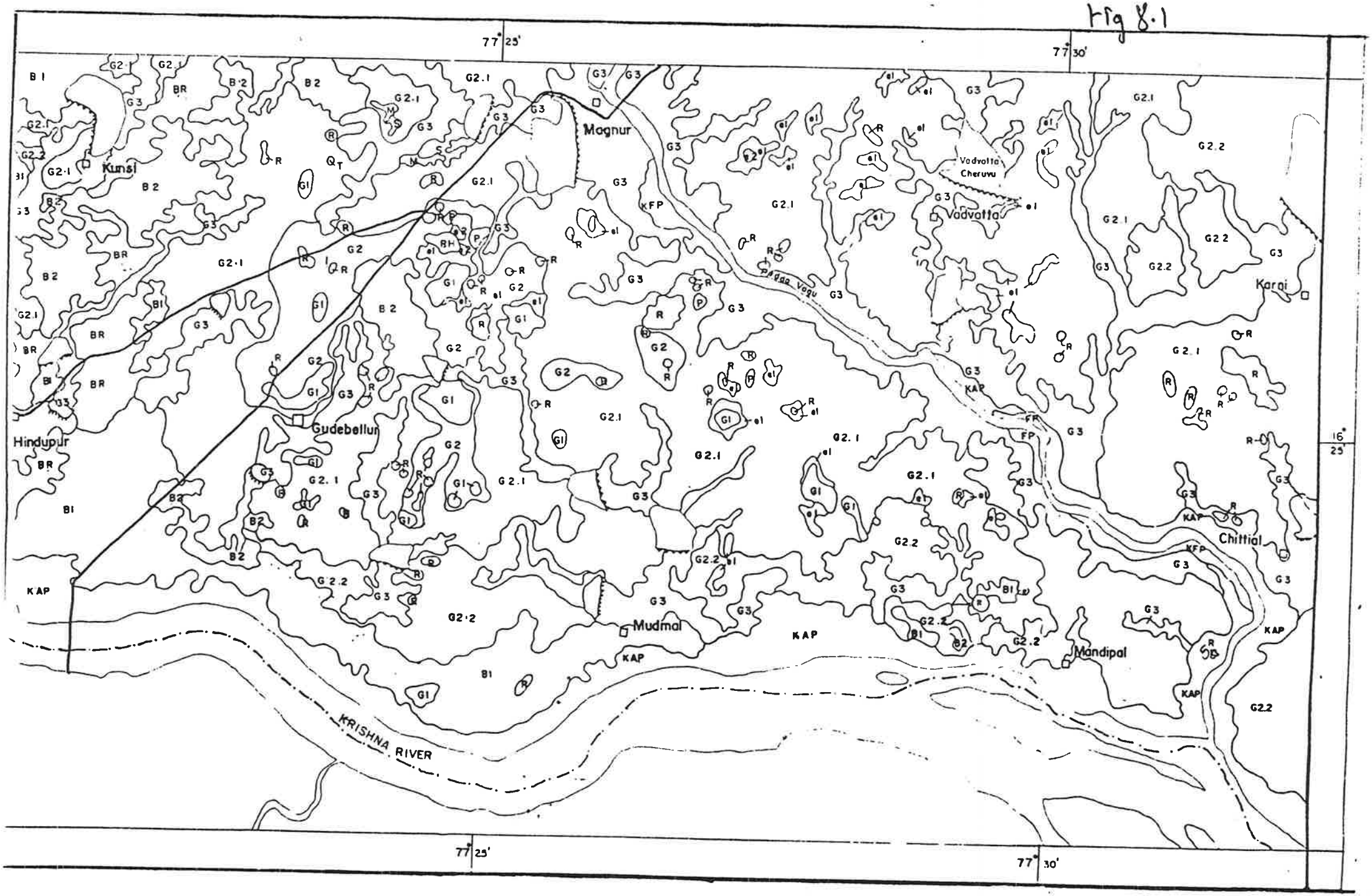
R E F E R E N C E

SOIL MAPPING UNIT	SOIL DESCRIPTION	LAND CAPABILITY CLASS, SUBCLASS
G	Granitic landscape	
G1	Very steep to steep isolated residual hills and inselbergs, bare rock and sub-strata exposed, exfoliation domes, fine earth is very little, excessively drained, severe erosion.	VII se
G2	Undulating to gently rolling upper pediplains. Shallow to moderately deep, light yellowish red, gravelly sandy loams, wel' drained, moderate erosion.	IV es
G2.1	Undulating to gently sloping middle pediplains, moderately deep to deep, light yellowish red to reddish brown, sandy loams at surface, sandy clay loams at sub-surface, well drained, slight to moderate erosion.	III ce
G2.2	Gently sloping to nearly levelled lower pediplains, deep to very deep, dark reddish brown, fine sandy loams at surface, clay loams to clay at sub-surface, well drained, slight erosion.	III c
G3	Nearly level, lower pediplains, mostly tank command areas, very deep, light greyish brown to dark brown, sandy clay loams at surface, clay loams to clay at sub-surface, well drained, nil to slight erosion.	II cw
KAP	Nearly levelled, Krishna river alluvial plain, very deep, light greyish brown to light grey, fine silty clay loam to silty loam, moderately well drained, nil to slight erosion.	II w
KFP	Nearly level, Krishna river flood plain, very deep, light yellowish red to light grey, coarse sandy loams, well drained, slight erosion.	III s
R	Tors and rock outcrop areas, mostly rocks and boulders, very shallow gravelly soils in pockets, Severe erosion.	VI es
e1	Slight to moderately eroded areas, most of the surface soil has been eroded, sills formed, substrata exposed.	IV es
e2	Moderate to severely eroded areas. The soil has been eroded to the extent of all or partially all of the original surface soil has been removed and shallow gullies are formed.	VI es
A	Area severely affected by saline/alkaline soils with poor physical conditions, moderately well drained.	VII s
M	Area moderately affected by saline/alkaline soils with poor physical conditions, well drained.	VI s
S	Area slightly affected by saline/alkaline soils.	IV s
B	Buried pediplain	
B1	Gently sloping to nearly level buried pediplains, very deep, grey to dark grey, clay (cracking clays), imperfectly drained, nil to slight erosion.	II wc
B2	Undulating to gently sloping, buried pediplains, moderately deep to deep, light grey to greyish brown, fine silty clay loams at surface, clay at sub-surface, moderately well drained, slight to moderate erosion.	III c
BR	Undulating to gently sloping buried pediplains, moderately deep to deep, light grey, sandy clay loams at surface, reddish brown, loams at subsurface, well drained, moderate to slight erosion.	III es

OTHERS: Settlement ▢ Road ——. River Stream Tank

APSRAC

Fig 8.1


77° 25'
77° 30'
16° 25'
Magnur
Kunsi
Hindupur
Gudebellur
Vadvatta
Vadvatta Cheruvu
Karai
Chittial
Mudmal
Mandipal
Pedda Vagu
KRISHNA RIVER
KAP
KFP
FP
BR
B1
B2
G1
G2
G2.1
G2.2
G3
R
P
Qt

Physico-chemical Properties
Soils in the study area show pH value in the range of 6.2 to 8.0. Such soils fall in the slightly acidic to moderate alkaline range. Most plants and soil micro organisms can thrive in this range. This range can promote (selectively) the availability of plant nutrients.

Electrical conductivity, the generally accepted parameter of salinity, in the soil samples are found to be very low i.e., 0.10 to 0.34 units. This indicates virtually free of salt. Sodium Absorption Ratio (SAR) of irrigation water which plays a significant role in 'salinization', is also quite low. Hence, we do not envisage any adverse effects on salinity front.

The Cation Exchange Capacity (CEC) is the sum total of exchangeable cations that a soil can absorb, reflect, in effect, ability to retain and exchange ions in the soils, particularly calcium, magnesium, potassium, sodium and ammonium. The CEC value of in our samples range between 4 to 28 which can be classified as 'low' to 'high'. This makes it possible to apply relatively high dozes of fertilizer economically and effectively.

Irrigability Classification
The lands in Mudmal scheme fall into three different irrigability classes - two good irrigable lands, Class-I A and Class-I B, and another non-irrigable Class-V lands. The land irrigability classification is mapped and presented in Fig 8.2. More than 95% of the area are irrigable lands.

Soil Nutrients
Major nutrients required for the plant growth are nitrogen (N), phosphorous (P) and Potassium (K).

Soil samples analysed for available nitrogen show values in the range of, 206-506 Kg/Ha which can be classified as 'low' to 'medium'. Of the total samples, 25% of them are low in nitrogen - and all of them are drawn from barren/uncultivated lands. The remaining 75% of the samples, all drawn from the cultivated lands have nitrogen, in the medium range.

Phosphorus values are in the range of 9-45 Kg/Ha which indicates that the levels in the soils vary considerably. About 80% of the samples are in the range of 'low' to 'medium' and the remaining 'high'.

Potassium with values in the range of 220-520 Kg/Ha induce soils in the range of 'medium' to 'high'.

Calcium levels are in the medium range. Soil does contain higher levels of magnesium, which normally induce more of vegetative and less of reproductive

Fig 8.2

INDO-DUTCH IRRIGATION PROJECT (EIA)

TENTATIVE LAND IRRIGABILITY MAP

A.P. LIFT: MUDMAL VILLAGE, MAHBUBNAGAR DISTRICT.

SCALE 1:50,000

Km 1 0 1 2 3 4 5 Km

R E F E R E N C E

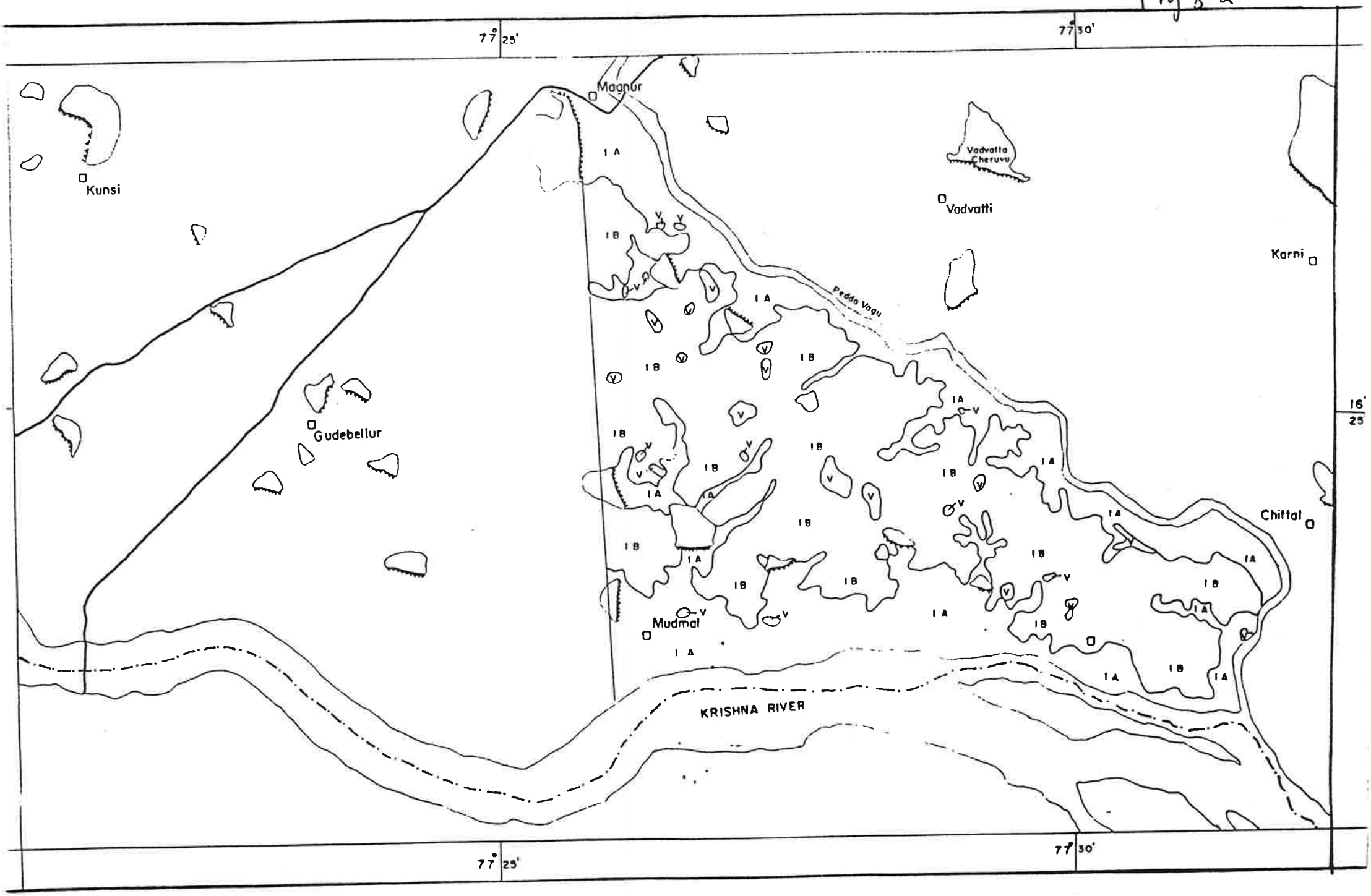
LAND IRRIGABILITY CLASSES

IA	Good irrigable lands
IB	Good irrigable lands with soil (Depth) limitation
V	Un- Suitable

SETTLEMENT	□
ROAD	——
RIVER	
STREAM	
TANK	
STATE BOUNDARY	—·—·—

APSRAC

Fig 8.2


77° 25'
77° 30'
16° 25'
Magnur
Kunsi
Vadvatta Cheruvu
Vadvatti
Karni
Pedda Vagu
Gudebellur
Chittal
Mudmal
KRISHNA RIVER
I A
I B
V

growth. Sulfur deficiency is noticed in patches. This particularly affects adversely quality of grain/oil in the crops, oil seeds, pulses and paddy.

Soil Pollutants
No soil pollution is observed due to trace metals like lead, cadmium, chromium and fluoride.

Organic matter, Fungi & Bacteria
Organic matter, estimated as organic carbon, is substantially low. However high the soil may be in CEC, low organic matter will affect adversely the uptake of nutrients. The lower organic matter, in turn, is reflected in lower bacterial and fungal density in the soil samples.

8.2.2 Soil Characteristics at the Control site

The remarks made for the proposed site also apply to the soil characteristics at the control, since the values of the soil characteristics at the control site are in the same range as those observed at the proposed site. There are no significant differences in the soil characteristics between the proposed and control sites. Neither are any difference between the two control sites which indicate that soil status is probably independent of the lining of the channels.

8.3 Prakasam district

In total 30 samples, 15 each from the proposed and the control lift irrigation schemes covering both uncultivated and cultivated lands were analyzed according to standard procedures. Detailed results are presented in Annex 8. An overview of the assessed soil characteristics and the range within which they fluctuate at the proposed and existing borewell sites is presented 8.9.

8.3.1 Soil characteristics at the proposed site

Soil Inventory
The proposed project site is classified into 2 different soil mapping units depending upon various soil and land characteristics. A brief writeup about the mapping units, and the corresponding land capability classification is presented below:

- Mapping unit BC
Lands are almost flat, buried pediplains, very deep, dark grey to greyish black, silt clay to clay (cracking clays), poorly drained and no erosion. These lands are classified as class IIcw. 99% of the scheme area is covered under this mapping unit.

Table 8.6
Role and Significance of some selected nutrients

Nutrient	Role	Impact	
		excess	deficient
1. Nitrogen	- Vegetative growth - Influence utilization of P and K	- Delays maturity - Impairs quality - Increases sucepti-bility to diseases - Causes lodging	- Retards growth - Shriveling of grains - Reduces crop yield
2. Phosphorous	- Vigour of plants - Quality of crops - Resistance to diseases - Checks lodging - Facilitates N-fixation	- Impairs growth - Impairs quality	- Slow start - Poor root system
3. Potassium	- Resist diseases & insect attacks - Withstand cold, & other adverse conditions	- Delays maturity	- Impairs growth - Impairs quality
4. Calcium	- Promotes cell growth - Promotes activity of soil bacteria - Good root system	- Suceptibility to diseases	- Impairs growth - Induces toxicity
5. Magnesium	- Formation of oil	- Influences Ca & K - More veg. growth - Reduces crop yield	- Premature defoliation
6. Sulfur	- Constituent of straw & plant stalks - Quality of the produce	- Toxic	- Leaves turn yellow - woodiness - Affects shape of fruits and juice - Affects quality of oils/grains
7. Iron	- Synthesis of chlorophyll	- Toxic	- Chlorosis
8. Manganese	- Disease resistance	- Toxic	- Chlorosis
9. Zinc	- Metal cultivator of enzymes	- Toxic	- Chlorosis
10. Boron	- Normal growth	- Toxic	- Growth abnormalities
11. Sodium	- Release of potassium	- Toxic	
12. Molybdenum	- Influences microbial activity	- Toxic	- N-fixation

Table 8.7

Rating-chart for the soil nutrients

Nutrient(Kg/Ha)	Low	Medium	High
Available nitrogen (n)	< 280	280-560	>560
Available phosphorous (P)	< 10	10-25	> 25
Available potassium (K)	< 110	110-280	>280

Table - 8.8

Soil analyses - A comparison

Sl. No.	Parameter	Mahboobnagar		
		Proposed	Existing	
			Lined Channels	Unlined Channels
	Physical Properties			
1)	Texture	Sandy Loam	Sandy loam to Silty Clay	Sandy loam to Silty Clay
2)	Bulk Density	1.17 to 1.70	1.28 to 1.32	1.19 to 1.62
3)	Hydraulic conductivity	$1.6x10^{-4}$-$2.3x10^{-4}$	$1.5x10^{-4}$	$2.82x10^{-5}$
	Physico-chemical			
1)	PH	6.2 to 8.0	6.5 to 7.5	6.4 to 9.5
2)	EC	0.10 to 0.34	0.11 to 0.32	0.04 to 0.8
3)	CEC	4.0 to 28.1	12 to 21	4 to 19
4)	ESP	24 to 57	33 to 43	15 to 54
5)	Calcium	67 to 345	240 to 410	45 to 290
6)	Magnesium	17 to 132	30 to 56	5 to 32
7)	Sodium	25 to 237	104 to 164	24 to 228
8)	Sulphur	0.5 to 2.9	0.5 to 0.8	0.5 to 0.8
9)	Iron	8 to 32	22 to 28	12 to 38
10)	Manganese	5 to 18	11 to 17	----
11)	Copper	1.0 to 2.3	1.6 to 2.0	0.5 to 2.8
12)	Zinc	1.0 to 2.6	1.6 to 2.2	1.7 to 7.8
13)	Nitrogen	206 to 506	246 to 543	323 to 612
14)	Phosphorus	9 to 45	17 to 64	9 to 68
15)	Potassium	220 to 520	310 to 624	221 to 625
16)	Organic Matter	2.6 to 3.6	3 to 6.0	3 to 6.0
17)	Nitrogen fixing bacteria	1000 to 4000	1100 to 2700	1800 to 4000
19)	Nitrifying bacteria	700 to 1700	231 to 600	200 to 1400

- Mapping unit BR
The lands are very gently sloping, plain areas, light greyish brown at surface, light reddish brown to brown at subsurface, very deep, silt clay at surface, loam to clay loam at subsurface, somewhat drained and slightly prone to erosion.

Detailed soil mapping is presented in Fig 8.3. For further details, the same may be referred to.

Physical characteristics
Typically the soils are black cotton soils derived from the Deccan and Rajmahal trap and ferruginous gneisses and schists. Most soils have high fertility. They are highly argillaceous, very fine grained and dark and are very tenacious of moisture and exceedingly sticky, when wet. Owing to considerable contraction on drying, large and deep cracks are formed. The soils are deep, as much as 6 metres, fine textured, have low permeability and high values of hygroscopic coefficient, pore space and maximum water holding capacity.

The hydraulic conductivity in the soil samples can be classified as moderate. The bulk density observed in the soils of study regions are in the range 1.51 to 2.18 units. These values indicate good porosity in the soils.

Physico-chemical Properties
Soils in the study area show pH value in the range of 7.9 to 8.2. Such soils fall in the moderately alkaline range. Not all plants and soil micro organisms can thrive best in this range. This range promotes relatively ready availability of plant nutrients.

Electrical conductivity, the generally accepted parameter of salinity, in the soil samples are found to be very low i.e., 0.9 to 1.2 units. This indicates virtually free of salt. Sodium Absorption Ratio (SAR) of irrigation water which plays a significant role in 'salinization', is also quite low. Hence, we do not envisage any adverse effects on salinity front.

The Cation Exchange Capacity (CEC) is the sum total of exchangeable cations that a soil can absorb, reflect, in effect, ability to retain and exchange ions in the soils, particularly calcium, magnesium, potassium, sodium and ammonium. The CEC value in our samples range between 38 to 49 units which can be classified as high. This do not enable applying high dozes of fertilizer economically and effectively.

Irrigability Classification
The soils in Adasumalli scheme fall into two different irrigability classes, Fig 8.4.

Fig 8.4

INDO-DUTCH IRRIGATION PROJECT (EIA)

TENTATIVE LAND IRRIGABILITY MAP

A.P. LIFT ADUSUMALLI VILLAGE, PRAKASAM DISTRICT

Km. 1 0 1 2 3 4 Km

REFERENCE

LAND IRRIGABILITY CLASS

- 1A — Good Irrigabale Lands
- 1B — Good Irrigable lands with soil limitation
- Settlement
- River
- Tank
- Road
- Canal

APSRAC

Fig 8.4

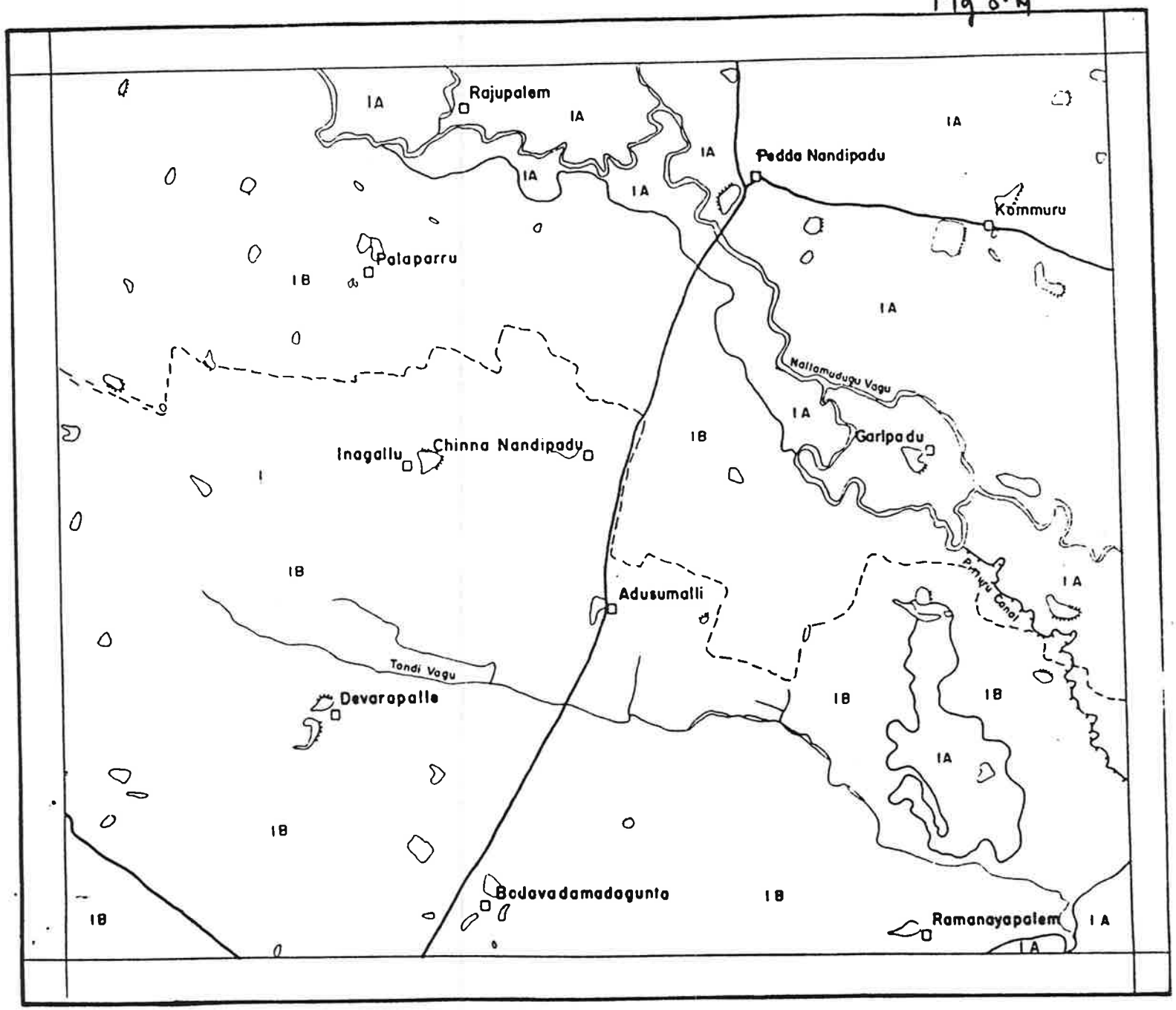

Rajupalem
Pedda Nandipadu
Kommuru
Palaparru
Nallamudugu Vagu
Inagallu
Chinna Nandipadu
Garipadu
Penuru Canal
Adusumalli
Tondi Vagu
Devarapalle
Bodavadamadagunta
Ramanayapalem
IA
IB

Fig 8.3

INDO-DUTCH IRRIGATION PROJECT (EIA)
SOIL MAP
A.P. LIFT : ADUSUMALLI VILLAGE, PRAKASAM DIST

REFERENCE

MAPPING UNIT	DESCRIPTION	LAND CAPABILITY CLASS,SUB-CLASS
BC	Nearly levelled, buried pediplains. Very deep, dark grey to greyish black, silty clay to clay (cracking clays), poorly drained, nil erosion.	II cw
BC1	Nearly levelled, buried pediplains under canal command, very deep, dark greyish black to black, clay, poorly drained, nil erosion.	II w
BR	Very gently sloping, plain areas, light greyish brown at surface, light reddish brown to brown at sub-surface, very deep, silty clay at surface, loam to clay loam at sub-surface, somewhat drained, slight to moderate erosion.	III es
AP	Nearly levelled alluvial soils along the stream courses, deep to very deep, light yellowish red to light brown, silty loam to sandy clay loam,well drained.	III sw
PC	Nearly levelled, paleochannels, deep to very deep, dark greyish brown,silty clay loam to clay, imperfectly drained, nil to slight erosion .	II w
FP	Nearly levelled, flood plain, light yellowish red, deep, medium textured soils, well drained, slight to moderate erosion.	III se

OTHERS: Settlement, Road, River, Stream

Tank, Canal

APSRAC

Fig 8.3

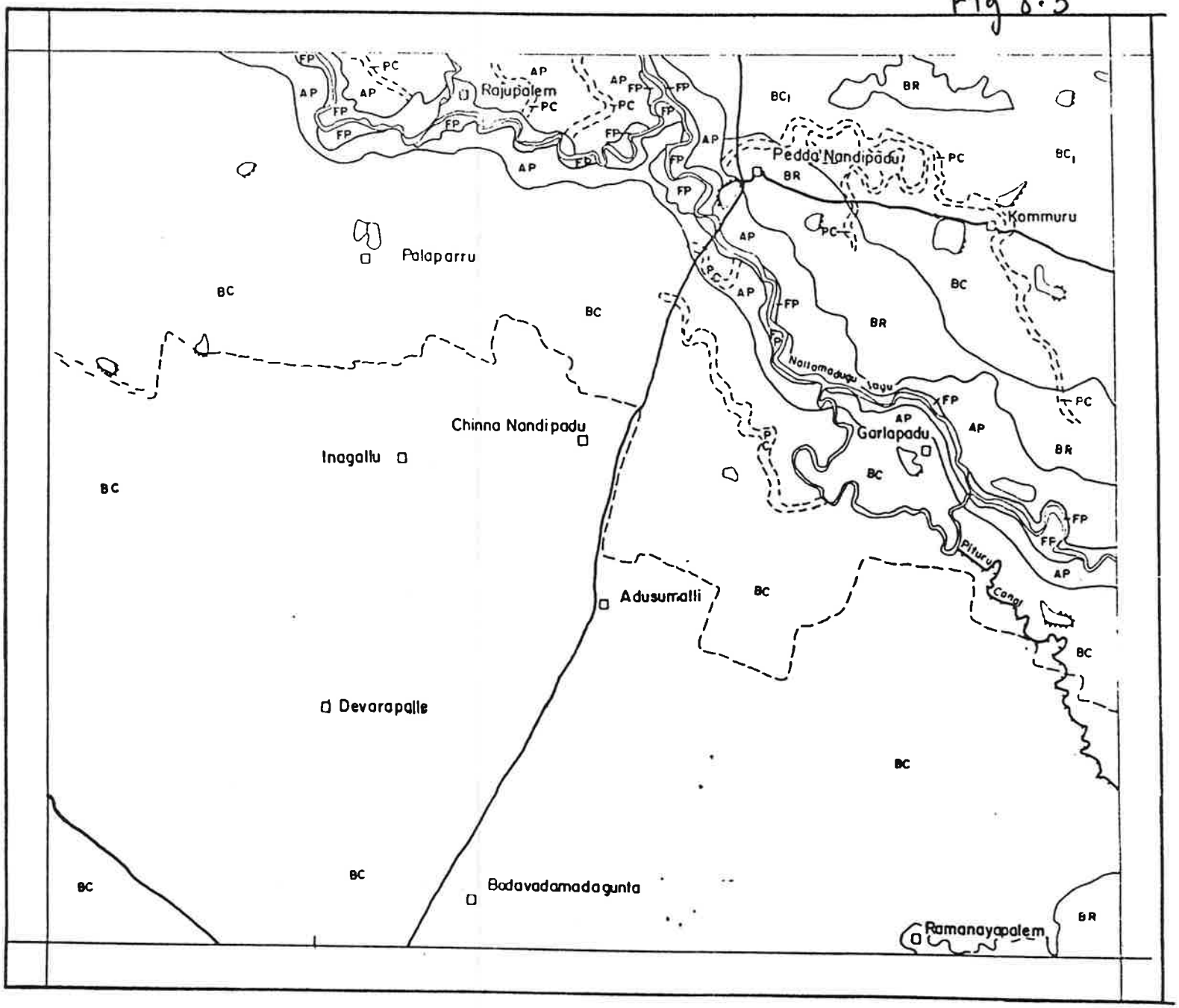

Rajupalem
Pedda Nandipadu
Kommuru
Palaparru
Chinna Nandipadu
Inagallu
Garlapadu
Nallamadugu
Vagu
Pituru
Canal
Adusumalli
Devarapalle
Bodavadamadagunta
Ramanayapalem
BC
BC1
BR
AP
FP
PC
FF

Table - 8.9

Soil analysis - A comparison

Sl. No.	Parameter	Prakasam	
		Proposed	Control
Physical			
1)	Texture	Clay/Silty/Clay	Clay/Silty/Clay
2)	Bulk Density	1.51 to 2.18	1.52 to 1.96
3)	Hydraulic conductivity	1.62×10^{-5} to 1.32×10^{-5}	1.41×10^{-5} to 1.44×10^{-5}
Physico-chemical			
1)	PH	7.9 to 8.2	7.2 to 7.96
2)	EC	0.9 to 1.6	0.7 to 0.90
3)	CEC	38 to 49	25 to 42
4)	ESP	18 to 24	16 to 29
5)	Calcium	390 to 520	210 to 445
6)	Magnesium	95 to 130	55 to 115
7)	Sodium	185 to 250	154 to 190
8)	Sulphur	0.1 to 6	0.2 to 5
9)	Iron	9 to 15	7 to 12
10)	Manganese	2 to 8	5 to 8
11)	Copper	0.4 to 1.4	1.1 to 2.5
12)	Zinc	. 8 to 12	5 to 12
13)	Nitrogen	500 to 690	510 to 680
14)	Phosphorous	14 to 22	21 to 32
15)	Potassium	200 to 360	240 to 330
16)	Organic Matter	1.3 to 1.7	1.3 to 2.3
17)	N-Fining bacteria	1800 to 2600	400 to 1160
18)	Nitrifying bacteria	1800 to 3900	300 to 1400

- Class-IA (Good irrigable lands)
These are good cultivable lands without any major limitation as regards soil, topography and drainage. These are nearly plains found all along the course of the drainage.

The soils are very deep and the drainage potential is moderate to good. The lands are suitable for both wet and irrigated dry cultivation and have high production potential.

- Class-IB
These are also good cultivable lands but with few limitations for sustainable use under irrigation. Permeability is slow to moderate and drainage potential being poor to imperfect. These soils are suitable for irrigated-dry rather than wet cultivation under

irrigation. Irrigation should be controlled and well regulated as otherwise it may lead to waterlogging resulting in the upward movement of salt i.e., surface salinisation. moderately good cultivable lands suitable for raising shallow rooted ID crops. Major part of the proposed site is under this classification.

- Class-V
These are not suitable for irrigation. These are steep broken residual hills. Severe erosion is observed in these areas.

Soil Nutrients
Major nutrients required for the plant growth are nitrogen (N), phosphorous (P) and Potassium (K).

Soil samples analysed for available nitrogen show values in the range of, 500-690 Kg/Ha which can be classified as 'Medium' to 'High'.

Phosphorus values in the range of 14-22 Kg/Ha indicate that the levels in the soils are 'Medium'.

Potassium with values in the range of 200-360 Kg/Ha induce soils in the range of 'Medium' to 'High'.

Calcium levels are in adequate quantities. Soil do contain slightly higher levels of magnesium, which normally induce more of vegetative and less of reproductive growth. Sulfur deficiency is not noticed in the proposed project site.

Soil Pollutants

No soil pollution is observed due to trace metals like lead, cadmium, chromium and fluoride.

Organic matter, fungi & bacteria

Organic matter, estimated as organic carbon, is substantially low. However high the soil may be in CEC, low organic matter will affect adversely the uptake of nutrients. The lower organic matter, in turn, is reflected in lower bacterial and fungal density in the soil samples.

8.3.2 Soil characteristics at the control site

The soil characteristics at the control site are presented in table 8.9. The remarks made for the proposed site also apply to the soil characteristics at the control, since the values of the soil characteristics at the control sites are in the same range as those observed at the proposed site. No significant differences are found in the soil characteristics between the proposed and the control

sites. But, as mentioned earlier, the experience of irrigated agriculture in the control site is too low to draw some useful lessons. The experts opine that unless plans for the drainage is made properly and that water is managed effectively, adverse soil modifications are likely to occur as a result of the APLIFT project.

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Chapter - 9

AIR QUALITY

9.1 Introduction

This chapter is devoted to discuss aspects related to air quality - both ambient and indoor. Nodoubt air quality has a direct bearing on the health status of all living organisms - plants, animals and human beings. Yet, even as the proposal to undertake EIA study was made, we had serious reservations about the significance of 'Air Quality' aspects for the APLIFT Project. This view was also supported by most of the participants of the scoping workshop. However, 'air quality' aspects were recommended to be covered, more out of inquisitiveness, on the grounds that, there are not many studies in the Indian context on air quality in rural areas. Particularly, the interest was focussed on indoor i.e., quality of air in the kitchen during cooking. Optimistically it was thought that the APLIFT Project might have positive impacts. One, irrigation will enable raise a second crop and the resultant green cover might reduce the dust. Two, with irrigation, cropping pattern will change and so also the crop residues available for cooking. Three, irrigation will increase biomass, inturn, the animal husbandry activities. With the result, more cowdung becomes available making way for biogas plants. However, the studies confirmed our initial reservation about the significance of the air quality for APLIFT project.

9.2 Air quality

Ambient air quality
Ambient air quality limits prescribed by Central Board for Prevention and Control of Water and Air Pollution are given in table 9.1.

Table 9.1

Ambient air quality limits

ZONE	SPM	SO2	NOx	CO
a) Industrial Mixed use	500	120	120	5000
b) Residential and Rural uses	200	80	80	2000
c) Sensitive zones	100	30	30	1000

micro grams per cubic meter

SPM : Suspended particulative matter
SO2 : Sulfur di-oxide
NOx : Oxides of nitrogen
CO : Carbon monoxide

Indoor air quality
Indoor air quality limits for rural houses prescribed by the World Health Organisation (no national standards are available) are given in table 9.2

Table 9.2

Indoor air quality limits

Respirable SPM	:	No limits prescribed
Sulfur di-oxide	:	< 1.35
Oxides of nitrogen	:	< 0.32
Carbon monoxide	:	< 30
Hydro carbons	:	< 0.12

milligrams per cubic meter

The detailed results are presented in Annex 9.

9.3 Mahboobnagar district

9.3.1 Ambient air quality

Proposed site
SPM value of 89 to 94 units is less than that of the prescribed limit of 200 units. The Sulfur Dioxide shows a maximum concentration of 5 to 8 units as against the limit of 30 units. The case is similar with regard to Nitrogen Oxide. Carbon Monoxide is below detectable levels.

Proposed Vs Existing site
Ambient air quality, based on the above parameters, in the existing site is no different from that in the proposed site. This indicates that ambient air quality will not be affected adversely due to the Project intervention.

9.3.2 Indoor air quality
Results of the analysis of the air quality characteristics of the proposed and existing sites are summarised in table 9.3

Table 9.3

Indoor Air Quality - Mahboobnagar

Parameter	Proposed	Existing
RSP	0.8 - 1.5	0.2 - 1.5
SO2	0.7 - 0.8	0.0 - 0.8
Nox	0.3 - 0.7	0.0 - 0.8
CO	0.2 - 0.5	0.0 - 0.5
HC	0.000 - 0.005	0.000 - 0.008

All air quality parameters of the proposed site are well within the prescribed limits. Further, no significant

difference exists between the proposed and existing sites. It is inferred that the project intervention will not affect the air quality.

9.4 Prakasam district

9.4.1 Ambient air quality

Proposed site
SPM value of 94 to 115 units is less than that of the prescribed limit of 200 units. The Sulfur Dioxide shows a maximum concentration of 5 to 6 units as against the limit of 30 units. The case is similar with regard to Nitrogen Oxide. Carbon Monoxide is below detectable levels.

Proposed Vs Existing site
Ambient air quality, based on the above parameters, in the existing site is no different from that in the proposed site. This indicates that the ambient air quality will not be affected adversely due to the project intervention.

9.4.2 Indoor air quality

Results of the analysis of the air quality characteristics of the proposed and existing sites are summarised in table 9.4

Table 9.4

Indoor Air Quality - Prakasam

Parameter	Proposed	Existing
RSP	0.6 - 1.2	0.7 - 1.2
SO2	0.5 - 0.9	0.5 - 1.1
Nox	0.2 - 0.9	0.4 - 0.9
CO	0.3 - 0.6	0.3 - 0.6
HC	0.00- 0.003	0.0 - 0.03

All air quality parameters of the proposed site are well within the prescribed limits. Further, no significant difference exist between the proposed and existing site. It is inferred the project intervention will not affect the air quality.

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Chapter 10

PUBLIC HEALTH

10.1 Introduction

The experience nation-wide indicates that water resource development projects are normally associated with a variety of diseases. However, from an environmental impact study point of view, one needs to differentiate the diseases based on its etymology. Some diseases like fluorosis and methaemoglobinemia occur as a result of excess fluoride\nitrate contents viz., the natural quality characteristics of water. Malaria and schistosomiasis are vector borne viz., water based diseases. Cholera, typhoid, gastroenteritis and jaundice are due to biological contamination and can be described as water borne\washed diseases. Exposure to petrochemicals like pesticides cause dizziness, nausea and skin rashes (in the short run) and respiratory problems like Asthma, in the long run, and these can be classified as pollution resultant diseases. Health hazards due to a particular disease, however, is a function of the environmental receptivity as well as community vulnerability. Disease spread particularly among the infants is a complicated mix of child spacing, immunization, family education, cultural practices like breast feeding and weaning, access to food and safe water supplies and sanitation. Intermittent water supply and distance from the water source to the home is sure to play a vital role in the health of the community. Moreover, distance from home to water source and amount of time spent carrying it home from the source will affect the amount of water used within the house. Water quality at the source may not pose any problems. Potential sources of contamination could be due to uncleaned vessels, type of storage (closed/open), dipping of uncleaned/unwashed hands into the vessels for retrieval etc.

Types of mitigation measures include an appropriate blend of the following:

* Environmental Modification - drainage, total earth filling, deepening and filling; land grading, velocity change and impoundment;
* Environmental Manipulation - clearance of vegetation, shading/exposure to sunlight, water level fluctuations, sluicing for flushing, aquatic vegetation control, salinity regulation;
* Modification of Human Behaviour - water supply and sewage, screening and bednets, refuse collection and disposal, land use restrictions, and improved housing; and
* Appropriate agro-chemical management practices

Table 10.1

Public health particulars
(Based on Primary information)

Sl.No.	Particulars	Mahboobnagar	
		Proposed	Existing
1.	Breast feeding		
	-Families practising breast feeding	90	92
	-Months of breast feeding	12-30	12-30
2.	Personal hygiene		
	-Hand wash before preparing/ eating food and after deification (use of soap)	83	90
3.	Washing of Utensils		
	a. Detergent	30	45
	b. Soap	--	--
	c. Mud/Ash/Others	70	55
4.	Drinking water source		
	a. Handpump	100	100
	b. River	--	--
	c. Open well	--	--
	d. Ponds	--	--
	e. Borewell		
5.	Storage of drinking water		
	-Metal containers	50	50
	a. Open	--	--
	b. Closed	30	30
	c. Both	20	20
	-Pots	50	50
	a. Open	--	--
	b. Closed	40	50
	c. Both	10	--
6.	Average number of diarrhea		
	-in last 3 months	--	--
	-in last one year	16	10
7.	Average number of malaria		
	-last 3 months	--	--
	-last one year	10	10
8.	Flurosis	--	--
9.	Other diseases		
	- Tuberculosis	--	--
	- Asthma	--	--
	- Jaundice	--	--
	- Rheumatic Pain	--	--
	- Throat Infections	--	--
10.	Wearing footwears (Particularly in the field)	Nil	

(all data are expressed as % of the number of families)

Given this background i.e., etymology of diseases and the mitigation measures, we wish to discuss sequentially, the prevailing socio cultural practices and their bearing on disease occurrence. Natural quality characteristics of water and its impacts are discussed subsequently. The relevant data are summarised in tables 10.1 and 10.2 respectively.

10.2 Mahboobnagar - Proposed site

Socio-cultural practices
Among the respondents, 90% of the families practice breast feeding. The child continues feeding on the mother's breast for more than 2 years.

Only 83% of the families report washing their hands before preparing/eating food and after defecation. That is, the remaining 17% are prone to contamination. Nearly one-third of the families use detergents for washing utensils. The remaining 70% use mud or ash. All the families obtain drinking water from the borewells, i.e., ground water. Half the families use metal containers to fetch and store water, and the other half use mud pots. And 30% of the families do not seem to close the containers fully while storing the water.

Diseases

Diarrhea is reported to occur almost regularly once an year during August and September, the months receiving new water in the river. A mere 16% of the people are affected. Diarrhea being a water borne disease it goes to show that, despite the availability of protected water in the village, residents do have the habit of consuming river water when they are out of the house, working in the fields. Apart from the fresh water borne disease spread, undesirable socio-cultural practices must be compounding the menace of diarrhea disease.

Malaria too seems to be occurring almost regularly every year, affecting 10% of the people. This is quite understandable as apart from the prevailing private lift irrigation schemes, the proposed site is sandwiched between two existing lift irrigation schemes, mostly covered by paddy. Associated with which is water logging in the low lying areas which must be acting as mosquito breeding centres and hence malarial spread.

Natural water quality related diseases
Quality characteristics of river water (see section 7) are all within the prescribed limits of national standards (ISO 10500). Hence no diseases are contemplated because of poor/bad water quality. The water in the village site, particularly ground waters are very poor and unsuitable for domestic purposes. Strangely, no adverse affects are reported.

Pollution related diseases
Levels of fertilizer and pesticides application are determined by the cropping pattern. Currently, cropping pattern is such that, the levels of application are too low to warrant any health hazard. In Mahboobnagar, the expected cropping pattern under APLIFT project is predominantly paddy-based, similar to that in the 'control' site. Fertilizer and pesticides application, as noticed in the 'control' site, will be at moderate levels, and hence, we do not anticipate adverse effects.

Secondary data
Secondary information on the diseases - frequency of occurrence, extent of spread etc., presented in Anex.10 indicate two major diseases viz. dysentry and syphilis.

Proposed vs existing site
A comparision of the public health status between the proposed site and that of the control site are presented in table 10.1. The farm families in the existing site seem to be little better as regards personal and domestic hygiene. This is probably due to larger availability of water which has become possible because of irrigation schemes. Consequently, the health status has improved, though marginally.

Conclusions
The quality of river water poses no problems but for some prevalence of two diseases - diarrhea and malaria. While the diarrhea is caused due to bacteriological contamination in surface water, (during particular months in an year) malaria is a result of a combination of socio-cultural practices (including personal and domestic hygiene, sanitation) and poverty (leading to malnutrition weakness and higher vulnerability to diseases). Thus disease prevalence/spread is not due to water quality (or infact quality alone) but due to a variety of other factors. It is inferred that the APLIFT Project as such is not likely to pose any adverse health impacts. On the other hand, the APLIFT Project is likely to have a positive impact as it makes more water available which is critical for maintaining a certain level of personal and domestic hygiene. More so, the poor people will be benefited, to quote Hardoy & Cairncross (1990), "water tainted by pathogens can affect anyone, including the engineer and government official. On the other hand, disease and hardships due to water scarcity affect only the poorest in a society". The provision and use of sufficient water can prevent the contamination of food, utensils and hand, thereby can reduce the transmission of major infectious agents of diarrhea (Esrey & Habient, 1986). Aziz Hoque et al.,(1990) explains that, in most health studies in which significant reduction in diarrhea was detected, there had been improved access to water in quantity. Infact most farmers express that, with irrigation, crop

yield and incomes increase resulting in increased food consumption and thereon better nutrition,thereby tremendously improving the health status. The APLIFT Project is likely to have a positive impact as it makes water available to the otherwise water-scarce rural poor.

10.3 Prakasam district

Socio-cultural practices
Among the respondents, 96% of the families practice breast feeding. The breast feeding is continued for one year. For details, please see table 10.2.

As high as 90% of the families report washing their hands before preparing/eating food and after defecation. And 70% of the families use detergents for washing utensils. And the remaining 30% use mud or ash. The families obtain drinking water either from protected water supply scheme or surface water tanks/ponds. 90% of the families use metal containers to fetch and store water and the remaining 10% use mud pots. About 90% of the families close the containers fully while storing water.

Diseases
Diarrhea A mere 6% of the families report having suffered from diarrhea in the last 12 months. But it is not reported to be a regular phenomenon. Malaria disease is not reported.

Natural water quality related disease
Quality characteristics of river water (see section 7) are all within the prescribed limits of national standards (ISO 10500). Hence no diseases are contemplated because of poor/bad water quality. The water in the village site, particularly open wells and tanks are very poor and unsuitable for domestic purposes. Strangely, no adverse affects are reported.

Petro-Chemical related diseases
In Prakasam, the current cropping pattern in the proposed site is predominantly based on cotton and chilies. Cotton cultivation is normally associated with usage of very high level of inorganic fertilizers and pesticides. The former results in nutrient leaching thereby polluting (at the minimum) surface waters and in the extreme case, groundwaters as well. Higher nitrate levels in drinking water can cause methaemoglobinemia in infants, carcinogenic nitrosomes in the stomach and gastric carcinomas (Lee and Bastermeijer, 1991). The injudicious use of pesticides has many adverse affects. It is commonly reported that during the pesticide application, field workers experience dizziness, nausea, become weak and unconscious. In the long run, some may suffer from Asthma. Soils, too, are affected, as the

pesticide reduces the nitrogen fixing and nitrifying bacteria. Management of petro-chemical inputs, particularly when cotton is cultivated, has been a focal issue in the recent years. Before discussing the same, we wish to draw the attention towards the fact that the primary information on diseases do not reflect any petro chemical related ones. Simply because, the study has drawn information from the farmer-households and not from labourer-households who actually undertake pesticide application.

Cotton cultivation in Andhra Pradesh

During the late 80s, the coastal districts of Andhra Pradesh, particularly prakasam witnessed unprecedented out break of American bollworm pest of cotton leading to severe devastation and crippling the economy of cotton farmers. All kinds of available pesticides and their combinations were tried in vain. Many resorted to hand picking and killing, and a few of them even abandoned cotton crop in desperation. Some even committed suicide. Farmers suspect that substandard and spurious agrochemicals sold in the market are responsible for the severity of the situation. The scenario remains unchanged even today. Indepth enquiries reveal that it is neither the pest nor the pesticides, but the answer lies in pesticide management. The contributory factors towards severe pest problems are :

-underdozing of pesticides ;
-usage of unrecommended product combinations which not only are incompatible but also antagonistic;
-usage of low volume of water and poor quality spray appliances which results in inadequate crop coverage;
-repeated usage of the same pesticides at shorter intervals without relevance to pest emergence and intensity would render immunity; and
-over reliance on pesticide dealers' recommendations.

APLIFT project impacts

Cotton being a very high risk proposition, farmers would like to switch over to some other crop(s), preferably paddy. To enable this switch-over, from cotton to paddy, farmers are demanding irrigation. Paddy in the normal circumstances consumes relatively much less of agro chemicals (fertiliser and pesticides) than that of cotton. Hence, with the project, petrochemical related pollution/diseases might get reduced. This is possible provided farmers adopt recommended level of agro chemical application which, in the absence of effective extension services, is doubtful as they are accustomed to injudicious applications. But, paddy cultivation particularly on black soils is expected to result in water logging unless the plans for drain are made properly. Else, mosquitoes and hence malaria will surface out on a large scale.

Table 10.2
Public health particulars
(Based on Primary information)

Sl.No.	Particulars	Prakasam	
		Proposed	Existing
1.	Breast feeding		
	- Families practicing breast feeding	96	96
	-Months of breast feeding	12	12
2.	Personal hygiene		
	-Hand wash before preparing/ eating food and after deification (use of soap)	90	90
3.	Washing of Utensils		
	a. Detergent	70	76
	b. Soap	--	--
	c. Mud/Ash/Others	30	24
4.	Drinking water source		
	a. Handpump (PWS)	34	66
	b. River	--	--
	c. Open well	--	--
	d. Ponds	66	34
	e. Borewell		
5.	Storage of drinking water		
	-Metal containers	90	90
	a. Open	--	--
	b. Closed	90	90
	c. Both	--	--
	-Pots	10	10
	a. Open	--	--
	b. Closed	10	10
	c. Both	--	--
6.	Average number of diarrhea		
	-in last 3 months	--	--
	-in last one year	6	5
7.	Average number of malaria		
	-last 3 months	--	--
	-last one year	--	--
8.	Flurosis	25	20
9.	Other diseases		
	- Tuberculosis	2	--
	- Asthma	--	--
	- Jaundice	5	--
	- Rheumatic Pain	2	--
	- Throat Infections	2	--
10.	Wearing footwears (Particularly in the field)	Nil	

(all data are expressed as % of the number of families)
PWS : Protected water supply

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Chapter 11

FLORA AND FAUNA

11.1 Introduction

Agricultural production systems are designed to exploit the natural resources available, with the aid of specific technologies, with a view to harvest primary and/or secondary products. Agriculture involves not only the use of labour, knowledge and capital, but also harnessing of natural resources (soil, micro-climate, natural vegetation, topography) and the mobilisation of natural and, possibly also artificially, means of production (nutrients, water, energy). These means of productions are reproduced in ecological and economic processes which together determine the specific nature of a given agricultural ecosystem. This agricultural ecosystem is the basis for every type of natural input in the production process. The production process itself influences the agricultural ecosystem. It can lead to soil pollution or degradation. Sustainable use of natural resources therefore means that the ecosystem is not fundamentally damaged, or in other words that plans should be made to predict, evaluate as well as prevent or offset unforeseen ecological backlashes. This chapter deals with the assessment of the APLIFT project on the flora and fauna in the proposed groundwater project sites of (Mahboobnagar) and Mudmal Adasumalli (Prakasam) villages. Of particular importance is towards unearthing the likely loss of and\or damage to the rare, endangered, threatened and endemic species, as well as on the normal agroecological properties of productivity, sustainability and stability. Initially, we present a brief description of the salient characteristics of the prevailing ecosystem, and impacts (adverse as well as favourable) are discussed.

11.2 Mahboobnagar district

Based on the species diversity, method of cultivation, type of producers and consumers, the ecosystem in the study area can be divided into (i) crop land and (ii) non-crop land ecosystems. While the crop land ecosystem is essentially characterized by man's intervention in the form of growing crops, non-crop land ecosystem is free of such interventions. The Mudmal scheme area, however, comprise mostly crop land ecosystem.

Crop land ecosystem

Cropland ecosystem is also known as man made ecosystem or artificial ecosystem because man tries to control biotic community and physical environment. The most important of these is an artificial force from man to maintain a uniformity in the species composition of the producers, in addition to maintaining the moisture

level of the soil and replenishing nutrients at times.

There is a mixture of abiotic as well as biotic setting prevailing in this area which is reflected by the prevailing plant and animal communities in irrigated (Murardoddi), unirrigated (Mudmal) and fallow zones (black buck area adjoining the river Krishna).
There are two cropping seasons, kharif from April to September and rabi from October to March. There is however, a little variation in these periods with regard to paddy which is cultivated in both the seasons. The kharif paddy cultivated between June to December, is also known as Rabi crop and rabi paddy,. cultivated between November and April, as Rabi crop in this region.

Crops
A variety of crops viz., Paddy, Groundnut, Jowar, Castor and Pulses are grown in the project area. Of late, Sunflower is also cultivated but in small patches.

Pests and diseases
Following are commonly prevalent pests and diseases in the study area:

Paddy:	**Pests**	- gall midge, brown plant hopper and stem borer
	Diseases	- bacterial blight and blast
Jowar:	**Pests**	- shootfly and earhead bug
	Diseases	- striga and smuts
Castor:	**Pests**	- Red headed hairy caterpillar Tobacco caterpillar
Groundnut:	**Pests**	- Red headed hairy caterpillar, root grub.
	Diseases	- seed rotting, leaf spots and rust.

At present, none of the diseases/pests, however, have assumed economic importance, particularly in the rainfed agriculture fields owing to the adoption of mixed cropping - jowar with grams or jowar with sunflower or bajra with grams or groundnut with peas/grams.

Weeds
Some of the common weeds in this area and its occurrence are as follows;

Lantana camara	:	Located in fallow lands
Xanthium strumarium	:	Located around the village and road sides
Parthenium hysterophorum	:	Located around the village and road sides
Eclipta, Celosea Sp	:	
Cynodo, Cyperus	:	Located near agricultural fields

Flora and Fauna
Detailed enumeration of flora and fauna are presented in Annex 11. Of the fauna, black bucks (Antilope cervicarpa) described as an important component of one of the most threatened ecosystems of peninsular India, draws the attention.

Black bucks

Habitat characteristics
Black bucks are classified as endangered species, as once having enormous and continuous population, is now restricted to a very few pockets. From a population of about 80,000 in the 40s, it got reduced to 8,000 in the 60s and the reduction continued well into the 70s. After which the situation improved thanks to the enactment of Wild Life Protection Act in 1972. Black bucks are inhabiting both the proposed as well as the control irrigation scheme areas. Normally, they are found along the river at a distance of 0.5 Km as in the case of Mudmal on the banks of river Krishna. The habitat characteristics in these areas normally fall into three categories: i) plains, mostly cultivated areas interspersed with grasslands, ii) forest fringes adjacent to the cultivated areas, and iii) forest areas. Mudmal area, measuring about 80 Sq Km, comprises mostly privately owned cultivated lands. Most lands are assigned (in the recent times) to poor people by the government. Over the years, with the increase in cultivation, grasslands are diminishing on which the black bucks used to feed upon. The conflicts between black bucks and farmers hence, are on the increase. In some areas in Andhra Pradesh, the conflicts are so severe that the black bucks are forced to withdraw themselves into the forests where they are struggling hard to survive.

Of the 80 Sq Km Mudmal area, as high as 80% is under cultivation; 5% is under grass lands; 4% under the groves of Phoenix species; and the remaining by rocky out crops and submerged areas.

Black buck movement pattern are mainly governed by the availability of fresh vegetation. As black bucks feed on a variety of crops, their movements are related to the condition of the crop and the weeds present in the crop fields. With the monsoons, the dry grasslands turn green attracting the black bucks. As the crops are grown, grass and weed availability reduces, and they start feeding on the crops causing damages as they cut the tender leaves. They also eat the grains of millets as well as the pods of pulses. They are totally denied the fresh grasses and weeds during the Rabi season. That is, growing a second crop renders the food availability (other than the agricultural crops) almost nil. The cultivation, in general, and Rabi cultivation,

in particular, results in the loss of black buck's preferred open scrub habitat, affecting their population.

Conservation of black bucks

Being a schedule I species, black bucks are protected under Wild Life Protection Act of 1972 which prohibits killing by any means, harming, taming and possessing of skin, horns and other parts of the body. The responsibility to implement this act rests with the state government. Despite being inhabited mostly on the privately owned (cultivated) lands, the state government has drafted 5 of their personnel to deter unwarranted claim of the animals and to prevent poaching. In some places, they are protected by the local people themselves mainly for religious reasons and partly due to the belief that black bucks increases soil fertility. Consequently, in Mudmal area, the population has increased from 80 in 1981 to 1000 in 1993. This is despite the homerange (an area in which an animal or group of animals move around and pursue the normal activities of food gathering, mating and raising the offsprings) remaining the same. This is probably due to the fact that not all lands are cultivated (during the Rabi season) with the result habitat carrying capacity has not yet been affected adversely.

Conclusions

Flora and fauna study in the proposed APLIFT project site at Mudmal revolves around black bucks. Specifically, the issue is what adverse impacts can be envisaged on the black buck population? It is some sort of an interface between man or the crop land ecosystem and the black bucks, with a characteristic blend of conflicts and complimentaries. While it is true that the people in the scheme area are poor and irrigation holds the key for their prosperity, the same might reduce the availability of preferred diet for the black bucks forcing them to the interior of the forests. And they become prey to the wild animals. Habitat conservation measures appropriate to the animal will have to form a component of the APLIFT project.

11.3 **Prakasam district**

The entire scheme area is under commercial agriculture. Tobacco, cotton, chili and paddy are the common crops. All diseases and pests normally associated with these crops are noticed in the scheme area. This is reflected in the higher levels of agro chemical application.

Weeds

Some of the common weeds and their occurrence in this area are as follows;

Lantana camara	:	Located in fallow land
Chrozophora	:	Dried canals
Agremone maxicana	:	Road sides
Eclipta alba	:	Field bunds
Asteracantha	:	Field bunds
Ipomoea sp	:	Nallas
Polygonum sp.	:	Agricultural fields
Xanthium strumarium	:	Located around the village and road sides
Parthenium hysterophorum	:	Located around the village and road sides
Eclipta, Celosea sp	:	
Cynodon, Cyperus	:	Located near agricultural fields

As the proposed area is already under cultivation, and there is hardly any virgin land left for the natural growth of plant species. As a result plant species that have wide range of ecological amplitude are only existing. Thus Adasumalli scheme is exclusively a crop land ecosystem. Change of cropping pattern from cotton to paddy is expected to result in some positive impacts as paddy consumes very less of agro chemicals. But the effect may not surface out as the surrounding 20,000 Ha will continue to grow cotton/tobacco applying high level of agrochemicals. On the other hand, unless water is managed effectively, water logging and the resultant problems are expected. Particularly soil microorganisms are likely to be adversely affected.

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Chapter 12

ENVIRONMENTAL IMPACTS AND MITIGATIONS

12.1 Introduction

In this chapter, environmental impacts of the APLIFT Project are discussed. In effect, it is a synthesis of the Chapters 6 through 11. The presentation will cover both positive and negative impacts. Mitigation measures serving as 'recommendations' are also suggested to encounter the negative impacts. The presentation is essentially based upon the cause and effect net work relationships involving project activities, environmental parameters and the public interests, as listed in Fig 5.1. The project activities can be distinguished into three broad categories, depending on the time/stage of occurrence - before construction, during construction and during the operation. Autonomous developments such as population rise, industrial growth and trade expansion also have a bearing on the project impacts. The relationship between the activities and the impacts are reflected in the environmental parameters - water quantity, water quality, air quality, soil characteristics and flora and fauna. The interrelationship among the impacts affect (adversely or favorably) the 'public interests' - agricultural production, socio-economic development, forward and backward linkages, public health, natural resources management and socio-cultural values. The impacts and mitigation measures are discussed in specific reference to each of these public interests. However, we would like to caution that the 'public interests' listed are not mutually exclusive, but mutually reflexive. Yet, for the sake of convenience, each one is dealt separately.

12.2 Agricultural production

Agricultural production chiefly is reflected in the environmental parameters of water quantity, water quality, soil characteristics, and the pests and diseases (biotic environment).

12.2.1 Water quantity

The entire APLIFT project rests on whether or not sufficient waster will be available for the development of a lift irrigation scheme at a certain point along the water course. The hydrological clearances are more political concurrences as they do not ensure either the quantity or quality of water. The onus to ensure sufficiency in water availability rests with the proponent. The entire project will suffer if the availability of water is not worked out precisely.

Mitigations and recommendations
Water availability at source should be worked out based upon the supply (making provision for normal natural fluctuations) and the current as well as committed demands. The demand and supply, however, are to be worked out not on a local, but at a river basin scale. This should be done on a sufficiently longer time horizon, say at least 15 years. Apart from considering the autonomous developments, the requirement of other uses and users -drinking water, fisheries, industry, tourism, navigation, ecology (some rest flow to prevent saline intrusion) - also should be taken into account. The water availability from Krishna river for new schemes is bound to be at the expense of the downstream uses and commitments. The fact that water availability for irrigation in the Krishna is critical is duly acknowledged in the APLIFT project document. Yet many lift irrigation schemes are planned on Krishna river. This decision needs a careful review.

12.2.1.2 **Water lifting**
After ensuring the availability of water at source, water lifting or intake points should be selected carefully or otherwise the scheme would suffer for want of desired amount of water for the stipulated period and the coverage or the water-reach will be poor.

Mitigation and recommendations
Water lifting or intake point(s) should be such that maximum water can be lifted for most months in an year at the lowest cost. For this, the intake point should be such that i) water should be hugging towards the point; ii) length of the main pipeline should be minimum; iii) the main pipeline should end in the highest command point so that water can flow freely by gravity; and iv) that the entire command receives water. Lifts designed on the fore shore of reservoir should not be located near the full reservoir level, but at realistic estimate of water levels. Consequently, the entire machinery should be able to withstand flooding. Given the above requirements, alternative intake point combinations should be formulated and the same be subjected to a techno-financial appraisal. The final selection, however, should keep the administrative convenience in mind as the APLIFT project contemplates that the schemes be managed by the farmers themselves.

12.2.1.3 **Cost effectiveness**

The APLIFT project contemplates that the scheme should be managed by the farmers themselves. For this to fructify, it is essential that the schemes are cost-effective in the longrun. The status of the channels - lined or unlined - and the power tariff differentials offered by the APSEB are the focal points in this regard.

-Lined vs. unlined channels
Unlined channels result in substantial loss of water, as high as 10-15% of water lifted. This has serious financial implications as the system has to be designed for higher capacity lifts. Operation and maintenance (O&M) costs will also be quite high.

Mitigation and recommendations
All channels should be lined. Consequently the system can be designed for lesser capacity (motor in terms of HP) and hence a reduction in the initial investments. Additional cost involved in lining, however, should also be considered. This would prove cost effective in the longrun as O&M expenses will be quite low. Moreover, the lining helps in saving the precious scarce water resource.

-Single vs multiple societies
Andhra Pradesh State Electricity Board has a differential power tariff system. Farmers or societies with a motor of capacity less than 70 HP are to pay power tariff on a fixed basis i.e., Rs 400/HP per annum, irrespective of the power consumed. If the capacity exceeds 70 HP, then the tariff is Rs 1.10 per unit of consumption. Subject to the technical feasibility, all efforts should be made to take advantage of the power tariff differential. Formulating schemes with capacity less than 70 HP and project each one of them as separate entities will enable reduction of power expenses to the extent of 80% Also, subject to the water availability, even a second crop can be planned at zero power cost.

12.2.1.4 **System design, crops and water utilization**
A major assumption on which the entire water budgeting, and hence the system design, is dependent, is on the crops likely to be grown by the farmers under irrigated agriculture. The project assumes and, infact, the hydrological clearance, barring some exceptions like that of Prakasam, is given only for the cultivation of ID crops like groundnut, sunflower, pulses etc., which require at the most 8 Ha cm of water. However much the desire may be on the part of the farmers to grow ID crops, particularly groundnut (commercially good proposition), in reality they will start to grow paddy, initially with an intention to meet the home-consumption needs. Water table around the paddy fields rise and renders the cultivation of ID crops impossible. As a result, the paddy area spreads out and commonly 30 to 50% of the irrigated area is under paddy after 5-6 years. Paddy requires normally about 24 Ha Cm of water (more in places like Mahboobnagar as water holding capacity of the soils are poor), and hence uses nearly all the water (meant to irrigate the entire command). Thus, some 20% of the area will not receive water at all, resulting in conflicts between farmers. Seepage is another problem related to paddy cultivation, in the

studied (control) schemes, some 30% of the area had become water logged and return flows, in the form of small streams are very high (up to 30%). Furthermore, illegal lifts, currently operated with diesel pumps cannot be excluded form drawing water from the APLIFT scheme. Diesel costs being very high, farmers would draw water from the APLIFT scheme rather than operating on their own. Taking all the above into account, excess of water to the extent of 40% will be required to irrigate the command. This is not taken into account in the system design.

Mitigation and recommendations
The command delineation i.e., the area irrigable should be assessed initially based on the amount of water available at source. Subsequently a realistic estimation of the cropping pattern and calendars should determine the command delineation. Due provision for conveyance and application losses should be made while working out the crop-water requirements. Under estimation of paddy growing will result in insufficient water supply to the tailend users. The actual capacity of the lift (HP) should be decided based upon the command delineated as described above. Hydrological clearance should be in conformity with the designed capacity of the lift. APLIFT project should take due cognizance of the implications of 30 to 50% paddy coverage (as against the assumed 100% ID crop coverage) and incorporate the same into its planning.

-Waterlogging and distribution
Apart from the design not being in conformity with the actual crop water requirements, unlined channels (currently in vogue in the APSIDC projects) results in waterlogging and distribution problems with water seeping into the fields along the canals. Blocking of the canals due to sedimentation and excessive aquatic weed growth (AAP) is also common. The water flow stagnates and water sweeps into the adjacent fields. Sedimentation is mainly a result of trampling of the unlined canals. Unlined channels have a natural tendency to depreciate very fast (unless maintained properly and regularly) widening/changing the water flows. Social differences among the people and the faulty design of the layout compound the problem of water logging and distribution.

Mitigation and recommendations
Channels should be lined. This not only reduces wastage of water and distribution problems, but also helps in saving the precious scarce resource. The lining of channels, however, is not the only and exclusive solution. The soil characteristics also play a vital role. In the case of black soils (Prakasam), unless plans for effective drainage are made, adverse soil modifications are bound to take place (see 12.2.3).

12.2.2 Water quality

12.2.2.1 Suitability for irrigation

In Mahboobnagar and Prakasam districts, all the quality characteristics of different parameters of the river/drain water are within the prescribed limits and hence are suitable for irrigation. No adverse impacts are foreseen due to the usage of this water.

12.2.2.2 Suitability for domestic usage

In Mahboobnagar district, the quality characteristics of different parameters of the river water are good and suitable for domestic purposes throughout the year.

In Prakasam, the quality of water remains good so long as the water is flowing in the drainage i.e. so long as the irrigation is practiced in the upstream and regeneration flows are continuous. The moment flow stagnates, the water quality becomes poor and unsuitable for domestic purposes. Animals, particularly, buffaloes are affected adversely.

Mitigation and recommendations
Surface water ponds are to be constructed in the near vicinity of the drainage and water should be lifted and stored when the flows are afresh, free of pollution. This practise is already prevailing in the scheme area but for domestic human drinking purposes only. In storing the water care should be taken to see that the same is not polluted due to nutrient leaching and/or bacteriological contamination.

12.2.3 Soil characteristics
Soils in Mahboobnagar and Prakasam districts are found suitable for irrigated agriculture. In Mahboobnagar, soils have low water holding capacity, with the result more water is required. Soils are also prone to erosion. In Prakasam, given the black soils, adverse soil modifications such as water logging, salinization, nutrient leaching, etc. are foreseen.

Mitigation and recommendations
While low water holding capacity of the soils in Mahboobnagar are more due to its inherent natural characteristics, it can be improved by improving the organic matter content in the soil. Application of organic manure is essential for this. As regards soil erosion, soil and water conservation measures, effected on a watershed basis, should be planned for. Typically, planning for watershed should take into consideration rainfall-runoff relationships, soil characteristics, slope, land use classification, existing features and farmers' choices and preferences for techniques and technologies.

Adverse soil modifications likely to occur in Prakasam can be minimised by effective water management practises with due attention towards plans for draining out the excess water.

12.2.4 Pests and diseases

In Mahboobnagar, as on now, no pest and/or disease seems to be of economic significance in both the proposed and control sites. No adverse impacts are likely to occur on this front.

In Prakasam, currently, the pests and disease problems are quite serious as reflected in very high level of fertilizer and pesticide applications. Infact the cotton cultivation has become highly risky because of the pest and disease menace. With the result the farmers are eager to change the cropping pattern from cotton to paddy. It is expected that this change will result in reducing the menace. In other words, growing paddy is bound to have a positive impact. However, injudicious application of fertilizer and pesticides, for which the farmers are accustomed to, should be curbed (see, 12.3).

12.3 Linkages

Agriculture production possibilities reflected in the parameters of water quantity, water quality, and soil characteristics, exists more as 'potential'. Transformation of the same into reality demands some sort of linkages enabling accessibility and affordability to the supply of inputs and services as well as output marketing including transportation, communications, processing and storage of agricultural produces. Of particular importance, among the linkages, are the role of extension (agricultural and irrigation) and the financial viability of the farmer managed irrigation systems.

12.3.1 Extension

12.3.1.1 Fertilizer application

At present the government extension services are almost nil. All management practices - agro chemicals and irrigation - are evolved by farmers themselves. Fertilizer dosages, with the result, are quite high and vary from farmer to farmer. For example, paddy growing farmers in the 'Control' sites of Mahboobnagar and Prakasam apply 138 Kg of Nitrogen (N), 48/118 Kg of Phosphorous (P) and 33/10 Kg of Potassium (K) per hectare (table 4.5). The recommended levels are 50, 30 and 30 Kg/ha respectively, for kharif, and during the rabi season, a nitrogen doze of up to 120 kg/ha is recommended depending upon the fertilizer response of the variety and soil type. Levels of nitrogen

application are very high. As regards phosphorous, it is lower than the recommended in Mahboobnagar and higher in Prakasam. The situation is just the opposite as regards potassium. It is higher in Mahboobnagar and lower in Prakasam. Higher dozes of N and P results eventually in K deficiency. Inappropriate nitrogen dozes result in more of vegetative growth and serious pest and disease problems. The scenario is more serious in the case of cotton. As against a maximum recommended level of 120N+60P+60K per hectare, the actual application in Prakasam is 285N+288P+0K Kg per hectare. In the case of chillies, the recommended levels are 60N+30P+30K per hectare. Actual applications are 267 Kg of nitrogen (almost 5 times higher), 165 Kg of phosphorous (again 5-6 times higher) and 50 Kg of potassium. N and P are very much high. This is bound to create potassium deficiency in the soils. Soils are lower in sulphur (see Chapter 8) which adversely affects biosynthesis of oil, influencing the oil quantity and quality. Growing the same crop year after year, monocropping, usually practiced under irrigated conditions not only exhausts the soil nutrients but also results in serious pests and disease problems.

12.3.1.2 Pesticide applications

During the late 80s, the coastal districts of Andhra Pradesh, particularly Prakasam witnessed unprecedented out break of American bollworm pest on cotton leading to severe devastation and crippling the economy of cotton farmers. All kinds of available pesticides and their combinations were tried in vain. May resorted to hand picking and killing, and a few of them even abandoned cotton crop in desperation. Some even committed suicide. Farmers suspect that substandard and spurious agro-chemicals sold in the market are responsible for the severity of the situation. The scenario remains unchanged even today. Indepth enquiries reveal that it is neither the pest nor the pesticides, but the answer lies in pesticide management. In Prakasam, where the farmers are accustomed to injudicious applications, the pesticide management should be given due attention. Else, it will seriously effect the crop/scheme economics as not only the production will prove costly but also associated with a very high degree of risks and uncertainties.

12.3.1.3 Irrigation

Irrigated agriculture requires altogether a different type of management practices. The transition from rainfed to irrigated agriculture is quite crucial to the success of the project. Designing irrigation channels, crop combinations and crop layout are very important. In a crop-mix of paddy and ID crops (as expected in the most schemes) unless the delineation and crop lay out

are made properly, seepages and waterlogging are bound to occur. Over the years, cultivating ID crops become impossible and the entire area gets covered by paddy. The irrigable command gets reduced disrupting the computations related to the returns on investment. Methods of irrigation too merits special attention otherwise lot of water gets wasted leading to nutrient leaching and waterlogging in the low lying areas.

Mitigation and recommendations
Location specific farmer oriented techno-management practices, covering the entire gammut of crop production are to be developed adopting participatory appraisal methods. Subsequently disseminating the same should be planned for. As regards pest management, underdosing of pesticides should be avoided. Only recommended product combinations should be used, as otherwise the combinations would prove not only incompatible but also antagonistic. Adequate quantities of water and quality spray appliances should be used or otherwise it will result in inadequate crop coverage. In order to avoid pests developing immunity, repeated usage of the same pesticides at shorter intervals without relevance to pest emergence and intensity should be avoided. Over reliance on pesticide dealers' recommendations must be discouraged. Efforts towards developing integrated pest management techniques should receive attention on a priority basis.

12.3.2 Farmer managed irrigation systems

APLIFT Project contemplates the system to be managed by the farmers themselves. But the proposed sites are likely to be located in remote, far-off places, in other words, accessibility will be very poor. Moreover the farmers in most of the APLIFT project areas (with the exception of some coastal areas) are poor and illiterates. Given all these, it is too much to expect the system to be managed by the farmers themselves, particularly the technical aspects such as repairs and replacements.

Mitigation and recommendations
A 2-tier set-up with individual schemes forming primary level institutions and federated/amalgamated into an Apex organisation would be ideal in enabling accessibility and affordability to technical services. We recommend that the APSIDC should assume the role of the Apex body with a pre-set mutually (APSIDC & the farmers) acceptable terms and conditions of the retainership.

12.4 Public Health

While it is expected that the positive/favourable impacts on public health will occur in both the districts, however, some negative impacts can not be ruled out in Prakasam district.

12.4.1 Positive Impacts

At present, the socio-cultural practices including personal & domestic hygiene and sanitation as well as poverty leading to malnutrition, weakness and the vulnerability to diseases, all are contributing to the poorer health status of the people. APLIFT Project is sure to make more water available which is critical for maintaining a certain level of personal and domestic hygiene. More so, poor people who otherwise have no easy accessibility to water will be benefited. Irrigated agriculture would also result if not higher at least in stabilised production and incomes thereby nutritional levels will increase improving the health status. Water availability in the nearby vicinity also will help in reducing drudgery on women, specially young girls, who otherwise will have to traverse substantial distances to fetch water.

12.4.2 Negative Impacts

Negative or adverse impacts are likely to occur in Prakasam district chiefly due to injudicious application of fertilizers and pesticides. The Prakasam farmers are accustomed to very high levels of application of petrochemicals. Unless the dosages and timing are appropriate, nutrient leaching will take place polluting heavily the surface water bodies. Higher nitrate levels in drinking water can cause methaemoglobinemia in infants, carcinogenic nitrosomes in the stomach and gastric carcinomas.

The injudicious use of pesticides has many adverse effects. while applying pesticides, it is commonly reported that the field workers experience dizziness, nausea, weakness and become unconscious. In the long run, some suffer form Asthma.

Mitigation and recommendations
Nutrient leaching and resultant nitrate pollution of surface waters is more an extension related 'Linkage' issue, as discussed in the previous section. Apart from developing and disseminating location specific farmer oriented techno-management practices, a strict vigil should be maintained on the water quality (at least on a sample basis) during the first three years of the project, with a provision for corrective measures (fertilizer-dozes and applications methods) if need be.

Pesticide application resultant adverse effects are rather more serious as only the agricultural laborers (poor people) are affected. Pesticides enter the body orally (through the mouth), dermally (skin) and through inhalation (nose/mouth). In most pesticide operations, exposure to skin is the most likely route of contamination because of spillage, splashes or spray contact. Prevention of the skin contamination should therefore receive the maximum attention.

Mitigation and recommendations

-Before application
When pouring and mixing the concentrated product avoid splashing or spilling on to skin or clothing. If any product falls on the skin, or into the eyes, wash it off as soon as possible. Heavily contaminated clothing must be removed and washed with detergent and water.

Use suitable equipment for measuring out and transferring the product. Never use hands as scoops or for stirring liquids.

When spraying the diluted product, always work upwind of the spray and avoid coming into contact with it. Avoid contact with freshly sprayed foliage.

Use the correct application equipment, maintain it properly and use it correctly. Do not use leaky equipment; leaks cause skin contamination.

Do not attempt to blow out clogged spray nozzles with the mouth. Clean them with water or a soft probe such as a grass stem.

-During application
Do all preliminary operations (opening of container, solution preparation, filling of dusting/spraying appliances etc.) with rubber gloves and apron. In case of seed treatment wear a gas-mask.

During operation, wear protective clothing and gloves, cap etc, and smoking should be prohibited

Treat the crop during morning/evening hours and when there is no wind.
Operator should not work for more than 6 hours/day.

Avoid drift on to other crops and livestock and prevent any contamination with water source.

Don't tear open bags but cut them with knife.

Don't blow, suck or apply mouth to any sprinkler, nozzle or other parts of appliances in case of defaults.

Insecticide mixtures/solutions should be made in deep vessels with long-handled mixers to protect operator from splashings and to permit stirring from a standing position.

Wash hands thoroughly with soap and water, every time the sprayer/duster is filled with insecticide.

-After application
Wash the hands, eyes, face with fresh water and soap and clean protective clothing (gloves, face shield, apron)

Clean the appliances with water. Safely dispose of all used containers. Liquid containers should be washed out thoroughly.

The containers/packages of insecticide powder or granules must be emptied before final disposal. Polythene bags and packets must be burnt. Puncture non-returnable metal containers (except aerosol dispensers) and bury them in a safe place, if possible with other refuse. The empty containers should never be used for any other purposes like storing foodgrains, cosmetics etc. On the contrary, unused materials, with labels, should be stored under lock and key.

Operators should undergo medical checkup periodically.

Human Excretion : A special problem
In Prakasam, as is the case elsewhere in rural India, most houses do not have latrines for want of disposal facilities. Most people use open fields as toilets. Once cotton is replaced by paddy which is expected to happen with the advent of the APLIFT project, this may not be possible as water would be standing in the fields. This may force people to use the open spaces available nearer to the settlements. In which case, serious public health problems are bound to occur as surface water bodies will be subject to bacteriological contamination.
Altogether from a different, social, perspective , women are going to be the worst sufferers as they will have to restrict themselves to some particular timings during the nights to avoid being seen.

Mitigation and recommendations
The study is aware that this particular aspect is beyond the purview of the APLIFT project. It would mean overstretching the project which is not advisable. Yet, this needs special attention, may be from some other agency/organisation.

12.5 Natural Resources Management

Any development activity involves utilization of natural

resources - water, soil, air plants, animals, and human power. While the utilization is inevitable, it should rather be on a sustainable basis i.e., the current usage pattern of a resource should not adversely affect the availability of that particular or other related resources in future. Moreover, scarce resources (such as water) should be put to the best usage. Hence utilization of a resource should also be accompanied by development and conservation activities, together termed natural resources management. From this point of view, in the context of APLIFT Project, water management and flora and fauna merit special attention.

12.5.1 Water Management

Normal practice in agricultural projects is to plan in such a way as to maximize the crop revenue per unit amount of land. That is, the land is taken as an unit of production. But between land and water, it is land which is awaiting for water. A scarce resource should be put to the best possible usage. That is, the crop pattern should be designed such as to maximize the net revenue per unit amount of water and not per unit amount of land. Efforts to maximize revenue per unit amount of land does not lead to efficient management of water. This becomes evident from the following table 12.1.

Table 12.1

Water requirement and crop incomes

No. Crop	Water requirement (Hacm)	Area irrigable with 1 mcft (Ha)	Net income per Ha (Rs)	Net income per 1 mcft of water (Rs)
1. Paddy	24	1.84	9000	16,560
2. Groundnut	8	5.52	8750	48,300
3. Jowar	8	5.52	5625	31,050
4. Ragi	5	8.83	3000	26,496
5. Cotton	12	3.68	30000	1,10,400
6. Chillies	10	4.42	14500	64,030

mcft: million cubicfeet

Leaving the commercial crops of cotton and chillies which require relatively larger investments and risks are high, the ID crops are better revenue earners per unit amount of water than that of paddy. Farmers, however prefer growing paddy as the income per hectare is maximum.

Mitigation and recommendations

Crop pattern and crop sequences should be worked out in such a way that both the farmer's perspective of

maximizing revenue per unit amount of land and the project's perspective of maximizing the revenue per unit of water coincides with each other.

12.5.2 Flora and Fauna

In Mahboobnagar, the study foresee both positive and negative impacts. No negative impacts are contemplated in Prakasam district.

12.5.2.1 Project impacts - Mahboobnagar district

Positive Impacts
As the proposed area is already under cultivation, no loss of important germplasm viz. endangered, threatened, rare and endemic plant sp. is envisaged which require conservation.

The proposed project activities does not require any tree felling.

Increasing the phytomass not only increases soil organic content but also the carrying capacity of the area.

Since moisture is the most limiting factor for the plant growth in this region, increase in soil moisture will promote crop yields.

Most of the small farmers purchase paddy straw and components of paddy seed grinding materials (Tavudi and Chittu) to be used as fodder for cattle. Paddy cultivation, enables farmers to own (more of) fodder (straws) themselves instead of purchasing. The cattle population increases followed by increase in milk yield, health status, manure production, replacement of inorganic fertilizers etc.

Cattle and eggs, provide additional income for women.

Binding nature of vegetation reduce soil erosion.

The black buck population was nearly 100 during the year 1980. The number is steadily increasing which can be attributed to increased vigilance by the Forest Guards and increased moisture content in the soil. The black buck population increased 10 times within the span of 10 years despite home range remaining the same. This implies the carrying capacity of the soil has increased. The reason for which is irrigation. A number of Lift Irrigation Schemes have emerged in the lost 10 years increasing the soil moisture and hence the bio-mass. Given this, we do not envisage in the short run any adverse impacts of irrigated agriculture on black bucks.

Negative Impacts

Unless the system is designed properly and water is managed effectively, the likelihood of water logging and soil salinization looms large. This will affect adversely the soil micro-flora. Microbial proliferation gets suppressed, limits gaseous exchange and lowers the oxygen supply creating an anaerobic environment.

Water logging brings about a decrease in the abundance of bacteria developing in the air and a parallel stimulation of the strict anaerobes.

Mitigation and recommendations
Issues related to system design, water logging and water distribution are already discussed.

Lack of effective water management will promote water logging leading to extensive proliferation of weeds.

With the irrigation, area currently under rainfed crops like jowar, groundnut etc are going to be under paddy. This results in a reduction in the jowar production. Consequently, families whose staple food is jowar may either have to purchase or change the diet.

With irrigation, crop mixes and crop rotation will fade away, and cropping pattern will be characterized by 'monoculture' which may promote pests and diseases.

Mitigation and recommendations
Issues related to the change in the crop from jowar to paddy are discussed in section 12.6. Monoculture's adverse effects can be countered by introducing appropriate crop rotations.

Black bucks, rare and endangered species, is bound to be affected in the long-run unless alternative measures for providing fodder are planned for.

Immunizing cattle is a must, else, they may carry diseases across black bucks. Spread of the diseases from black bucks to cattle, also cannot be ruled out.

Mitigation and recommendations
Black bucks prefer open grass land area with sparse scrub growth. Such areas should be acquired and well maintained with the preferred plant species so that fresh dietary items are available throughout the year. This would avoid conflicts between black bucks and the cultivators. In other words, some sort of a buffer zone should be created so that black bucks need not have to invade the cultivated fields. Such areas also have to be protected from the cattle, sheep and goat grazing. All domestic animals are to be vaccinated against all communicable diseases. Additionally, surface water

storages should be planned for to meet the water requirement particularly during the summer months.

12.5.2.2 Project impacts - Prakasam district

Positive impacts
As the proposed area is already under cultivation there is hardly any virgin land left for natural growth of plant species. As a result plant species that have wide range of ecological amplitude are only existing. Species that need to be conserved viz. endangered, threatened and rare are absent.
The proposed project activities does not require any tree felling.
Irrigation increases the soil moisture which would promote primary production (phytomass).

Most of the small farmers in this area purchase paddy straw and components of paddy seed grinding materials as a fodder to their cattle. With the irrigation, they would be growing paddy themselves and need not purchase form outside.

Provision of irrigation promotes paddy cultivation, improves fodder availability, promotes cattle population followed by increase/improvement in milk yield, health status, manure production, usage of inorganic fertilizers etc.

Shift from cotton to paddy will reduce the amount of pesticidal application.

Negative Impacts

Indiscriminate use of fertilizers and pesticides may lead to soil sterility. Nutrient leaching may pollute surface water bodies adversely affecting the aquatic microflora.

Lack of proper water management may result in water logging and weed proliferation .

Water logging may also affect soil microorganisms adversely.

Water may stagnate and act as breeding centres for mosquito and other insects affecting the human beings and animals.

Mitigation and recommendations
Fertilizers and pesticides are more an issue related to the 'linkages' to be tackled as a part of the extension activities. Water management also is an extension related issue. Effective measures to drain out excess water should be planned for.

12.6 Socio-Cultural values

The APLIFT project would affect particularly the socio-cultural values as regards food habits and conventional wisdom or the indigenous technical knowledge (ITK) reflected in terms of crop rotations, crop-mixes, and crop sequences. This, however, is foreseen only in Mahboobnagar district.

Food habits
In Mahboobnagar, at present, inferior (an urban elite's version & not on nutritional grounds) cereal crops like jowar, ragi and sajja are grown under rainfed agriculture. They are also the staple food of the masses in the proposed project areas. With the irrigation, the inferior crops would give way for the superior food grains or commercial crops. The households will, either have to purchase jowar/ragi/sajja or change their food habits. Cooking pattern also undergoes a change in case a household decides to change its food habits. The larger implications. however, will be on the nutritional levels.

Indigenous technical knowledge
With the irrigation, the conventional wisdom accumulated by a farmer over number of years becomes historical. Crop rotations and crop mixes too get eroded away paving way for monoculture.

Mitigation and recommendations
Very little can be done as regards food habit changes which we feel is more a transitory phenomenon. The human body is flexible enough to accommodate wide range of food intakes. In the case of ITK, we recommend a documentation of the same in the proposed project site and try and attempt incorporating the same into the new techno-management practices.

12.7 Socio-economic development

Altogether two different perspectives emerge in the two districts. In Mahboobnagar, the APLIFT project is expected to increase production and productivity of crops, and in Prakasam, it is expected to bring in stability. The farmers in the two districts are not comparable. They differ tremendously in social, political, cutural and economic aspects.

Mahboobnagar
In Mahboobnagar, most of the prospective beneficiaries practice subsistence agriculture and are very poor. Being located in highly inaccessible places, they are politically weak. Till recently, they were landless labourers and culturally they are not into 'agriculture'. At present, the prospective beneficiaries

make a living out of growing rainfed crops. The advent of irrigation would make way for commercial crops such as paddy, groundnut and cotton. Not only productivity gets stabilized, production too increases, leading to increased level of incomes. More fodder becomes available and animal husbandry activities increase manifold times making available milk and milk products, egg and poultry, meat (sheep,goat) etc. Nutrition and health status, thus improve substantially.

A comparison between the family incomes of the proposed and control sites (see, table 4.4) reveal that APLIFT Project would result in substantial increase in the income levels. Per capita per month income will increase from Rs. 148 to Rs.450, up by 200%. The Project is also expected to reduce the wage income. Proportion of the income due to wages in the total family income is expected to get reduced by 50%. Overall income of the irrigated agriculture families being higher, this implies that the number of days of work as wage laborer gets reduced. A farmer can as well work on his own fields,instead of working for others. Similarly, proportion of people migrating out of the village in search of work is expected to get reduced substantially. APLIFT Project is sure to result in substantial socio-economic development in Mahboobnagar.

Prakasam

In contrast to Mahboobnagar, the farmers in Prakasam are relatively richer and politically strong. Traditionally, they are agriculturists, farming is practiced for more than 100 years. They are entrepreneurs and highly market responsive. They are not looking forward to increased production and productivity. Commercial agriculture currently practiced is too risky due to fluctuation in yield and prices. From the APLIFT project, they expect to stabilize their returns. High market responsiveness may prove detrimental from the APLIFT project point of view. Any development leading to some improvements in the cotton/tobacco situation will result in the farmers giving up paddy overnight. In which case, the entire investment will be a waste.

Mitigation and recommendations

APLIFT project sites are bound to differ from one to another. The physical conditions as well as people differ from one region to another. Drawing generalized inferences, particularly, from an environmental point of view would serve limited purpose. It is recommended that every scheme should be preceded by a rapid EIA not extending over a week.

12.8 Impact Review

This chapter, and the report, is concluded with answers to the general impact review criteria raised in section 5.4: THE PROJECT

- does not cause unwarranted losses in precious irreplaceable natural or other resources;
- does not make unwarranted accelerated use of scarce resources in favour of short than long term grains;
- will not adversely affect the national energy/foreign exchange situation;
- will not result in unwarranted hazards to endangerous species;
- does tend to decrease undesirable migration; and
- does enhances the welfare of the poor and vulnerable sections of the society.

In conclusion, we recommend that the APLIFT Project be grounded, but with a provision to address to the mitigations and recommendations of the study.

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REFERENCES

Project documentation APMIS:

Groundwater Minor Irrigation Schemes. Draft Report for Financial Assistance (revised). A.P. State Irrigation Development Corporation Ltd Hyderabad. not dated.

Report of the Appraisal Mission to the groundwater Minor Irrigation Schemes of the Government of Andhra Pradesh, India. December 1990.

Report on socio-economic impact study in the scheme areas of APSIDC highlighting the role of women in agriculture. For APSIDC Ltd Hyderabad by Andhra Pradesh Productivity Council Hyderabad. not dated.

Andhra Pradesh Groundwater Minor Irrigation Schemes (APMIS). Mission Report. March 1992.

Andhra Pradesh Groundwater Minor Irrigation Schemes (APMIS). Project Document. March 1992.

Project documentation APLIFT:

Surface Water Lift Irrigation Schemes. Project Report for External Assistance. A.P. State Irrigation Development Corporation Ltd Hyderabad. September 1990.

Identification Memorandum Andhra Pradesh Surface Water Lift Irrigation Schemes. ROYAL NETHERLANDS EMBASSY, May 1991.

Andhra Pradesh Surface Water Lift Irrigation Schemes (APLIFT). Fact finding Mission. April 1992.

Andhra Pradesh Surface Water Lift Irrigation Schemes (APLIFT appraisal). June 1992.

Project documentation APLIFT/APWELL:

Project Document. Andhra Pradesh Surface Water Lift Irrigation Schemes. Government of the Netherlands, Government of India. February 1993.

Project Document. Andhra Pradesh Ground Water Borewell Irrigation Schemes. Government of the Netherlands, Government of the Netherlands, Government of India. February 1993.

Mission Report. Andhra Pradesh Minor Irrigation Schemes. Government of the Netherlands, Government of India February 1993.