Enabling Rural Poor for Better Livelihoods through Improved Natural Resource Management in SAT India

NRSP
MRAG

DFID - NRSP (U.K)
PROJECT R8192

FINAL TECHNICAL REPORT (2002 - 2005)

ICAR

Central Research Institute for Dryland Agriculture (CRIDA),
Hyderabad, India

In collaboration with

BAIF ANGRAU UAS(B) ICRISAT

Enabling Rural Poor for Better Livelihoods through Improved Natural Resource Management in SAT India

DFID-NRSP (U.K) Project R8192

FINAL TECHNICAL REPORT
(2002-2005)

Central Research Institute for Dryland Agriculture (CRIDA),
Hyderabad, India

In collaboration with

About this report

This project was sponsored by UK Department for International Development (DFID), National Resource Systems Programme and executed by CRIDA (ICAR) in collaboration with two State Agril. Universities, ANGRAU, Hyderabad, UAS, Bangalore, ICRISAT and a reputed NGO, BAIF (BIRD-K) during 2002-2005.

Project Team

CRIDA (Hyderabad)

Dr. Y.S. Ramakrishna, Director and Project Leader

Dr.K.V.Subrahmanyam, Head, TOT and Principal Investigator

Dr. B. Venkateswarlu
Dr. C.A. Rama Rao
Dr.V.M. Mayande
Dr. V. Maruthi
Dr. P.K. Mishra
Dr. K. Srinivas
Dr.M. Osman
Dr. K. Nagasree
Dr. A.K. Mishra

ARS, Anantapur (ANGRAU, Hyderabad)

Dr. T. Yellamanda Reddy
Mr. M. Vijay Sankar Babu

AICRPDA (UAS, Bangalore)

Dr. M.A. Shankar
Dr. A. Manjunath

ICRISAT (Hyderabad)

Dr. S.P. Wani
Dr. T.J. Rego

BIRD-K (Tiptur, Karnataka)

Dr. G.N.S. Reddy
Mr. C. Doreswamy
Mr. B. Shivarudrappa

Manuscript processing : Smt. S.L. Prasunamba, CRIDA

Correct citation:
Central Research Institute for Dryland Agriculture, 2006. *"Enabling Rural Poor for better Livelihoods through Improved Natural Resource Management in SAT India"*. Final Technical Report 2002-2005, DFID-NRSP (UK) Project R8192; Hyderabad, India: Central Research Institute for Dryland Agriculture; Bangalore, Karnataka, India: University of Agril. Sciences; Hyderbad, India: ANG Ranga Agril. University; Tiptur, Karnataka, India: BIRD-K and Hyderabad, India: ICRISAT.

Printed at : **Sree Ramana Process Pvt. Ltd.** Secunderabad - 500 003. Ph : +91-40-27811750

Contents

Contents

Contents

Preface

At a macro-policy level, agricultural growth continues to be viewed as a key to poverty alleviation. Sustainable mechanisms and institutions for improving natural resource management, and the associated service provisions, that are accessible by and relevant to the poor are now recognized as integral to linking greater agricultural productivity with improvement of livelihoods of the poor. The natural resource base in semi-arid areas has undergone degradation because of neglect and over-exploitation. The resource base has to be restored to sustain agriculture and animal production. Besides, most of the poor people living in semi-arid rural areas depend heavily on natural resources to earn their livelihoods. Management of natural resources in ways that are sustainable and ensure fair and free access to the poor will have a bearing on the quality of life.

Although watershed development for improvement of dryland agriculture is an important approach followed by the Government of India, it does not give desired results. Because it is biased towards landed and resource rich people, ignoring the livelihood issues of the landless people. Most of the user groups formed for watershed development did not represent landless, cattle herders, women, etc.

The policy makers recognized the need to shift the focus from increasing the productivity of the crops to improved livelihoods of the people. The equity issues and gender consideration have also attracted the attention of the implementing agencies of development programmes.

The emphasis in the project "*Enabling Rural Poor for Better Livelihoods through Improved Natural Resource Management in SAT India*" was on improving the livelihoods of all communities in the village with special focus on the poor people i.e., small, marginal and landless including herders and women. Both social and technological interventions were carried out with full participation of the people. The innovative informal institutional mechanism approach adopted in this project i.e., formation of *Salaha Samithi* with representatives from all groups of villagers resulted in much needed equity and transparency of the development efforts. Consequently, good impact at the project sites sustained the interventions. Improved implements were made accessible to the small and marginal farmers by custom hiring centres, and the drudgery of the women was reduced. Besides soil and water conservation measures, crop and enterprises diversification, livelihood interventions for poor such as sheep rearing, poultry, training of youth in AI, operation and maintenance of implements were carried out in this project. The results of the study are briefly reported in this book. We hope that this will be widely useful for implementing agencies of development programmes as well as to policy makers for appropriate livelihood interventions.

Y.S. RAMAKRISHNA
Director, CRIDA

K.V. SUBRAHMANYAM
Head, TOT, and Principal Investigator
DFID-NRSP R8192

Hyderabad
July 2006

Acknowledgement

We are grateful to the Natural Resources Systems Programme (NRSP) of the UK Department for International Development (DFID) for sponsoring this project as a non-competitive contract research project. We are highly indebted to Dr. F.M. Quin, Ex-NRSP Programme Manager and present Member of NRSP Steering Group for taking keen interest in shaping the project, getting it sanctioned from NRSP and for her guidance in preparing the Final Technical Report. We are also thankful to Dr. Christopher Floyd, NRSP Programme Manager, for his excellent co-operation and guidance given to execute this project. The guidance of Ms. Edna Muraya, NRSP Programme Finance Officer, in the financial matters was of great help to us in receiving the funds in time.

We wish to thank Dr. Mike Carr and Dr. Jon Lovett, MTR Members, for their visit to CRIDA and to the project sites and for their valuable suggestions that have helped us to give more focus to the research component of the project.

We sincerely thank Dr. Mangala Rai, Secretary DARE and Director General, ICAR, and Dr. J.S. Samra, Deputy Director General (NRM), and Dr. Gurbachan Singh, Ex-Assistant Director General (Agronomy), ICAR, for their support and guidance throughout the project period.

We are grateful to Dr. H.P. Singh, Ex-Director, CRIDA, who was instrumental for getting this project to this Institute and for his initial support and guidance.

We wish to place on record the contribution made by CRIDA scientists, Dr. Sreenath Dixit, Sr. Scientist; Er. I. Srinivas, Scientist (Selection Grade); Dr. D.B.V. Ramana, Scientist; and Dr. D. Balgurvaiah, Senior Scientist, AICRPDA Centre, Anantapur who were associated in the initial stage of the project. We also wish to thank the contractual staff of the project i.e., Research Associates, DEOs, and field staff for their help in implementation of the project.

We are indebted to the members of the village institutions and the village communities in the selected cluster of villages in Anantapur and Mahabubnagar districts, Andhra Pradesh, and Tumkur district in Karnataka for their wholehearted participation and co-operation in carrying out the project work.

We sincerely acknowledge the three reviewers who gave valuable comments and suggested steps for improving the earlier draft of the report. We express our sincere thanks to Dr. Ruth Urben, NRSP specialist, who spent considerable time at CRIDA and helped us to revise the initial draft of the FTR.

We wish to thank the administration, Finance & Accounts staff of CRIDA for their help in smooth implementation of the project, and to all others who directly or indirectly contributed to the successful implementation of this project.

Y.S. RAMAKRISHNA
Director, CRIDA

K.V. SUBRAHMANYAM
Head, TOT, and Principal Investigator
DFID-NRSP R8192

Hyderabad (India)
July 2006

Abbreviations and Acronyms

ACIAR	:	Australian Centre for International Agricultural Research
AI	:	Artificial Insemination
AICRPDA	:	All India Coordinated Research Project for Dryland Agriculture
AL	:	Action Learning
ANGRAU	:	Acharya NG Ranga Agricultural University
APRLP	:	Andhra Pradesh Rural Livelihoods Project
AP	:	Andhra Pradesh
BAIF	:	Bharatiya Agro-Industry Foundation
BIRD-K	:	BAIF Institution for Rural Development-Karnataka
BPL	:	Below Poverty Line
CBOs	:	Community Based Organisations
CGIAR	:	Consultative Group for International Agricultural Research
CHC	:	Custom Hiring Centre
CMEY	:	Chief Minister's Empowerment of Youth Programme
CPR	:	Common Property Resources
CRIDA	:	Central Research Institute for Dryland Agriculture
DFID-UK	:	Department for International Development – United Kingdom
DWACRA	:	Development of Women and Children in Rural Areas
FTR	:	Final Technical Report
GKVK	:	Gandhi Krishi Vigyan Kendra
HH	:	Households
ICRISAT	:	International Crops Research Institute for Semi-Arid Tropics
ID	:	Irrigated Dry
IFFDC	:	Indian Farm Forestry Development Cooperative
ILRI	:	International Livestock Research Institute
INM	:	Integrated Nutrient Management
IPM	:	Integrated Pest Management
JFM	:	Joint Forest Management
KAWADA	:	Karnataka Watershed Development Agency
LGP	:	Length of Growing Period
NAIP	:	National Agricultural Innovations Project
NARS	:	National Agricultural Research System
NATP	:	National Agricultural Technology Project
NGO	:	Non-Government Organization
NR(M)	:	Natural Resources (Management)
NRSP	:	Natural Resources Systems Programme
PD	:	Process documentation
PPR	:	Private Property Resources
PRA	:	Participatory Rural Appraisal
PRI	:	Panchayat Raj Institution
R&D	:	Research and Development
RDT	:	Rural Development Trust
Rs.	:	Rupees
SAT	:	Semi-Arid Tropics
SC	:	Schedule Caste
SHG	:	Self Help Group
SS	:	Salaha Samithi
ST	:	Schedule Tribe
TCB	:	Trench–cum-Bund
UAS	:	University of Agricultural Sciences
UG	:	User Group
UMMB	:	Urea Molasses Mineral Block
VO	:	Village Organisations
VSS	:	Vana Samrakshna Samithi (Plant/Trees Protection Committee)

Glossary

Wealth groups

Poorest of Poor	:	No income source
Poor	:	Labour, < 1 ha dryland
Medium	:	Own house, 1-4 ha, Govt./Private work
Rich	:	Own house, vehicle, >4 ha, bore/well irrigation, vehicle, Govt./ Private work

Local terms

Anganwadi	:	Village level centre to take up the developmental activities operated under ICDS (Integrated Child Development Scheme) funded by the World Bank
Bajra	:	Pearl millet
Dhobi	:	Washerman or woman
Gram sabha	:	Meeting of all villagers
Green festival	:	Local festival where tree planting was taken up
Jowar	:	Sorghum
Kalajattas/jathar	:	Local religion festivals
Kharif	:	Monsoon season
Khurpi	:	Small sickle
Krishi mela	:	Farmers' fair
Mahila mandal	:	Women's group
Niger	:	Minor oilseed – The niger (*Guizotia abyssinica* L. f. Cass.) crop is grown for seed used for extracting oil which is about 37 to 43 per cent of the seed weight
Panchayathi Raj	:	Grass root body of Local Self Government elected by the villagers
Quintal	:	100 Kilograms (Quantity of Measurement of yield)
Rabi	:	Post-monsoon season
Ragi	:	Finger millet

Tree Names

Cassia	:	*Cassia siamea*
Casuarina	:	*Casuarina equisetifolia*
Custard apple	:	*Annona squamosa*
Dalbergia	:	*Dalbergia sissoo*
Emblica	:	*Emblica officinalis*
Eucalyptus	:	*Eucalyptus camaldulensis*
Gliricidia	:	*Gliricidia sepium*
Leucaena	:	*Leucaena leucocephala*
Mango	:	*Mangifera indica*
Neem	:	*Azadirachta indica*
Pongamia	:	*Pongamia pinnata*
Sesbania	:	*Sesbania sesban*
Silver oak	:	*Grevillea mimosaefolia*
Subabul	:	*Leucaena Leucocephala,* A Forage tree with multiple uses
sughandi	:	***Hemidesmus indicus*** local name of Medicinal Plant
Teak	:	*Tectona grandis*

Executive Summary

The purpose of the project is to identify and promote strategies for sustainable management of natural resources to improve the livelihoods of landless, small, marginal farmers and herders (including women) and to do so by applying existing technical and social research knowledge and skills within an enabling environment. The project was executed by an inter-disciplinary partnership, comprising scientists from CRIDA (Central Research Institute for Dryland Agriculture), the Andhra Pradesh and Karnataka State Agricultural Universities (ANGRAU and UAS-B), ICRISAT, and staff of a NGO, BIRD-K [BAIF (Bharatiya Agro Industries Foundation) Institute for Rural Development-Karnataka)]. The project sites covered eight villages within three semi-arid districts (Anantapur and Mahabubnagar in Andhra Pradesh and Tumkur in Karnataka) in southern India.

Project interventions were need-based and developed in consultation with villagers. The project aimed at outputs such as (1) increased capacity of rural institutions to improve access of the poor to natural resources (NR); (2) improved conservation and sustainable use of NRs in common and private property resources (CPRs, PPRs); (3) improved rural livelihoods through improved NR-based livelihood enterprises; (4) promotion of improved tools that reduce drudgery and increase productivity; (5) communication to policy makers of the improved knowledge of enabling processes for rural community motivation and service provision.

Action-research was undertaken on the process of setting up and performance of social and technological interventions. The project has taken a village/cluster of villages approach that can take into account the needs of all the sections of village communities instead of a watershed approach as it was found by default to be biased towards landed and resource rich people, often ignoring the livelihood issues of the landless people.

The project has come up with an important institutional innovation in the formation of *Salaha Samithi* (SS), which is an advisory group of villagers, formed by members who are acceptable to the community and willing to work for common good. It is an informal and inclusive body in which existing PRIs and SHGs are also represented, besides representatives from women and weaker sections (SC, ST, etc.) The SS has helped in smooth implementation of the project activities with assured people's participation in all the project interventions. Some members of the SS assumed the role of early adopters of technological interventions.

The project also to some extent succeeded in enabling the poor and landless people to have access to the CPRs. The willingness of PRIs to spare a portion of the unused tank bed in Mahabubnagar cluster and temple land in Anantapur cluster for cultivation to the poor is a point in this direction.

Interventions such as water harvesting structures (farm ponds, check dam, TCBs, etc.);

soil nutrient management; bio-mass planting; improved crop varieties; legume intercrops; irrigated dry crops including fodder crops, agri-horticulture and agri/silvi-pastural systems were also taken up to improve the productivity of CPRs and PPRs. Improved agricultural implements and machinery such as seed planters, threshers and shellers were introduced to reduce the drudgery for women and to enhance the production.

Entrepreneurial development activities such as nursery raising and backyard poultry for women, sheep rearing, beekeeping, vermi-compost for landless people, custom hiring centres (CHCs) for agricultural implements were undertaken for the poor. Artificial Insemination (AI) Centre was started for gainful employment of rural youth.

Capacity building through training and exposure visits yielded good results in changing the mindset of people. The successful running of nurseries by women, saving groundnut crop through adoption of farm pond technologies for water harvesting in Anantapur cluster, fish rearing in Mahabubnagar cluster, and increased milk production and income of households through wide adoption of fodder cultivation demonstrated the fact that '*seeing is believing*' is an effective extension strategy.

The interventions enabled the project to achieve the objectives. The livelihoods of rural poor target households in all three districts has benefited as evidenced from reported increase in income through various activities. New pro-poor rural service providers are functioning effectively (SS, CHC). The project partners gained in confidence to apply the project learnings to other regions. Project outputs have contributed to policy-level and strategy planning discussions. Four policy briefs on issues such as alternate crops for paddy to efficiently utilize ground water, create awareness about rapid depletion of ground water, water harvesting through farm ponds for life saving irrigation during dry spells, and access of CPRs to poor were the outcome of this project. The focus of research within CRIDA, ICAR (Indian Council for Agricultural Research) and ILRI (International Livestock Research Institute, CGIAR Institution) has also shifted towards livelihood issues.

Key learnings were as follows:

- The Institutional innovation of the project – *Salaha Samithi* (SS) which is informal, representative and potentially sustainable – can result in strong, non-conflictual, community ownership and pro-poor management of NR interventions.
- A good scope exists for SS as a liaison body with PRI for harmony and to enable transparent utilization of funds for the benefit of whole community.
- A livelihood perspective that recognises socio-economic-cultural factors facilitates effective implementation of development interventions.
- 'Seeing is believing' still holds good for changing the mindset of people and for introduction of interventions.
- Women and rural youth are very receptive to interventions and should be involved from the planning stage of the project.
- Flexibility, transparency and enabling environment are cardinal principles for the success of a project.
- Access of the poor to CPRs can be improved with a proper dialogue with PRIs.
- The action-research, project partnership, interdisciplinary project model is effective in implementing NR research.

The project duration should be sufficient to assess the outcome/impact of the NR interventions and for village communities to fully internalise the enabling, pro-poor, NR development process and organization.

Section 1

Project Overview

This section gives a brief account of the origins of the project, the project approach, and the project sites. An overview of the project partners and the approach to implementation of the project are also covered.

1.1 Background

Natural resources (NRs) are the main stay of the life supporting system in rural areas. Both humans and livestock sustain on this resource base, which is rapidly degenerating because of growing population pressure and over exploitation. Common property resources (CPRs) such as grazing lands and water bodies are key avenues of income and livelihood for poor people in the villages. But demographic pressures are also taking a heavy toll on the CPRs affecting the livelihoods of the poor. In addition to the declining quality of NRs in CPRs and private property resources (PPRs), the evolving socio-economic and demographic patterns in the rural areas are negatively influencing the ability of poor to access NRs. Against this backdrop, the project "Enabling Rural Poor for Better Livelihoods through Improved Natural Resource Management in Semi-Arid India" was sponsored by the Natural Resources Systems Programme (NRSP) of the U.K. Department for International Development (DFID). The Central Research Institute for Dryland Agriculture (CRIDA), in partnership with other institutes in the National Agricultural Research System (NARS), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and a non-governmental organization (NGO) led the project. Five outputs covering research processes, specific technical interventions in the clusters related to NRs, and communication and documentation of the improved understanding / lessons learnt from project implementation were clearly defined. The outcomes are described in Sections 2 to 5. The project commenced preparatory fieldwork in January 2003, was officially inaugurated in May 2003, and closed in March 2005. Field activities were supported in Andhra Pradesh (A.P.) and Karnataka in southern India.

In its design, the project drew upon the experiences gained in three earlier NRSP projects (NRSP R 7877, 2002; NRSP R 7973, 2002; NRSP R 7974, 2002) – "Common pool resources in semi-arid India – dynamics, management and livelihood contributions"; "Policy implications of CPR knowledge in India, Zimbabwe and Tanzania"; "Human and social capital aspects of soil nutrient management, semi-arid India". The first two projects considered the status, and livelihood role of CPR and the emanating policy implications of this. Some of the key findings were degradation and encroachment of CPRs, open access and unmanaged use of grazing lands, the need for research into the conditions for successful CPR management, localization of responsibility for CPR management and local capacity building. The third project (R 7974) investigated the human and social capital aspects of soil nutrient management practices. Farmers were found to manage the soil fertility prudently through a range of practices and are aware of the ill effects of overuse of chemical fertilizers. Livestock

redistribution resulted in an emerging market for organic matter (OM), which is an opportunity for the increasing proportion of landless poor who now own livestock. Soil fertility constraints are only one component of a larger set of constraints that limit productivity, and addressing this aspect of NR management is better achieved through a livelihoods perspective.

The project also addresses the capacity building issues. Management of CPRs through appropriate integrated technological crop and livestock interventions could contribute to the livelihoods of the poor. The project emphasises on soil fertility management; and through its different communication activities, provides policy makers with the necessary information.

1.2. Project Overview

The project spins around its goal of identifying and promoting strategies for improving livelihoods of the rural poor in semi-arid areas of India. Integrated management and increased productivity of CPRs and PPRs, and better access of the poor to CPRs are key mechanisms to achieve these goals. The CPRs include water, grazing land and forest as the basic resources. The development of these resources would depend on the status and management of NRs of the region, i.e., soil, water and vegetation. The livestock of the landless poor were given utmost importance. The project was to identify and promote strategies for sustainable management of NRs in a participatory, poverty and gender sensitive mode, through firstly understanding the local livelihoods, then applying research and local knowledge to develop the improved livelihood strategies, and through establishing an enabling environment and social mechanisms for managing and sustaining the change. The project was to focus on specified target groups (small and marginal farmers, landless and women) and target areas (eight villages, seven from A.P. and one from Karnataka). However, the project also sought to take a more inclusive approach to facilitate smooth implementation as well as to create conditions for sustainability through involvement of rural communities. village organisations and institutions.

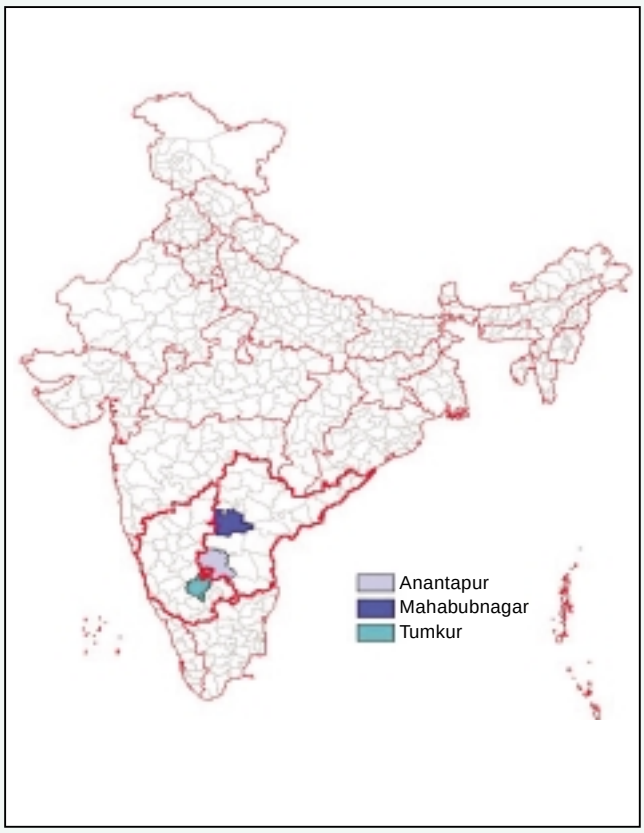
The project would contribute to a positive change in the livelihoods of the rural poor if its interventions resulted in

- increasing the productivity of water through appropriate rainwater harvesting utilization and nutrient management technologies in target areas,
- increasing access to CPRs by the poor by strengthening social institutions at the village level,
- strengthening the livestock-based farming to address the landless people and marginal farmers,
- understanding the strengths and weakness of rural service providers for further strengthening their services through capacity building,
- increasing adoption of simple and proven technologies, techniques/interventions/ tools and implements relating to soil water conservation, Integrated Nutrient Management (INM) and livestock production and management in the target areas, and
- improving livelihood quality of the rural women by reducing drudgery and hardship in farming operations.

All project interventions were to be fully participatory with target group members and rural institutions/organizations as partners in planning, implementation and review.

1.3 Project Location

The project was implemented in a cluster of villages in each of two districts of A.P. (Anantapur and Mahabubnagar) and in Tumkur district of Karnataka. Figure 1.1 locates the target districts in India. The names of the villages in the selected clusters are listed in Table 1.1.



The locations were chosen to represent the natural resource base available to rural communities in semi-arid regions in southern India. The previous exposure of the villages to NR-related development aid was considered (villages that had had extensive and recent assistance, e.g., through the Watershed Development Programme were excluded) as a logistic issue of access (contiguity of villages within a district for efficient use of travel time). The local field experience of the partner institutes and particularly the NGO BIRD-K (Bharatiya Agro-Industry Integrated Rural Development-Karnataka) was also considered.

The three districts have contrasting characteristics in terms of climate and rainfall viz. semi-arid in Mahabubnagar and Tumkur and arid in Anantapur; soils range from very shallow-to-shallow and are mostly alfisols in all the three clusters.

Anantapur, the largest district of A.P., is a hot arid zone. It falls under the rain shadow region with a mean annual rainfall of 520 mm. The topography of the district is undulating with ridges and valleys. The soils are red sandy loams with patches of black cotton soils in certain areas. Mahabubnagar is another chronically drought prone district of A.P. with light textured soils and severe erosion. Crop failures are common and people's dependence on livestock is high. Though the rainfall is scanty in both the districts, there are opportunities still to harvest rainwater by preventing or accumulating runoff and to use it productively (CRIDA, 2000). Excess withdrawal of groundwater is a major problem as groundwater is considered a private property. Its use is not at all regulated. The relative economics of irrigated agriculture vis-à-vis rainfed agriculture, government policies with respect to power supply (free power supply to irrigation) and credit (easily available) are the principal reasons of excessive groundwater use. (In combination, they resulted in large numbers of bore wells being dug). The government recently enacted the Andhra Pradesh Water, Land and Trees Act (in 2002) to regulate the groundwater use, but it is yet to be implemented. Severe degradation of marginal and forest lands has occurred in the last four decades because of population pressure. Acute scarcity of drinking water, fodder and fuel is faced frequently.

Tumkur in Karnataka is part of the central dry zone of Karnataka and has bimodal rainfall distribution. Soils are mostly sandy loam with high slopes and high erosion rates. Because of the high altitude, the temperatures are relatively low. The cropping pattern is distinct compared to the other two clusters. Apart from rainfed crops such as finger millet and groundnut, orchards of coconut are a major economic activity in the district.

Table 1.1. Villages of the three clusters in three target districts.

District	Mandal or block	Villages part of the cluster
Anantapur (A.P.)	Atmakur Pampanur	Pampanur Tanda Y Kothapalli
Mahabubnagar (A.P.)	Mahabubnagar	Dharmapur Chowdarapalli Zamistapur Bukkalonpalli
Tumkur (Karnataka)	Tiptur	Shankaranhalli

In all the clusters, a majority of families depend on agriculture. The land holdings are small. A significant proportion of families in most of the villages are below poverty line (BPL). The proportion of BPL families is more than 50% in six out of eight project villages (Table 2.2, Section 2). Most of the CPRs are privatised. Villagers face acute water and fodder shortages particularly during summer. However, all the three clusters were receiving some degree of developmental and financial inputs during the last two decades, which resulted in the formation of community-based SHGs. The activities of these groups were however limited to thrift only. (Further information on the biophysical, demographic, institutional and agricultural profiles of these clusters is presented in Section 2; as relevant in Sections 3 to 5).

1.4 Project Partners

The project was implemented and managed by a partnership between leading research institutes in the region and an NGO with considerable field experience (Figure 1.2). CRIDA, which led the project, is a national research institute under the Indian Council of Agricultural Research (ICAR) with a primary mandate of improving the productivity and sustainability of the rainfed farming systems all over the country. It has a national network of 25 cooperating centres and a team of 70 well-trained multidisciplinary scientists. CRIDA has developed a large number of cost-effective technologies for management of NRs in rainfed areas. These standardized the productivity of crops and livestock in these regions.

ICRISAT is an international institute, part of the Consultative Group on International Agricultural Research (CGIAR) system, head quartered in Hyderabad, A.P. The institute has a mandate for improving the productivity of major crops grown in the semi-arid tropical (SAT) regions of the world. ICRISAT also has a strong NRs management research group, which has been actively involved in several national and regional projects in the country. In particular, the institute is an active partner in the Andhra Pradesh Rural Livelihood Project (APRLP), focusing on improving livelihoods, with field experience in A.P.

The University of Agricultural Sciences, Bangalore, and Acharya N.G. Ranga Agricultural University, Hyderabad are, respectively, the Karnataka and A.P. state Agricultural Universities. They have research centres close to the project clusters and have adequate knowledge on the NRs of the region and the socio-economic dynamics of the target population.

BIRD-K an associate organization of the Bharatiya Agro Industries Foundation (BAIF), is a leading national NGO with more than 50 years experience in the area of rural development, particularly in participatory NR management and livestock improvement. It was working actively in Tumkur District and recently started working in Mahabubnagar district and had a network of field-based staff.

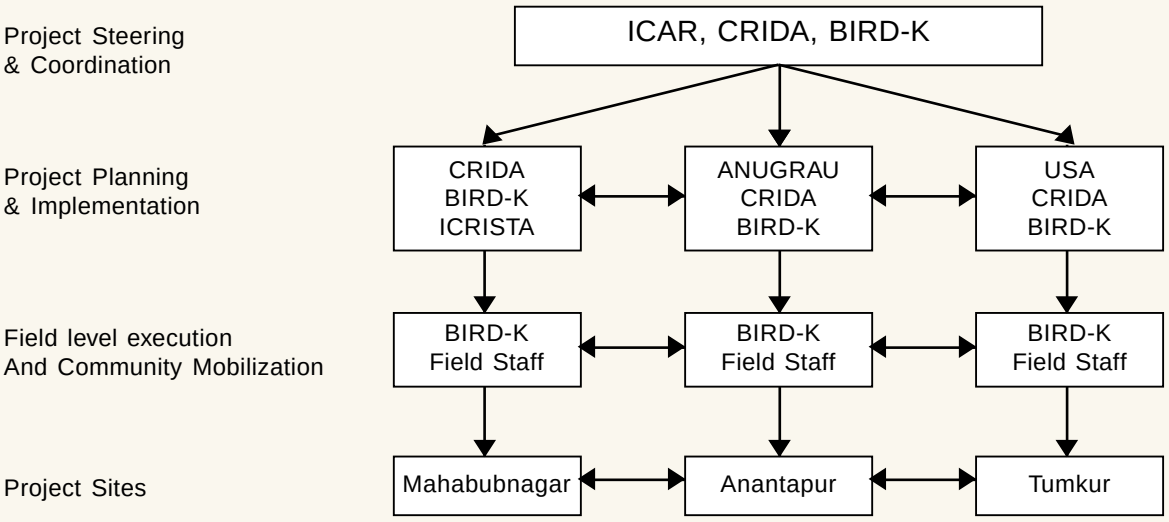


Figure 1.2 : Schematic diagram of project structure

1.5. Partner expertise and knowledge base

Multidisciplinary teams of scientists and other experts were constituted from each of these institutions keeping in view the objectives of the project and the responsibilities of individual institutions. The team consisted of agronomists, soil scientists, soil and water conservation engineers, economists and communication specialists. The field-based implementing agency, BIRD-K have proven expertise in social mobilization and also in issues related to livestock development. The specialist background of the project team helped in identifying a range of options for consideration by the village households before they chose an appropriate technological or organizational intervention. Also, the expertise and knowledge of the project staff came in handy while working with the villagers to deal with any problems that arose during the course of implementing the interventions.

Considering the size and diversity of the project team, putting in place an effective communication mechanism was thought imperative to take project work forward. While regular communication was done through emails and telephone, interactions through different workshops gave opportunities to review the progress and plan. Such a regular interaction was found highly useful. In hindsight, however, it is felt better to have a more compact team, which can put in a larger proportion of time on the project than to have a larger team with each member working for relatively shorter time in the project.

The project also kept the various development agencies that are active in the region informed, in particular the state departments of agriculture and animal husbandry. Representatives of these agencies participated in the launch workshop and regional workshops of the project. In some cases, they were actively involved in project activities. For example, the officers from the department of animal husbandry participated in the animal health camp conducted in the Mahabubnagar cluster. Their services were also utilized in training the local animal health practitioners. The intention was that these agencies could pick up the project experiences and adopt them in their activities.

1.6 Project process

The project followed a participatory approach to develop interventions with stakeholder farmers in the selected clusters. The approach was to take advantage of indigenous knowledge and the capacity of farmers to experiment and solve their own problems. It uses many of the principles of Participatory Rural Appraisal (PRA), but extends the active participation of farmers well beyond the initial stage of appraisal to intervention planning, intervention development and evaluation on farms and in the village. In this way, farmer-stakeholder input to project implementation decisions is continuous. The approach begins with in-depth participatory diagnosis by a broad cross-section of the community, including men and women from the different wealth and age groups. This process helps the villagers to define, group and prioritise their main development needs, opportunities and problems.

After identifying the major issues, various interventions, mostly in the form of participatory or observation trials together with capacity building of village organisations and villagers, were planned and discussed in meetings with the volunteer villagers who formed an advisory committee (S*alaha Samithi*) in the village. Several interventions were brought to the doorsteps of farmers in the form of a 'basket' of technologies. The farmers were expected to select those interventions they thought could lead to better farm management systems. Then, a comprehensive schedule for implementing the interventions was discussed and finalised in the meetings. The farmer advisory committee facilitated implementation and monitoring and evaluation of interventions and adaptations were considered and changes made if agreed with the community. The core principle of this process is active, decision-making involvement of farmers at all stages of intervention development with specialist input and facilitation by project staff.

The project though planned to officially commence in October 2002, could only begin the actual work in January 2003. The project was concluded in March 2005.

The project was designed to be participatory and flexible. Though the key issues the project attempted to address were identified in the beginning, the ways and means of achieving them were arrived at by actively involving the rural communities. In interactive group discussions, the village households and the project staff identified issues related to livelihoods, and considered a range of options. The villagers were given opportunity to choose whatever they found was feasible. These chosen options were then implemented and evaluated in an action research mode. The project did not delimit the budget into specific types of technological interventions and thus provided for flexibility in executing the interventions chosen by the villagers. Thus the project decisions were more interactive and flexible within the focused theme of NRM and livelihood enhancement. This is in contrast to a rigid top-down approach where the clientele can only accept or reject a given option and with a completely open-ended approach wherein the emphasis is completely on 'enabling' without any material or financial support.

Reference

Central Research Institute for Dryland Agriculture. 2000. *ACIAR Project Report.* Hyderabad, India: Central Research Institute for Dryland Agriculture.

Section 2

Capacity Development and Cross-cutting Methodologies

2.1 Introduction

This section deals with Output 1 of the project and by so doing, deals with the methodologies adopted to achieve Outputs 2-4. Output 1 is related to strengthening the capacity of the rural institutions to provide the rural poor with better access to specified natural resources. Building up of social and human capital in the community is the main concern addressed. The activities undertaken to achieve this output were designed to (i) create awareness about the project among the rural community, institutions and organizations; (ii) help the project staff understand the existing agro-climatic, NR and socio-economic setting of the villages so that they could work effectively with the villagers; (iii) develop and put in place mechanisms and processes that would help achieve Outputs 1-4; (iv) and enable the community to deal with the problems. This relationship between the outputs is presented in Figure 2.

Attempts were made under Output 1 to

- create a general awareness within the cluster villages about the project;
- analyse with the villagers the NRM-related issues that have a bearing on their livelihoods;
- analyse the existing situations for possible interventions that could improve rural livelihoods, and
- foster an enabling environment that would elicit and ensure people's participation, strengthen their capacity to manage their own NR development, and ensure that the interventions were appropriately targeted, facilitating faster adoption.

2.2 Participatory Rural Appraisal (PRA)

The participatory nature of this project has been introduced in Section 1. One part of this participatory approach is the importance of understanding the bio-physical, socio-cultural and economic contexts in which any interventions will occur. The PRA provided an occasion for this learning interaction between the communities and staff from partner institutes and its findings informed and guided all outputs.

2.2.1 PRA Process

The PRA was conducted in all the three clusters of villages in order to assess the existing farming situations; assess the conditions and use of NRs under common and private property regimes, and existing rural institutions [(the PRI), CBOs such as self help groups (SHG), Youth Clubs, etc.]; and create awareness about the project. The process adopted to conduct the PRA typically included fixing prior dates in consultation with the PRI and the village community, conducting a *gram sabha* (village assembly) to put forth the project objectives and project scope, and then conduct the PRA spread over 3–4 days. Before actual conduct of the PRA the project staff drafted the time-table for the PRA including who should participate in the PRA, established contacts with the key persons in the villages and the intended outcome of the PRA.

Group meeting

Social mapping

The PRA was facilitated principally by the field staff of the project (BIRD-K staff), and the technical experts moderated the proceedings (Table 2.1). A majority of the villagers including the PRI participated in various PRA exercises. The existing agro-climatic and socio-economic situation in all the three clusters was characterized using various PRA tools such as social mapping, resource mapping, village transect, seasonality and trend analyses, Venn diagram, wealth ranking and focus group discussions involving the PRIs, women, and landless.

The major problems related to crop and livestock production and NRM in the villages were identified during the PRA. The outcome of the PRA was then considered and discussed among the project staff as well as with the villagers to arrive at appropriate solutions.

Table 2.1. Steps in the PRA process.

When	PRA activity	Output	Participants
Week 1	Planning for the PRA	Time schedules, participants, outline of intended outcome	Project staff, key persons from the villages
Week 2-3	Conduct of the PRA –mapping, wealth ranking, problem-cause diagrams, Venn-diagrams, etc.	Characterization of agro-climatic and socio-economic setting in the villages	Project staff, villagers
Week 4 onwards continually	Focus group discussions with specific groups/individuals	Identification and impleme-ntation of potential solutions	Project staff, and villagers

Resource mapping

Interaction with farmers

2.2.2 PRA Findings

The major findings from the PRA in all the three clusters of villages are summarized in Tables 2.2 to 2.4.

2.2.2.1 Socio-economic and agro-climatic profile

It can be seen from Table 2.2 that the number of households varied from 150 in Pampanur in Anantapur cluster to 528 in Dharmapur in Mahabubnagar cluster. The number of SC families was also found to vary across villages. A majority of land holdings were found to be small (< 1 ha) in almost all the villages. The proportion of poor families varied between 21% in Y. Kothapalli and 69% in Pampanur in the Anantapur cluster. Thus, a conspicuous proportion of households in the villages were poor. A majority of villages are not well placed in terms of infrastructure development. For example, out of eight villages selected, only two have veterinary clinics, only one has a hospital and only one village in Tumkur has a milk collection centre (Table 2.3).

Table 2.2. Socio-economic and demographic profile of the three clusters

Parameter	Anantapur			Mahabubnagar				Tumkur
	Pampanur	P. thanda	Y. Kotha-pally	Zamista-pur	Bukkal-onpally	Dhar-mapur	Chowder pally	Shankarna halli
Population	770	746	1055	2316	1535	2486	1244	835
Male	373 (48)	372 (50)	531(51)	1112 (48)	770 (51)	1274 (51)	624 (51)	285 (49)
Female	397 (52)	374 (50)	524(49)	1204(52)	765(49)	1212 (49)	620 (49)	295 (51)
No. of families	150	160	220	425	267	528	297	235
No. of SC families	53 (35)	-	47 (21)	250 (58)	52 (19)	150 (28)	85 (29)	54 (23)
No. of ST families	-	160 (100)	3	-	-	-	-	6 (3)
Literacy %	35	37	40	39.9	52.9	40.1	36.6	72.5
Farm households								
Small (<1 ha)	35 (36)	5 (4)	68 (38)	196 (55)	103 (49)	250 (54)	147 (69)	68 (29)
Medium (1-2 ha)	38 (39)	53 (47)	77 (43)	107 (30)	58 (27)	149 (32)	39 (18)	68 (29)
Large (2-4 ha)	22 (23)	42 (38)	22 (12)	35 (10)	36 (17)	44 (9)	17 (8)	66 (28)
Very large (>4 ha)	12 (12)	12 (11)	12 (7)	17 (5)	15 (7)	23 (5)	10 (5)	33 (14)
Landless families								
Wage employment	40	30	11	42	35	31	68	*20*
Self employment	shepherds	limestone	flowers	20	17	15	19	79
Services: Govt/pvt.			-	8	3	16	2	44
Wealth ranking								
Rich/ upper class	8 (6)	8 (6)	29 (14)	30 (7)	60 (22)	40 (8)	85 (8)	26 (11)
Middle class	33 (25)	40 (28)	135 (65)	110 (26)	41 (15)	190 (36)	105 (35)	130 (55)
BPL/poor	92 (69)	94 (66)	44 (21)	285 (67)	166 (62)	298 (56)	107 (36)	79 (34)

Figures in parentheses are percentages.

Table 2.3. Infrastructure and service facilities available in the clusters (No.).

Particulars	Ananta-pur	Mahabub-nagar	Tumkur
Primary school (No)	3	4	1
High school	-	1	1
Post office	1	1	-
Gram panchayat office	1	4	1
Veterinary clinic	1	1	-
Hospital	-	1	-
Anganwadi	-	4	1
Milk collection center	-	0	1
Self Help Groups (SHG)	2	4	5
DWACRA group	17	-	-
CMEY group	1	-	-
VSS	1	3	-

An assessment of the agro-climatic situation revealed that the three clusters differed in terms of rainfall, soil types and cropping pattern. Whereas the Anantapur and Mahabubnagar clusters were more drought prone because of low rainfall and poor water holding capacity of the soils, the Tumkur cluster was relatively better placed because of better soils and higher altitude. These differences had implications for identifying appropriate solutions. The problems identified by the villagers (Table 2.5) have become the basis for planning other technological interventions that are discussed in the subsequent sections. Further details from the PRA are presented in Sections 3 to 5 as relevant to the output and activities being described.

2.2.2.2 CPRs

It came out during the PRA that the use of the CPRs such as tank beds and water bodies are generally regulated by the PRI. The PRI either grants the use rights to a specific user group (UG) or individuals. In some cases, the use of CPRs is generally regulated by the conventions that have been in vogue for generations. However, such local institutions are on the decline. The PRA also revealed that most of the common property land resources were privatised because of government policies. However, a significant part of those privatised lands continue to be *de facto* CPRs because of various reasons (e.g., poor quality of land which discourages investment by the owner). In such private lands, though they are *de facto* CPRs, it is unwise to plan for community investments. Some opportunities where the existing CPRs could be put to better use were identified. For example, in one village (Chowderpally) in Mahabubnagar cluster, the tank bed was identified as a potential livelihood option for the poor if access was provided for cultivation. Similarly, in one Anantapur cluster village (Pampanur), temple endowment land was identified for use by the poor for their livelihoods. How a combination of institutional and technological interventions proved to be effective in such endeavours is described in subsequent sections.

Table 2.4 Existing agro-climatic situations in the three project clusters

Particulars	Anantapur	Mahabubnagar	Tumkur
Rainfall (mm)	520	600	600
Soil	Red, sandy, loamy; patches of black soil. Depth: 30–50 cm, moderate in nutrient	Red sandy, patches of black clayey soil, 30–50 cm depth, moderate in nutrient content	Red, sandy, loamy, small pebbles, saline soils; depth 20–50cm; moderate in nutrient.
Land use			
Total area (ha)	361	10686	NA
Forest (ha)		3073	Nil
Fallows and waste lands (ha)	51	2027	272
Net Cultivated area (ha)	304	3970	517
Major crops			
Kharif (Rainy season)	Groundnut, pigeonpea, sorghum, castor, other pulses; papaya, sweet lime	Castor, sorghum, maize, paddy, groundnut, pigeonpea	Finger millet, sorghum, pulses, groundnut, castor, sesame, niger, coconut, banana, mango, paddy
Rabi (Post-rainy season)	Groundnut, paddy, horse gram, vegetables	Ground nut, paddy, vegetables	Sorghum
Irrigation sources			
Tanks	2 (55 ha)	25	7
Dug & Bore wells (No)	25 + 100	448	65
Check dam (No)	1 (50 ha)	16	1
Percolation tank (No)		5	
Farm pond (No)		15	32

2.2.2.3 Existing rural organizations

The PRA was used to identify the existing village organizations in the three clusters. PRI, a local government institution democratically elected, and other CBOs such as SHGs, Youth Clubs, *Mahila Mandals* (Women clubs), *Vana Samrakshana Samithis* (VSS) [Joint Forest Management (JFM) Groups], etc., existed in all the villages. Village administration and development are the mandate of the PRI. SHGs recently initiated under various development projects which are being implemented by government and non-government agencies. Creating financial assets and making them accessible to the members within the group for investment needs is the chief motive of SHGs. Institutions such as VSS are formed specifically to protect and manage the forest resources by working with the forest department.

No specific groups with an explicit interest to deal with the problems in crop and livestock production were found to exist in the village. Thus, a need was felt by the village community and the project staff to form institutions based on specific needs as well as an institution that can facilitate the project activities in the larger interests of the village. These institutions, if properly enabled, would be able to start addressing various development needs. Though a PRI exists in all the villages, it is not appropriately placed to mobilize the people's participation given its political nature and its preoccupation with other village administrative responsibilities. The project however did take care to keep the PRI informed from time to time, as to what was going on. Involvement of the PRI in project-supported interventions was thought to be essential for sustainability.

The PRA also created an awareness of the project activities among the community and helped the project staff understand the village dynamics better which subsequently helped in executing the project interventions.

2.2.2.4 Opportunities, issues and problems identified

The problems identified by the villagers (Table 2.5) have become the basis for planning other technological interventions that are discussed in the subsequent sections.

In the follow-up meetings, the issues and options for interventions (Table 2.6) were discussed thoroughly within the villages to enable villagers to identify their preferred interventions. This process and the outcomes are presented in Sections 3 to 5.

In addition to the problems mentioned, there were some generic problems expressed by all the villagers during the PRA. These included non-availability of quality seeds at affordable prices, unremunerative output prices, escalating cost of cultivation, and deteriorating water availability.

2.2.2.5 Sensitization of CBOs and rural institutions

By involving various institutions existing in the village (Table 2.3) in the PRA and focus group discussions, awareness was created regarding the condition and use of the NRs and possible interventions that could be made for the better use of NRs. Thus, PRIs and other CBOs were sensitised regarding the need for better NRM. This awareness was re-inforced during the interactions throughout the project duration as well as during the regional workshops that were conducted in the clusters and attended by representatives of the government and non-government agencies.

Table 2.5. Issues identified in the three clusters.

Anantapur	Mahabubnagar	Tumkur
Lack of appropriate village organizations (VO) to support the NR-based livelihood activities	Lack of appropriate village institutions (VI) to support the NR-based livelihood activities	Lack of appropriate village institutions (VI) to support the NR-based livelihood activities
Poor crop yields due to moisture scarcity conditions	Declining *rabi* cropping due to depletion of ground water	
Non-availability of appropriate crop varieties	Poor crop yields because of use of inferior seed	Poor crop yields because of local varieties
Monocropping of groundnut and lack of alternative choices		Lack of crop diversification
Lower profits from crop production due to high costs on seed and fertilizer		Lack of vegetation, soil erosion, low fertility,
Inadequate fodder supply to milch animals	Low milk yields of animals because of local breeds and fodder scarcity	Lack of diversified enterprises
	Non-availability of appropriate implements causing drudgery and lengthy farm operations	Lack of improved agricultural tools and implements
	Poor management of CPRs	Lack of CPR land due to encroachment
		Landless labourers do not have livelihood options

2.3 *Salaha Samithi* (SS)

2.3.1 Formation of SS

Formation of a *Salaha Samithi* (SS) in the cluster is an important institutional innovation developed by the communities and the project and put in place in all the three clusters. The SS, an advisory group of villagers, is formed considering the need expressed by the villages for an institution that can facilitate the implementation of the project activities in association with the project staff (see Box 2.1). The SS is formed by members who are voluntarily willing to work for the common good of the villagers and who are acceptable to the community as a whole. It is an inclusive body in which existing CBOs (PRIs and SHGs) are also represented to achieve coherence in the activities and to keep the PRI informed of what is going on in the project. Women and weaker sections (SC, ST) of the society were also included in the SS.

Table 2.6 Intervention choices for cluster villagers

Lack of awareness and confidence [to initiate NRM improvements] among people

- Formation and capacity building of people's organizations
- Training programmes
- Exposure visits

Water scarcity in agriculture

- Construction of trench-cum-bunds, farm ponds, water diversion structures, mini-percolation tank, check dam, gully plugs
- Testing irrigated dry crops

Poor crop yield

- Diversified farming systems (agri/silvi/horti/pasture systems)
- Introduction of
  - improved varieties
  - irrigated dry crops
  - integrated nutrient management (INM) practices
  - integrated pest management (IPM) practices
  - improved implements
- Soil and water conservation (see above)

Poor fodder resources

- Introduction of
  - agri-silvi/pastoral system
  - multi-purpose trees
- Supply of fodder slips / seeds

Low cattle productivity

- Awareness creation about cross-breeds
- Establishing local AI (artificial insemination) and pregnancy diagnosis (PD)
- Improving livestock management through de-worming, vaccination and castration camps
- Testing feed supplements

Landless labourers do not have livelihood options

- Introduction of
  - backyard poultry
  - vermicomposting
  - sheep rearing

Improving access of poor to alternative livelihoods

- Introduction of
  - improved backyard poultry
  - vermicomposting
  - forest nursery
  - bee keeping
- Developing sheep-rearing
- Increasing access to CPRs

Box 2.1. Steps in formation of SS

Arriving at a decision: Based on the PRA outcome, both the community and the project staff desired to form an SS

Identification of individuals willing to participate in SS: Individuals volunteered or were nominated during interactions with the community.

Obtaining broad consensus of the villagers: The candidature of the individuals for participation in the SS was discussed in *gram sabha* and a consensus obtained.

Agreeing upon the roles and responsibilities of the members: Discussions were held with the SS members.

Capacity building of the SS: The members were trained to keep minutes and accounts (to be able to track the cash flow) and on-the-job backup was provided by project field staff (BIRD-K).

In spite of the individuals with motivation and willingness to work for the village development, no organization such as SS was formed in the villages. The project experience suggests that an external stimulus (such as a project of this nature) and resources are needed. In the absence of such stimulus, the innate motivation may go unrealised without being crystallized into action. The tendency of the government-initiated development programmes to rely on the PRIs was another reason why organizations such as SS would not evolve naturally. The perceived benefits from the contacts with the external agencies would also stimulate the individuals to participate in such initiatives.

Salaha Samithi meeting at Tumkur cluster

2.3.2. Roles of SS

The SS helped *elicit and assure* people's participation in all the project interventions. In doing so, it made the implementation of the project activities more transparent. In those interventions which needed large amounts of earth work and financial investment (e.g., check dam construction, farm ponds, trench-cum-bunds in private and common properties), the SS was actively involved in implementation by bringing forth peoples' contribution in terms of money and labour. It was also actively involved in selecting sites for soil and water conservation measures such as check dams, farm ponds, etc.

It acted as a *liaison* agency between the project staff and the village community in general, and through open meetings, it facilitated communication and interaction among the community as well as between the community and external agencies including the project. The SS played a major role in obtaining the necessary permissions and clearance from the district administration, and in providing the access to the endowment land by the poor in Anantapur cluster. Similarly, in Mahabubnagar cluster, the SS played a crucial role in negotiating with the PRI for providing temporary use rights for the tank bed for cultivation by the poor and, in conjunction with the project staff was instrumental in reaching a written agreement between the users and the PRI. It was also instrumental in negotiating with a farmer whose land was identified as suitable for construction of a check dam in Anantapur cluster. Thus, the private property was used for the common good of the community.

Some members of the SS assumed the role of *early adopters* of technological interventions, which helped others to accept the technologies. In Mahabubnagar cluster, people were initially reluctant to take up vermicomposting as an option for better crop nutrient management. Then, some of the SS members took up the activity following which some others accepted the technology. Thus, the SS also helped hasten the technology adoption and diffusion among the village community.

Salaha Samithi Meeting in Mahabubnagar

decisions on *targeting* the technological interventions. By identifying the needy and appropriate clientele for different interventions, the SS guided the technology testing to those households that could benefit from the technology and hence enhanced the chances of technology acceptance and minimized the conflicts.

It also identified people for exposure visits and training programs for capacity building. All these activities were done in a transparent and interactive manner in which the rationale for selecting the participating villagers was openly discussed. This minimized the conflicts. The composition of SS, with all socio-economic groups represented (Appendix 2.1), also ensured that the decisions were equitable. The landless poor were given preference in interventions related to livestock, especially sheep and poultry. In Tumkur cluster, the SS organized an exposure visit for farmers without any assistance from the project staff, which is a testimony to the post-project sustainability.

The SS also took up the responsibility of *maintaining* the assets created in the project. In Tumkur cluster, the SS was instrumental in discouraging the over-use of ground water by coaxing the villagers not to dig bore wells subsequent to the construction of check dam. By way of providing space and identifying the participants, the SS also provided a foundation to the custom hiring centres (CHCs) that the project initiated for enabling the small and marginal farmers to access the improved tools and implements (see Section 5).

Because of the SS, the project staff could save 30–50% interaction time with the community. Villagers did not have to wait until the next visit of the project staff to obtain the information that they needed. They could contact the SS for advice at their convenience. The SS members did spend more time in communicating with project staff and the villagers and also in planning the project activities. However, since most of these activities were carried in an informal manner and within the village, they saw little in terms of transaction costs. Thus, the SS proved to be an effective and efficient mechanism for quicker communication and technology diffusion.

2.3.3. Inter-cluster differences in SS

The formation and performance of SS differed across the clusters. There were nineteen SS members in Tumkur cluster compared to 12 (now 14) in Mahabubnagar and 13 in Anantapur. In all the clusters, people from different social strata (OBC, SC, ST, etc.) were represented in the SS (Appendix 2.1). In Mahabubnagar, some members of the SS were nominated by the village president, but no women and landless were included as no one came forward voluntarily. (Subsequent to the discussions in the regional workshop, two women came forward to be a part of SS and were included.). The representation of women was more in Anantapur (5 out of 13) compared to other two clusters. In Tumkur, the SS members were selected by the *gram sabha*, which has the authority to dismember the individual from SS if it feels so. Thus, a conflict resolving mechanism was put in place in Tumkur. The frequency of SS meetings differed across clusters. In Anantapur, the SS was more active and decided to meet once every fortnight instead of once a month, which is the practice in Mahabubnagar.

These differences in the functioning and effectiveness of SS were due in part to the differences in individual motivation of the members as well as the effectiveness of the facilitating staff. For example, the villagers in the Tumkur cluster were well aware of the community organizations in the neighbouring villages where BIRD (K) was already working. In Anantapur, one of the project partners had earned the faith of the villagers. In these terms, the situation in Mahabubnagar was not so conducive. However, it was found that the

functioning of SS could be improved if the members were sufficiently motivated. This was evident in the case of SS in Mahabubnagar cluster whose performance improved subsequent to an exposure visit to the Anantapur cluster.

2.3.4. Assets of SS

All three SS built up an asset base by charging a membership fee (Rs. 100). Members will be able to access the development resources (information, contacts and interventions). The community is mobilized to make cash/kind payment as their contribution to project interventions which is sometimes greater than the agreed amount. In such cases the balance if any after meeting the expenses was credited to the SS account. In Tumkur cluster, SS constructed a building, which is being hired out for different needs of the village and also used as a storage facility. This facility is also hosting a Tailoring Training Center and also used to keep the implements. In Anantapur, people voluntarily contributed land for construction of an office for SS and sought project support for construction. In Mahabubnagar, the SS is planning to construct a building and use it as a community hall and Artificial Insemination Centre in addition to using it as a meeting hall for SS. Thus, in all the three clusters, SS could mobilize and create assets.

2.3.5 The future of SS

Formation of SS proved to be an effective institutional innovation both from the project's perspective as well as from the clientele's (community) perspective. Motivation and commitment of individuals constituting SS, transparency and flexibility in arriving at the decisions, liaison with the existing local organizations especially the PRI and the continuous support from the project staff were the important reasons why the institutional arrangement in the form of SS was successful and likely to be sustainable beyond the project. The feasibility of post-project sustainability of SS is best seen in the way the assets have been created and operated in the three clusters. The continued presence of the NGO beyond the project period, which is very likely, would augur well to these initiatives. Such a continued handholding relationship would result in further strengthening of capacity of SS ensuring fair play in handling the assets created (the NGO and the SS operate a joint bank account for managing the funds).

Whether SS should continue to operate after the project period is a question to be researched upon and answered. At the same time, as the value of assets grows, it may as well result in an undue competition for the control of those assets and may become another source of power and to that extent may result into conflicts with other CBOs, especially the PRI. Another consequence would then be that it might cease to be an advisory body and rather become a 'political' body. In the event that it continues in the village, then there is a need for certain conventions to evolve, (which must be flexible enough to suit each community) as to who should be the members, how and how often the members should be changed, how to resolve possible conflicts, etc. However, it can be concluded from the project experience that partnerships with existing organizations, which can play the roles that the SS assumed, or the formation of an organization such as the SS would be of great help whenever a developmental project is initiated in rural villages.

2.4. Capacity building of communities

2.4.1 Formation of SHGs

Organizations such as SHGs, UGs and VSS were largely limited to thrift and credit. The villagers felt it useful to form SHGs based on the specific needs and interests. Accordingly, specific SHGs were formed for shepherds and wool weavers, dairy farmers, beekeepers, etc.

The process of formation of SHGs included identifying the people with similar needs, where the SS played a major role, informal discussions with the potential members of the group, negotiating agreements on functional roles and responsibilities, training on book keeping and finally forming a group. The interactions among the group members and with the project staff and other external agencies strengthened the knowledge and confidence of the members. Consequently, the groups were better placed to articulate their needs.

By bringing together people with similar needs, strategies for technology adoption, participation and monitoring the performance of technological interventions were put in place. The groups also provided fora to discuss the merits and demerits of the proposed technological interventions along with helping to build up social capital. In Mahabubnagar cluster, an SHG raised the need for a wool-cording machine. The resources were mobilized. The SHG then pursued further with the project and the suppliers of the machine in consultation with the SS. The machine, which met the needs of not only the project villages but also those of the surrounding villages, was obtained. Subsequently, a significant number of people could earn their livelihoods by weaving carpets from sheep wool.

2.4.2 Exposure Visits and Training

The exposure visits and training strengthened the human capital. The programs (see Appendix 2.2) were mainly centred around the proposed technological interventions specific to different groups, though there were some 'general' exposure visits and training. For example, the wool weavers group in the Mahabubnagar cluster visited the wool cording facility in the district so that they could learn the operational details for themselves. Similarly, groups with specific needs for training on fodder production were

Exposure visit to LRS Bandameedipalli

taken to the research stations specializing in fodder technology. Individuals who came forward to take up the nursery as a livelihood option were trained on nursery raising including the grafting techniques. The visits and training programs hastened the process of technology testing and decision-making on adoption. A logical process was followed to undertake these activities. Once the needs and groups were identified (where the SS played an active role), the place of training/exposure visit was identified. The potential trainees and the trainers were consulted to agree up on other details.

Exposure visit to BIRD-K, Teptur

In addition, farmers were also taken to different *'kisan melas'* (farmer gatherings) organized by different agricultural research centres including CRIDA, where the farmers had the opportunity to see new technologies

in operation. One such exposure to the rainfall simulator helped farmers see how the unprotected top soil got lost taking the nutrients away with it. This subsequently helped them accept the conservation technologies (Section 3).

The effect of training was also conspicuous in the case of maintaining and upkeep of farm implements made available through the CHC, which is another organizational arrangement, initiated in the project clusters (see Section 5).

Nursery training at S.Lakkihalli for Mahabubnagar Cluster villagers

Without the necessary training, initiatives such as this would not have been successful. Though no formal attempt to measure the effectiveness of these training programmes was made, the interventions were helpful in understanding specific problems, which then stimulated individual to look for potential solutions.

2.4.3 Awareness Campaigns

Mass awareness campaigns were conducted to generate awareness on the need for natural resource management. In Tumkur cluster, '*Hasiru Habba*' (green festival) was organized where mass plantation of trees was carried out with active support from the SS, SHGs, the PRI and the village community. Similarly, in Anantapur and Mahabubnagar,

Cycle rally

cycle rallies were conducted to spread the awareness. These campaigns also communicated the project details to the villagers. In the process, the PRIs and other CBOs were also sensitised, which was useful while negotiating for use rights for cultivating the tank bed in Mahabubnagar cluster and temple land in Anantapur cluster.

2.5 Synthesis

The activities of Output 1 laid the foundation for Outputs 2 to 4. Through conflict minimization and people's participation, the SS contributed to smoother implementation of the project and faster diffusion of interventions. That the SS could create assets and developed plans to continue even after the project ends is a testimony to the effectiveness and utility of such institutional interventions. The social capital built through forming these institutions and the human capital strengthened through exposure visits, training programs and regular interaction with the project staff also contributed to the success of the project in improving NR based livelihoods of the rural poor.

The new institutional arrangements attempted in the project addressed three main issues related to sustainability. These arrangements in themselves are the 'enabling' mechanism as could be seen from the self-initiatives undertaken by the SS in Tumkur. By involving these local organizations in decision-

making and managing implementation, project implementation became more transparent. In fact, transparency is the single most important reason for why the decisions of the SS were accepted. As all the interventions were identified in consultation with the villagers and the SS, there was enough flexibility to choose the options that responded to their needs. This maximized the chances of adoption of technologies. Thus, given the short duration of the project through which these interventions could be tested, it could be concluded that the interventions such as SS could be highly useful in promoting improved and sustainable NRM and livelihood opportunities.

2.6 Key Learnings

- The key to success of any development initiative is establishing good rapport and gaining confidence of the community. However, achieving this is a slow process. Inclusion of diverse social groups and transparency and flexibility are important to achieving the initial acceptance as well as the final outcome of the project. Exercises such as the PRA are helpful to achieve the twin objectives of striking rapport with the community and obtaining the information needed for the project.
- Equal importance to the social interventions as to the technological interventions is needed. The interventions in terms of formation of SS and capacity building through training and exposure visits contributed to the technology adoption and to enabling the community to take control of their own development. Whereas the former helped in identifying appropriate clientele as well as in ensuring people's participation wherever needed, the latter helped the community to appreciate the benefits of the proposed technological interventions.
- The individuals in the community have the innate capability and willingness to contribute to the welfare of the village. However, they still need an external stimulus and support to build a proactive organization.
- More attention and expertise are needed to document the process of enabling the community. In this project, for example, the impact of training and exposure visits could not be measured.
- In summary, transparency, flexibility and enabling factors go hand in hand and are vitally needed to promote better NRM.

Appendix 2.1 *Salaha Samithi* composition

Table A 2.1.1. Composition of *Salaha Samithi* in Anantapur Cluster.

Sl. No.	Name of the member	Sex M/F	Age	SC/ST/ OBC/ Others	Present position in village Institution	Village
1.	Y. Raji Reddy	M	52	OC	Gram Panchayat Member	Y. Kothapally
2.	Y. Chinna Obul Reddy	M	62	OC	Progressive farmer	Y. Kothapally
3.	B. Sreeramulu	M	35	BC	SHG Member	Y. Kothapally
4.	Thirupal	M	38	ST	SHG Member	Y. Kothapally
5.	Ramakrishna	M	29	BC	SHG Member	Pampanur
6.	Pulla Reddy	M	65	OC	Progressive farmer VSS member	Pampanur
7.	Subhadramma	F	30	OC	Vice Sarpanch and	Pampanur
8.	Ramalakshmamma	F	25	SC	Anganwadi Teacher	Pampanur
9.	Obulpathi	M	25	SC	—	Pampanur
10.	Padmavathi	F	34	ST	VO Leader and Anganwadi worker	Pampanur Thanda
11.	Kiramma	F	40	ST	VO Member	Pampanur Thanda
12.	Jyothi	F	25	OC	Anganwadi Teacher	Y. Kothapally
13	Narasamma	F	29	SC	Anganwadi Teacher	Y. Kothapally

Table A 2.1.2. Composition of *Salaha Samithi* in Mahabubnagar Cluster.

Sl. No.	Name	Sex M/F	Age	SC/ST/ OBC/ Others	Present position in village Institution	Village
1.	B. Venkat Reddy	M	53	Others	Member Rythu Sangam	Dharmapur
2.	Narayan Reddy	M	62	Others	Member Rythu Sangam	Dharmapur
3.	Gopal Reddy	M	65	Others	Member Rythu Sangam	Dharmapur
4.	Anjaneyulu	M	32	SC	Sarpanch	Zamistapur
5.	Yadaiah Goud	M	38	OBC	Member Rythu Sangam	Zamistapur
6.	Balakistaiah	M	40	OBC	Vice Sarpanch	Zamistapur
7.	Bucha Reddy	M	50	Others	Member Rythu Sangam	Bukkalonipally
8.	Balanagaiah	M	55	SC	Vice Sarpanch	Bukkalonipally
9.	Ramulu	M	52	OBC	Member Rythu Sangam	Bukkalonipally
10.	Dayanand	M	38	OBC	Member Rythu Sangam	Chowderpally
11.	Krishna Reddy	M	32	Others	Member Rythu Sangam	Chowderpally
12.	Bheemaiah	M	38	OBC	Chairman Vidya Committee	Chowderpally
13	Saraswathamma*	F	27	SC	SHG Member	Zamistapur
14.	Venkatamma*	F	33	SC	SHG Member	Zamistapur

***** Joined subsequently.

Table A 2.1.3. Composition of *Salaha Samithi* in Tumkur Cluster.

Sl. No.	Name	Sex M/F	Age	SC/ST/ OBC/ Others	Present position in village institution	Village
1.	S.R. Marulappa	M	57	OBC	President (Salaha Samithi)	SHK
2.	S.H. Vishwanathappa	M	57	OBC	Vice President	SHK
3.	S.M.Gurumarulasiddappa	M	43	OBC	Secretary	SHK
4.	S.V. Mallikarjunappa	M	48	OBC	Member	SHK
5.	S.M. Jayanandamurthy	M	43	OBC	Member	SHK
6.	S.H. Mrutyunjayappa	M	57	OBC	Member	H.M. Kaval
7.	S.R. Mayashetty	M	58	OBC	Member	SHK
8.	Govindanaik	M	40	SC	Member	SHK
9.	Marulasiddanaik	M	45	ST	Member	SHK
10.	S.C. Halappa	M	50	OBC	SHG Member	SHK
11.	S.S. Basavaraju	M	38	OBC	SHG Member	SHK
12.	S.B. Basavaraju	M	43	OBC	SHG Member	SHK
13.	Shashidhara	M	30	OBC	SHG Member	SHK
14.	S.C. Mallikarjun	M	30	OBC	SHG Member	SHK
15.	S.C. Marulasiddappa	M	30	OBC	SHG Member	H.M. Kaval
16.	Ganeshappa	M	50	OBC	SHG Member	H.M. Kaval
17.	Susheelamma	F	33	OBC	SHG Member	SHK
18.	Maheswaramma	F	40	OBC	SHG Member	SHK
19.	Leelavathi	F	32	OBC	SHG Member	SHK

SHK: Shankaranhalli

Appendix 2.2 Training and exposure visits

Table A 2.2.1. Training programmes in Anantapur Cluster.

Training on	Place of training	No. of farmers attended
Improved practices for cultivation of groundnut, pigeonpea, castor and papaya	Y. Kothapalli	75
-do-	Pampanur	35
-do-	Pampanur Thanda	30
Ethno-veterinary training	BIRD – K, Tumkur	3
Nursery raising and grafting	BIRD – K, Tumkur	10
Vermi composting	Y. Kothapalli	25
Dryland agricultural implements	Tractornagar, Garladinne	10

Table A 2.2.2. Exposure visits in Anantapur Cluster.

Place visited	No. of participants	Activities observed
BIRD–K, Tiptur	17	Watershed, agroforestry, horticulture, composting, medicinal plants, participation in community mobilization
CRIDA, Hyderabad and BIRD–K Jadcherla	21 (5 women participants)	Farmers' field day, rain simulation, agro-forestry, cropping pattern, horticulture, dye and *sugandhi* oil plantation, mulching, Agricultural equipments, watershed, people's organization

Table A 2.2.3. Training programmes in Mahabubnagar Cluster.

Training on	Place of training	No. of farmers attended
Nursery raising and maintainence	S.Lakkihally BIRD-K, Tumkur	9
Ethno-veterinary training	BIRD-K, Tumkur	5
Cultivation aspects of Mango	BIRD-K, Jadcherla	10
Orchard (mango) management	BIRD-K, Jadcherla	22
Capacity building of rural youth for breed improvement (Cow & Buffalow)	BIRD-K, Jadcherla	16
Demonstration and training of paddy reaper	Bukkalonipalli	10
Dryland agricultural implements	Hayatnagar Research Farm, CRIDA	16
Action learning exercise using rainfall simulator	Chowderpally	500

Table A 2.2.4. Exposure Visits in Mahabubnagar Cluster.

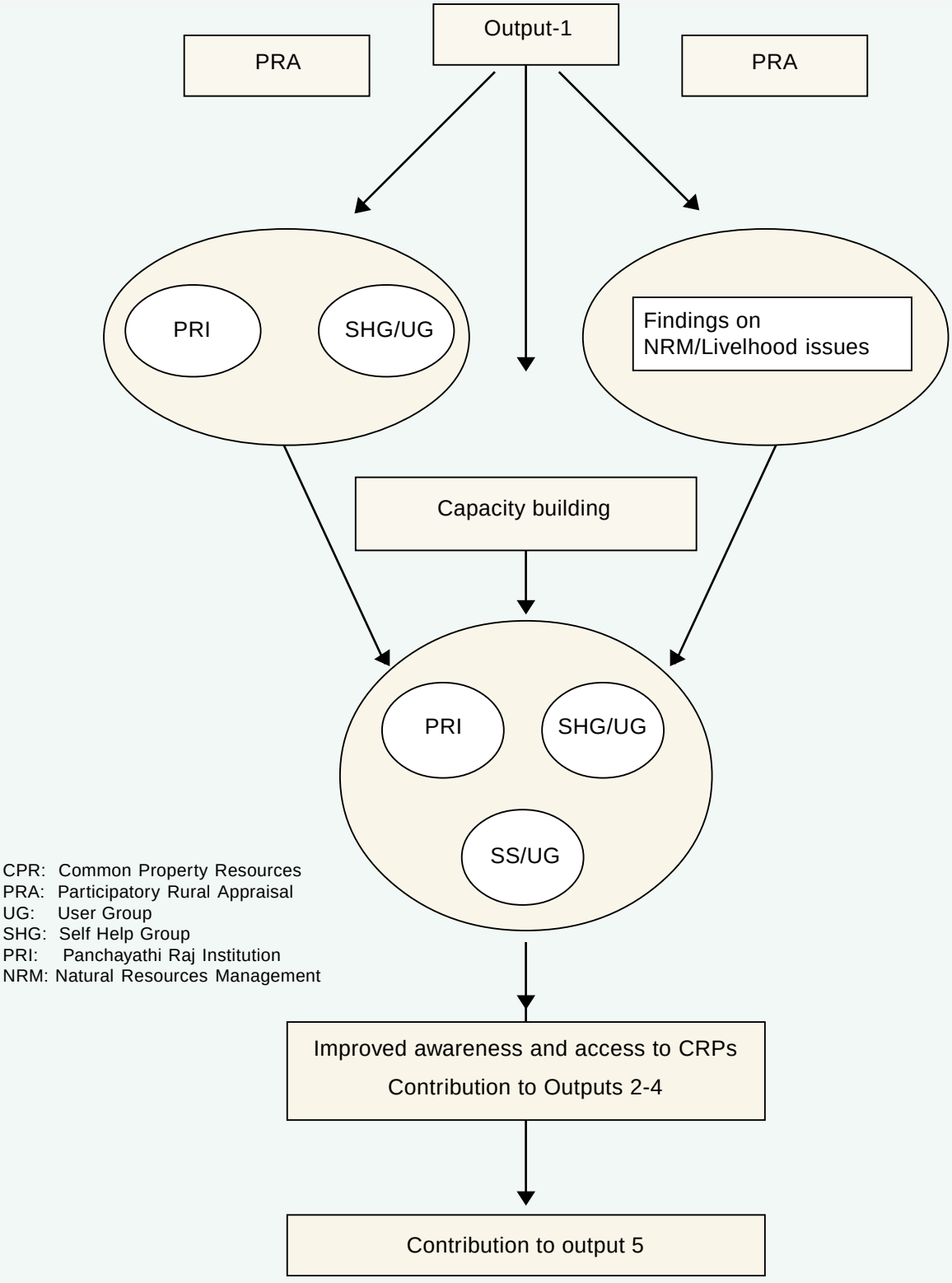
Sl. No.	Subject	Place	Participants Male	Female
1	R8192 work in Anantapur	Project villages in Anantapur	16	2
2	'SRI' method of rice cultivation	On-farm demonstration of ANGRAU at Bhutpur village	0	5
3	Fodder crops and production practices	Regional Station for Fodder Production and Demonstration, Mamidipalli	15	5

Table A 2.2.5. Training Programmes in Tumkur Cluster.

Sl. No.	Participants M	F	Total	Places visited
1.	26	—	26 (batch 1)	Visit to Lakkaihalli farm and existing watershed on soil and water conservation methods
2	28	—	28 (batch2)	
3	20	7	27 (batch3)	
4	6	4	10 (3 days)	Bee keeping technique at Shankarnhalli
5	2	—	2	Ethno-veterinary practices at Lakkaihalli
6	—	27	27	Training on nutrition programme at Lakkaihalli
7	28	6	34	Soil and water conservation at Shankarnhalli
8	16	—	16	Kitchen herbal garden training at Shankarnhalli
9	19	3	22	Training on INM, IPM practices at Handhankere
10	22	27	49	Training on IGA, at Shankarnhalli
11	40	—	40	Training on after care technique for Horticulture plants
12	11	—	11	Fertility management on coconut
13	9	12	21	Training on commercial nursery making at Lakkaihalli

Table A 2.2.6. Exposure visits in Tumkur Cluster.

Sl. No.	Participants M	F	Total	Places visited
1	32	13	45	Krishi mela at UAS, Bangalore
2	18	6	24	Kasargode, ICCRI (Institute for Coconut Research Center) and Progressive farmer Ramachanderiah's Organic Farming fields at Cherkadi
3	10	0	10	Krishi mela at UAS, Bangalore
4	15	0	15	Krishi mela at UAS, Bangalore to learn adopt new technologies



CPR: Common Property Resources
PRA: Participatory Rural Appraisal
UG: User Group
SHG: Self Help Group
PRI: Panchayathi Raj Institution
NRM: Natural Resources Management

Figure 2. Schematic diagram of output-1 and its linkage to other outputs.

Section 3

Soil and Water Conservation

3.1 Introduction

Project R8192 belongs within the semi-arid production system portfolio of NRSP projects. One of the OVIs of output from the semi-arid system portfolio is the development and promotion by 2005 of strategies for improving the livelihoods of poor people, by increasing the productivity of water in rainfed agriculture, through use of appropriate rainwater and/or soil fertility management practices. It is in this context that the water harvesting and soil fertility management interventions described in this section have been promoted in the project sites.

The natural resource base in semi-arid areas has undergone degradation because of neglect and over-exploitation. The most important natural resources (NRs), ie, soil and water, hold the key for improving the livelihoods of the rural poor located in semi-arid areas. Nearly 67% of the cultivated area in India comes under rainfed agriculture and supports 40% of the population and 60% of the livestock (CRIDA 1997). The project sites selected typically represent the semi-arid areas in India. The project districts are frequently affected by droughts due to failure of monsoons. The rainfall distribution, which is primarily uni-modal results in heavy rains in a short period causing high runoff and soil loss. Prolonged dry spells between two rains during the monsoon can occur, resulting in drying of the sown crops. The soils are also poor and degraded. Farmers report that the groundwater is over-exploited resulting in lowering of the water table and drying of open wells (PRA findings). Crop cultivation in most of the area is restricted to a single season i.e. rainy season.

In view of the above situation, proper harvesting of the rainwater received during the monsoon and storing it to utilize later is one way to improve livelihoods. *In-situ* conservation of the rainfall and moisture would also help crop growth and productivity. Accordingly, a number of rainwater harvesting technologies were offered to the farmers in the selected clusters. The technologies included farm ponds, trench-cum-bunds, check dams, gully plugging and diversion channels. Preliminary indications suggest that these NRM-based interventions yielded immediate results in terms of water resource development: farmers reported that dry wells were filling and the water table was rising. However, verification of this needs further scientific assessment, monitoring and documentation. Similarly, soil fertility management practices such as vermicomposting, bio-fertilizers, and planting bio-mass generating trees were introduced to improve soil fertility, which is expected to increase the productivity of crops and further the livelihoods of small and marginal farmers.

A PRA specific to the NRM interventions was followed in the planning process. Since S&WC issues and causes are watershed or community based rather than person based, emphasis was placed on the interest of the villagers as a community while deciding S&WC measures to be taken up by each cluster. For interventions such as vermicomposting and forest nursery raising, which use private resources for private benefit, stress was given

on the interventions' potential for contributing to the livelihoods of the poorer households in the community, and on encouraging the community, through the *Salaha Samithi* (SS) (Section 2), to target these interventions on the interested landless and poor.

The details of these interventions on rainwater harvesting and soil fertility are presented in Table 3.1 and some preliminary indications of results are described in Sections 3.2 and 3.3, respectively.

Table 3.1. Soil and water conservation activities by cluster and village.

Sl. No	Activity	Number of beneficiaries/area covered*							
		Anantapur			Mahbubnagar				Tumkur
		Pampa-nur	Pampa-nur Thanda	Y.Kotha-palli	Chowd-erpally	Bukkalo nipally	Zamis-tapur	Dhar-mapur	
1	Farm pond unlined	7 + 1 lined	-	19 + 1 lined	7	5	3	-	45
2	Mini perco-lation tank	-	1	2	-	-	-	-	-
3	Check dam	-	-	1	1	-	-	-	1
4	Gully plugs	-	-		-	-	-	36	25
5	Trench cum bund	2	1	16	3947 m	3411 m	-	890 m	222 11791m^3 105 ha
6	Roof water harvesting	-	-		-	-	-	1	-
7	Diversion channel for dried wells	4	2	8	10	10	-	-	-
8	Participatorywater table monitoring	-	-		10	10	-	-	-
9	Tank bed CPR development	-	-		-	-	2 women, 1.6 ha	-	-
10	Biomass plantation	-	-		13	6	-	-	-
11	Soil testing and advice	20	20	20	20	20	18	24	42
12	Vermicompost	8	-	4	5	6	6	6	9

* Where units are not mentioned, numericals are number of participants

3.1.1 The process

3.1.1.1 Awareness building on resource losses using rainfall simulator

A portable rainfall simulator was used as an action learning (AL) tool for creating awareness on resource losses in the selected clusters. During the AL, the farmers could see the runoff water coloured with soil moving out. This led to discussion in the field about the approximate amount of soil displaced from the villagers' lands over years and its implication on agricultural production and land degradation. The farmers asked many questions on mulches to contain runoff and soil loss and for conservation of moisture. The simulator exercise convinced the villagers of the need of soil erosion control. Farmers from Mahabubnagar and Anantapur clusters realized that loss of soil and water was more when rain falls on soil without vegetative cover as compared to soils with vegetative cover. The need to check the rainfall-induced runoff to prevent the soil erosion was felt. Farmers were also able to understand that if runoff was properly harvested, it could be utilized to save the crops during the dry spells. This change in their attitude was helpful in promoting NRM related interventions.

Creating awareness : Action learning – Rainfall simulator

3.1.1.2 Exposure visits and training

In two of the project sites viz. Anantapur and Mahabubnagar, farmers initially were reluctant to adopt some of the water harvesting structures such as farm ponds and trench-cum-bunds for fear of losing part of their land. But exposure visits to other cluster at Tiptur, interaction with farmers and also the visits to research stations at Anantapur and CRIDA helped them to understand the beneficial effects of water harvesting through farm ponds and trench-cum-bunds. The proverb 'seeing is believing' played a key role in the acceptance of technologies. Besides this, training on production of vermicompost and explaining the benefits of INM in focus group interactions helped the farmers to take up the technological interventions for improving the NRs. The SS and PRI played active role in carrying out the interventions, and helped in improving the access of CPRs to poor and conversion of PPRs to CPRs.

3.1.1.3 Participant contribution

The participants' share of the intervention cost was decided by the SS in consultation with the field team. In Anantapur and Mahbubnagar clusters, participants of soil and water conservation activities contributed 10% of the cost of interventions in the form of cash or labour, while in Tumkur cluster, the participants contributed 25–30% in the form of cash or labour. In case of vermicomposting, participants at Anantapur contributed 35% of the cost in the form of labour and shade provision, and participants at Tumkur cluster contributed 30% in the form of labour while at Mahbubnagar, the full cost was borne by the project. The level of contribution indicates the level of awareness and interest among the participants and the bargaining power of the SS, which became the beneficiary of the contribution.

3.2 Rain Water Harvesting Technologies

3.2.1 Anantapur cluster

3.2.1.1 Introduction

The normal rainfall of Anantapur district is about 520 mm, which, as indicated in Section 2, is characterized by erratic distribution and long dry spells during the cropping period. The soils in the cluster of villages are red sandy loams with shallow depth and poor water holding capacity. Heavy rainfall goes unutilised *in situ* in the form of runoff. There are not enough water harvesting structures in this area. The major crop in the district is rainfed groundnut, which frequently encounters long dry spells during the critical growth stages. Due to this, the groundnut crop often fails to produce an economic yield. Earlier research results showed that one supplemental sprinkler irrigation of 10 mm at pod development stage increased the yield by 33% (AICRPDA, 2003). If the runoff water is stored in dug-out ponds and trench-cum-bunds at suitable locations, it could be utilized to irrigate the crops at critical stages.

In the beginning, the farmers were reluctant to adopt farm ponds and trench-cum-bunds (TCB) due to their earlier experience with contour bunding, which typically took a lot of land and created a problem for field operations such as ploughing. Exposure visits to other clusters viz., Tumkur, where water harvesting structures were widely adopted by the farmers, and interaction with the Tumkur farmers helped the Anantapur farmers to understand the benefits and costs of such structures. Initially, three farmers came forward to take up the rainwater harvesting structures. One of these farmers successfully used the farm pond for supplementary irrigation: this convinced another three farmers to construct farm ponds. The success of the first farm pond also helped the farmers to accept other technologies. Water harvesting technologies adopted by farmers in Anantapur cluster are discussed in the following sections.

3.2.1.2 Diversion of runoff water into dry open well

During the PRA, 45 open wells were found dried up and left unused due to the drought conditions and heavy use of bore wells. An option to recharge these drywells was to divert runoff into the wells in the farmers' fields through laying of PVC pipes and stone pitching. Fourteen farmers came forward willingly to adopt this.

Defunct well filled with rain water through diversion pipes in Anantapur

With summer showers and early monsoon rains, this technology resulted in filling up of the wells, some of which were lying dry for the last 20 years. The farmers were happy to see their dried up wells filled up by 30 to 70% and the water was used for irrigating their crops. In some cases, the area irrigated was almost doubled. For example, a farmer named Mr. P. Bhale Naik increased his area under

Recharging defunct wells through rain water diversion in Anandapur

irrigated groundnut to 3.2 ha from 1.2 ha, due to the diversion of water to his old dried well of 324 m^3 capacity. During the two years of project interventions, all 14 wells were treated successfully.

3.2.1.3 Farm ponds

Two types of farm ponds were advocated and adopted by the farmers for harvesting the runoff in farmers' fields, viz., farm ponds with lining and farm ponds without lining. Unlined ponds are dual purpose, serving both as percolation ponds for groundwater recharge and as an irrigation source.

Digging of farm pond by villagers at Anantapur cluster

Vegetables cultivation near farm pond in Anantapur

Twenty-eight farm ponds were constructed in the farmers' fields, 26 without lining and 2 with lining. This was done in a participatory cost-sharing mode wherein farmers contributed their share of 10% of the total cost in the form of labour. A storage space of 4156 m^3 was created by digging the farm ponds. The average pond size was 115 m^3 and it ranged from 62 m^3 to 179 m^3. A rainfall of 90 mm in two consecutive days filled all the ponds. In a matter of 4 to 10 days, the unlined ponds dried up, due to the porous nature of the soils. This indicates good groundwater recharging potential but poor water holding capacity and hence limited potential for use of the farm pond for supplementary irrigation during dry spells. The farm ponds with lining could store the water for more number of days, typically for at least one month. Farmers could make use of the stored water for life-saving supplementary irrigation of their groundnut crop during any long dry spells in the summer months, i.e., May and June (Case Study 2; Section 6.4). Water was also used for pot watering of the horticultural plants in their fields.

Informal agreements in the community allowed some of the stored farm pond water to be seen as a common property in terms of drinking water for livestock. The community agreed this in recognition of the pond being constructed with project resources.

3.2.1.4 Trench-cum-bunds (TCB)

Trench-cum-bunds are constructed around individual plots to check runoff and soil erosion and are advocated in farmers' fields having mild slopes. A series of TCBs of 5 m x 2 m x 0.3 m (3 m^3) size across the slope were dug on farmers' fields. Multipurpose and agro-forestry tree species such as *Gliricidia* and *Subabul leucaena* were planted in the trenches and these showed excellent survival. The average cost of construction was Rs. 1880 ha^{-1} with an intensity of 24 m length of TCB per ha of area.

3.2.1.5 Check dam

A check dam (24 m length and 2 m height) was constructed in the CPR land of Y Kothapalli, where water was flowing through

this area unutilised. About 20% of the cost of structure was borne by the villagers in the form of labour contribution. The beneficial effects of the check dam were observed by the farmers in the first year as the dam was full during May 2004 rains a few months after construction. The check dam also served as a source of drinking water for cattle and helped in the growth of forestry trees such as *Prosopis juliflora* that are used by the villagers as firewood. Farmers reported that the construction of the check dam helped in recharging 10 surrounding bore wells. Seeing the benefit, now the farmers are demanding for more check dams. However, with the type of rainfall prevailing in the area, on farm conservation and harvesting rather than building check dams is recommended.

3.2.1.6 Mini percolation tank

In 2003, three mini-percolations tanks, one at Pampanur Thanda and two at Y. Kothapalli were constructed. Because of these tanks, drinking water for cattle improved and the surrounding bore wells (18 nos.) were recharged, which enabled the cultivators to draw more water for agriculture. Besides harvesting eroded fertile soil, these tanks were sources of drinking water for the animals.

3.2.1.7 Assessment

Due to the construction of harvesting and recharging structures, farmers reported rise in water level in about 30 bore wells. A groundwater level rise of up to 2.25 m was recorded in a defunct well due to check dam construction in a 32 ha catchment. About 4070 workdays of employment was generated for the needy by construction of farm ponds, TCBs and mini-percolation tanks. Farmers used the stored water for their groundnut crop, or horticultural crops, for livestock watering and reported better establishment of trees and crops near or on the TCBs.

3.2.2 Mahabubnagar Cluster

3.2.2.1 Introduction

Dharmapur cluster of villages near Mahabubnagar covers a geographical area of 10686 ha: the majority of the cluster farmers are marginal (56% with less than 1 ha land). The normal rainfall of the mandal is 549 mm received through southwest monsoon. The rainfall is erratic: for example, actual rainfall received during 2003 and 2004 was 815 mm and 383 mm respectively. Due to the hilly terrain, the unchecked rainwater flows downstream causing severe soil losses. Therefore, effective utilization of run-off water is essential for higher crop productivity.

In this cluster of four villages, Dharmapur and Zamistapur are already covered under earlier watershed programmes and the livelihood programme of APRLP. The other two villages Bukkalonipally and Chowderpally were not exposed to any development programmes in the past and hence the focus was given to the latter two villages.

With the help of the PRI, and SSs, interventions in this cluster were successful in providing the poor access to CPRs (village tank bed for cultivation, see Section 3.2.2.6). The water in a check dam constructed on PPRs was also made available for the benefit of the whole community.

3.2.2.2 Check dam

A check dam was constructed in Chowderpalli, one of the non-watershed villages. The location of the dam was finalized in consultation with the SSs and villagers. The dam is located on PPRs, i.e., on poor quality land owned by three farmers that has remained fallow for quite some time. The owners readily agreed to spare their land for the construction

of the check dam that would help the entire village community by storing the runoff water. This is a typical case of an unused PPR being used (as a CPR) for the benefit of the whole village. The construction of check dams helped in storing runoff water. The check dam has a catchment area of 50 ha and storage capacity of 2600 m^3 with an upstream space of 300 m: and held water for more than one month after the monsoon.

Check dam at Chowderpalli in Mahabubnagar

The villagers found the construction of the check dam very useful as the water could be used as drinking water for cattle. The dam also helped in recharging groundwater in the surrounding 10-15 bore wells in the area.

Check dam filled to brim during first rain in Mahabubnagar

During the 2004 monsoon, the water flowed over the dam: this led to the villagers requesting the dam height to be increased. The need for this was discussed and analysed with the villagers. They realized that overflow was likely to be a rare event, which downstream farmers could be deprived of water and that upstream in-situ water harvesting would be a better alternative.

3.2.2.3 Farm ponds

Fifteen farm ponds were constructed on farmers' fields in the villages not covered under the watershed programme. Farm ponds were constructed for a catchment area of about 2 ha: each pond had a capacity of 250 m^3 (average depth 2.5 m) and each beneficiary contributed 10% of the cost, usually as labour.

Farm pond filled with rain water in Mahabubnagar

Farm pond at Chowderpalli village in Mahabubnagar

In the 2005 monsoon, two innovative farmers increased the pond depth to rear fish. The water in their ponds could stay longer without seepage because of the rocky bottom. Considerable seepage water was flowing into the ponds from the nearby fields. Hence, they have decided to take up fish rearing in these ponds (see 3.2.4; Table 3.3 for a cost analysis).

3.2.2.4 Trench-cum-bunds

An area of 51 ha of land in non-watershed villages was covered under TCBs during the project period with active participation of farmers and a 10% cost contribution from them. The intensity of bunding was 64 m per ha of area. Farmers could observe the collected soil and water in the TCBs and became motivated to plant horticulture, forestry,

Trench cum bund for conservation of soil & water in Mahabubnagar

fodder crops, which in the long run would yield some returns.

3.2.2.5 Gully plugs

Gully plugging was carried out at 36 places, especially near hillocks, to arrest the water flow and soil for recycling. The farmers observed that the gully plugging, while preventing soil erosion, also helped in recharging groundwater. They are demanding more such structures.

3.2.2.6 Tank bed CPR Development

It was observed during the PRA exercise that in Zamistapur, the village tank which has a total area of 8 ha was silted up and that only up to 30% of the tank area was filled even in years of normal rainfall. The remaining area is full of weeds and remains unutilised. From the village records, it was known that in the last 25 years, the tank did not fill completely even once. Hence, the unfilled area of 4–5 ha could be brought under cultivation, by growing crops with residual moisture. The idea was discussed with the PRI and SS who decided to allot this land to landless poor so that they can cultivate the tank bed and generate some income. Initially 1.6 ha of land was to be brought under cultivation as a trial.

The first group of villagers to express interest in cultivating the land wanted a bore well to be dug for them. They were not satisfied with the open well agreed by the SS and project and gave up the idea. Two landless women then came forward and the PRI accorded them user rights through a written agreement.

Fodder maize and vegetable cultivation in CPR land (tank bed) in Zamistapur, Mahabubnagar

The women grew fodder crops such as *jowar* and maize, vegetables and chickpea, and generated income from the sale of fodder (Rs. 100) and vegetables (Rs. 250). This shows that with proper mobilisation, the village institutions can respond favourably to enabling access of the CPRs to landless people. This arrangement is being tested by the landless women as well as the community. Based on the outcome, the mechanism for granting usage right to the land can be strengthened. (Policy Brief IV; Section 6.4).

3.2.2.7 Diversion channels (recharging through dried-up wells)

Followed by exposure visit to assess the usefulness of such structures in Anantapur cluster, the farmers from two of the villages viz., Chowderpally and Bukkalonipally, came forward for the construction of 20 units of diversion channels to divert runoff water to dried-up wells for recharging the groundwater and rejuvenating the wells.

3.2.2.8 Roof top water harvesting

A roof top harvesting structure for drinking water purposes was constructed in a high school (with 11 staff and 370 students) located in Dharmapur. The estimated storage volume is 24 m^3. This structure was the first of its kind in the area and therefore evoked great interest among the villagers.

3.2.2.9 Participatory groundwater monitoring

One of the main problems in semi-arid areas is excessive exploitation of groundwater, which is both a CPR and a PPR. Hence, to create awareness on proper utilization of groundwater, a participatory monitoring mechanism was introduced in this cluster. Chowderpalli village was given a water level indicator for measuring the depth of the water level in the bore wells.

Ground water level measuring device

The project officials and the 10 participating farmers monitored the depth every fortnight and maintained a record. The data were recorded for a season and discussed during open SS meetings. A sample data set on water level rise in a bore well (80 m deep) in Chowderpalli village is depicted in Figure 3.1.

The participatory monitoring gave excellent insight to farmers on the rate of groundwater depletion and its recharge. It also created awareness about judicious use of groundwater. Formalizing this process and encouraging the SS to take full responsibility of the groundwater monitoring would provide the PRI with a useful crop and village development planning tool.

Farmers measuring level of ground water through measuring device

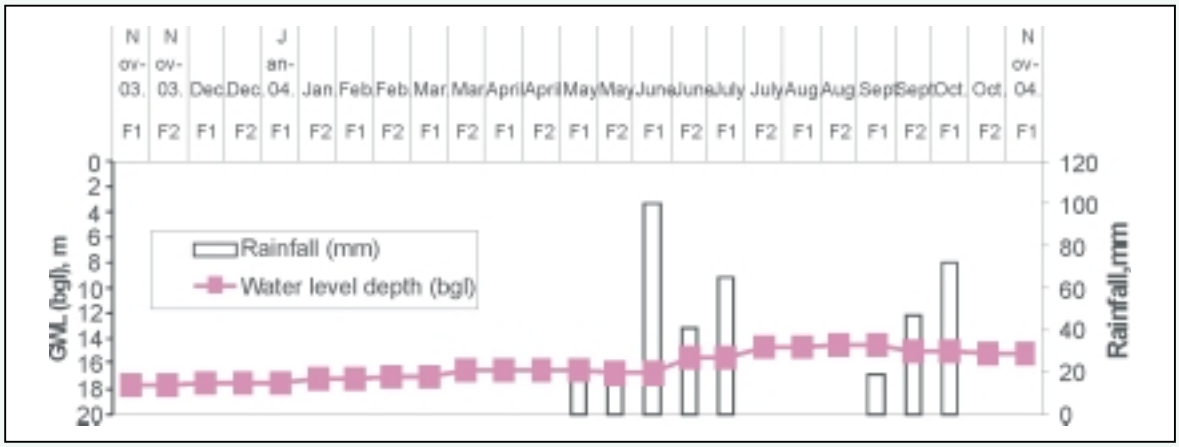


Fig. 3.1 Groundwater level fluctuations in a typical irrigation well

3.2.3 Tumkur cluster

3.2.3.1 Introduction

This cluster has a total geographical area of 711 ha. The annual rainfall varies from 600–650 mm. The monsoon commences in May and ends in December with the peak rainfall period between September and October. The area has been experiencing continuous drought for the last three years. In uplands soil erosion, poor fertility, groundwater depletion, lack of vegetation and gully formation are common problems. Most of the rainwater runs off unchecked in the watershed area, carrying a lot of topsoil with it. This tremendous loss, which has a direct bearing on the economic condition of the people, can be checked through appropriate soil and water conservation measures. After discussions with scientists and BIRD-K officers during PRA, the farmers chose to take up soil and water conservation measures such as trench cum bund, farm pond, gully plugs, check dam and *nala* (stream) bund.

3.2.3.2 Trench-cum-bund (TCB)

According to the farmers' NR development preferences, TCB is a second choice after planting forestry seedlings. Traditionally, farmers follow the practice of opening trenches in coconut gardens for safe disposal of water from fields. They were exposed to the new concept of opening the trenches as a soil and water conservation measure in drylands. However, marginal farmers who own small pieces of fragmented land are not interested in constructing TCBs as it removes land from cultivation.

Trench-cum-bund in Tumkur cluster

TCBs have been implemented in 105 ha of land in 2003. The beneficiaries contributed 30% share of the total cost in the form of labour. The typical trenches are 5 m long, 1 m wide and 0.3 m deep respectively with a storage capacity of 1.5 m^3 (1500 litres). Depending on the soil condition, a labourer can dig 4–5 trenches per day. Such trenches (55–60 per ha) can harvest 148 m^3 to 162 m^3 water. Both the trenches and bunds are utilized for plantation of forestry seedlings, fodder, with good survival and establishment.

Trench-cum-bund with seedings planted in Tumkur cluster

3.2.3.3 Farm ponds

Before the introduction of farm ponds, the people were not aware of the concept of digging ponds specifically for water harvesting. They were familiar with water collection in pits, since in this village, many small dugout pits were seen in the farmers' fields. The soil from the pits was used for coconut plantation to improve the soil fertility and the dugout pits then acted as water-storage structures. Normally, the dugout pits are 1 to 3 m deep with varying volume (3 to 5 m^3). Farmers came to know about the concept of farm ponds and their role in rainwater harvesting and recharging of groundwater through the earlier work of the NGO project partner BIRD-K, which had already made

considerable impact in neighbouring villages. So, farmers readily accepted the concept of farm ponds after field visits and interaction with the beneficiaries of the neighbouring village.

Farm pond with harvested water in Tumkur cluster

Forty-five farm ponds were dug with partial contribution from the farmers. The SS members in consultation with BIRD-K officers selected the site for excavation of farm ponds. For every 2 ha area, one farm pond was proposed in lands having 2-3% slope.

When dug out manually, the side slopes were cut into steps around the pond boundaries. The capacity of the ponds varied depending on the size and location of the farmer's plot. On an average, the ponds were of 10 m long, 10 m wide and 3 m deep with 1:1 side slope. This means creating a water storage of 170 m^3. The dug out soil was used to build a mound of 1–1.5 m high around the pond to protect the pond and act as wall around it. Protective grasses, forest tree species and vegetables were planted on the mounds. Each pond has inlet and outlet channels. The inlet channel has a silt trap and stone pitching was done to protect the inlet from erosion. Due to the farm ponds, the groundwater level improved considerably.

Informal agreements in the community allowed some of the stored farm pond water to be seen as a common property in terms of drinking water for livestock. The community agreed this in recognition of the pond being constructed with project resources.

During the visit of farmers to *Krishi Mela* (Agricultural festival) at GKVK (*Gandhi Krishi Vigyan Kendra)*, UAS, Bangalore, farmers came to know about the lining of the farm ponds. Some of them were ready to take up lining activity, but under the project, only one farmer was selected for this in consultation with the SS. A pond of 243 m^3 capacity was dug and lined with soil cement (8:1). The performance of the lining material is to be observed.

Because of the ponds, there was recharge of groundwater, and the dried open well was rejuvenated. The ponds were also serving as drinking water source for cattle, and supported nursery activities and watering of vegetables and fruit trees. The extent of groundwater recharge is being monitored in open wells and tube wells using a water level indicator designed by ICRISAT.

3.2.3.4 Gully plugs

Gully plugs were constructed in the coconut plantation of the farmers to arrest soil erosion. Twenty-five gully plugs were constructed under this project with 30% contribution from the farmers. The total catchment area covered was 8 ha and average gully depth ranged between 1 and 1.5 m.

3.2.3.5 Check dam

The land in the project area has an average slope of 1–6%. During the PRA, it was noted that, as in the other clusters, considerable runoff was flowing from the village into streams. The community and project decided to construct a check dam to store water in the lower reaches of the farms. Though the site selected for construction of the check dam was in PPR, the landowners readily agreed for constructing the check dam for the benefit of the whole village community. The farmers contributed their 30% share towards the cost of the construction of the check dam.

The check dam benefited more than 30 families in the village. Its benefit extended over an area of 16 ha of land besides making water available for washermen, animals and household use. The check dam also helped in increasing the soil moisture availability to the coconut plants.

3.2.4 Cost and benefits from water harvesting structures:

The cost and type of benefits expected from the water harvesting structures are presented in Table 3.2. The benefits varied depending on the structures and the purpose for which they were used. Meaningful and reliable quantification of the benefits is not possible at this time due to the short run of the project. Some of the anticipated impacts as in the case of groundwater recharging demands more time.

Table 3.2. Cost-Benefit analysis of water harvesting structures.

Structure	Cost (Indian Rupees)	Benefits**
1. Farm ponds	Rs. 6,000/- to Rs.15,000/-*	i) Groundwater recharge ii) Supplementary irrigation iii) Raising vegetables and horticultural plants iv) Rearing fish
2. Check dams	Rs. 1,00,000/-	i) Prevent wastage of run-off water i) Prolonged availability of water ii) Availability of drinking water for cattle, household purposes, washing clothes etc. iii) Groundwater recharge
3. Trench-cum-bunds	Rs. 2,000/ha	i) Prevent soil loss ii) Better establishment of fodder and agro-forestry trees on the bunds/ trenches iii) Increased soil moisture availability in the surrounding area for crops/plants

* This varies depending on the pond size and whether it is lined or unlined
**Varies according to the purpose for which the structures are used

The cost-benefits expected from different harvesting structures are briefly discussed below: wherever possible, quantification was attempted.

3.2.4.1 Farm ponds

The primary use for which farm ponds were constructed varied from cluster to cluster. In Tumkur cluster, the farm ponds were mainly used for percolation and recharging. Hence, the farmers decided not to pump water from farm ponds for irrigation purpose. The water was used sometimes for manually watering a few plants planted around the farm ponds using pots filled from the pond.

In the case of Anantapur, some of the farm ponds were used as supplementary irrigation by pumping water. In Mahabubnagar, two farmers decided to use the ponds for rearing fish.

3.2.4.2 Cost and returns from farm ponds used for fish rearing:

The estimated cost and benefits from this activity (3.2.2.3) based on the information provided by the two farmers is given in Table 3.3. Farmers need to invest around Rs. 9,300/- (in addition to the construction cost of farm pond) and can expect around Rs.34,000/- net income in 8 months. Thus, the farm ponds in the farmers fields is profitable, if the harvested rainwater can be supplemented to prevent drying of the pond.

Table 3.3 Estimated cost and returns of fish rearing in existing farm ponds
(Mahabubnagar cluster)

Size of farm pond : 10 m x 10 m x 3 m
Cost of farm pond : Rs. 8000/- (dug as project activity)

A. COST			
Input cost			
i)	Cost of 3000 seed fish	Rs.	300-00
ii)	Cost of transport	Rs.	50-00
iii)	Feed cost:		
a)	Rice bran 320 kg. (10 kg. per week for 8 months) @ Rs.3/kg	Rs.	960-00
b)	Sorghum flour 256 kg (8 kg/week for 8 months) @ Rs.10/kg	Rs.	2560-00
iv)	Cost of labour for feeding 60 days (2 hr/day for 8 months) @ Rs.30/day	Rs.	1800-00
v)	Cost of harvesting 16 labour @ Rs. 40/day	Rs.	640-00
vi)	Transport cost and packing material	Rs.	3000-00
	Sub total	Rs.	9310-00
Fixed cost			
	Amortised farm pond cost (based on 5 years life)	Rs.	1600-00
	Total cost		**Rs. 10910-00**
B. RETURNS			
	Yield 2250 kg @ Rs. 20/kg		**Rs. 45000-00**
C. NET RETURNS			**Rs. 34090-00**

Note: For farm ponds which can store harvested rain water for 4-5 months and/or having facility for supplementary water from another source

3.2.4.2 Cost and benefits from farm ponds for supplementary irrigation:

One farmer in Anantapur, who had dug an unlined farm pond, sowed 2 ha of land with groundnut during early rains. But there was poor germination due to soil crust formation. From the water collected in the farm pond during the May and July rainfall, he could irrigate one hectare of groundnut crop.

This resulted in crust breaking and good germination of the crop, and a harvest of 1050 kg/ha yield from the supplementary irrigated plot as against 525 kg/ha from the plot for which no irrigation was provided. The cost and benefits towards supplementary irrigation to the groundnut crop are given in Table 3.4. One light irrigation for crust breaking resulted in additional net income of Rs. 5375 per ha, which is almost double the income as compared to the plot without supplementary irrigation.

Supplementary irrigation from farm pond to groundnut crop using sprinklers in Anantapur

Table 3.4 Cost and benefits of supplementary irrigation from unlined farm ponds for crust breaking in a groundnut crop on sodic soil.

Size of Farm Pond	:	10x10x2.5 m	
Cost of the Farm Pond	:	Rs. 8000/-	
Total area under the crop	:	2.00 ha	
Area irrigated from farm pond	:	1.00 ha	
A. COST		(per ha)	
Additional cost for giving supplementary irrigation (hiring cost of sprinkler and pump set, diesel, etc.)		Rs.	400-00
B. FIXED COST			
Amortized farm pond cost (based on 5 years life)		Rs.	1600-00
Total cost		Rs.	2000-00
C. RETURNS			
Additional yield			525 kg
Additional returns		Rs.	7375-00
NET RETURNS		Rs.	**5375-00**

Another farmer, who had a lined farm pond in his field, also took advantage of the runoff water by providing supplementary irrigation to his groundnut crop. The farmer took up early sowing of the groundnut crop taking advantage of the May rains and provided supplementary irrigation through sprinklers during pod formation stage using the water collected in the farm pond during July rains. This farmer would have reaped substantial benefit from the farm pond but his crop was badly damaged by wild pigs from nearby hillocks, which caused a loss of 70% of the expected yield (nearly 1000 kg/ha).

3.2.4.4 Check dam

The check dams are highly capital intensive and cost around Rs. 1,00,000 as they are masonry structures built with sand, cement and stones to withstand the force of runoff water during rains. The check dams were mainly used to recharge groundwater, provide drinking water for animals, for washing clothes, etc. All the check dams constructed in the project sites resulted in prevention of runoff and also helped in recharging the groundwater. Although the benefits cannot be quantified, the duration of availability of water for pumping in the tube wells has increased by 1 or 2 hours. There is perceptible increase in the groundwater levels due to the check dams. In Tumkur and Anantapur clusters, the water retained by the check dams helped the washer men. The washer men could increase income. Earlier they used to spend time searching for water.

3.2.4.5 Trench-cum-bund

Soil accumulation in the trenches prevents soil loss from the fields. Besides this, the water in the trenches helped in better establishment of planted trees and grasses on the bunds along the trenches. These benefits could not be directly quantified due to short duration of the project.

3.2.5 Synthesis: water harvesting

- The AL tool (see Section 3.1.1.1) created awareness and interest among farmers about soil and water conservation measures. This change in their attitude was helpful in promoting NRM related interventions.
- The exposure visits to different land and water development programmes (at CRIDA farms, BAIF centres and Anantapur) were very effective in building confidence among farmers and bringing change in their attitude towards conservation programmes. They readily accepted to have farm ponds, trench-cum-bunds, check dams and gully plugs in their fields with suitable vegetative cover. The farmers in Anantapur cluster wished to have lined pond after visiting Regional Research Centre of the State Agricultural University at Anantapur. They reaped the benefit of stored runoff water in lined pond and gave supplemental irrigation to save drought-affected groundnut crops. The unlined ponds helped in recharging groundwater.
- The interest of farmers in farm pond construction was stronger than expected by the project staff. The technology has been available and promoted for over a decade in the past but with limited uptake. The exposure visits, availability of funding and increasing occurrence of drought in recent years could all have contributed to the better uptake in this project. This highlights that uptake of a technically viable intervention is dependent on the context in which the farmer operates.
- In two communities (Pampanur in Anantapur and Zamistapur in Mahabubnagar), the villagers could find ways to use CPRs (temple land and tank bed, respectively) for the benefit of a poor landless family and landless women. This

process is unconventional and brought a change by increasing the livelihood opportunities for three needy families. Promoting agro-forestry in CPR and degraded lands has started the process of changing them to productive lands. The facilitation of this process by the SS was very much effective.

- Participatory monitoring of groundwater created awareness among the villagers on the depletion of groundwater resources. One outcome is that a farmer in Chowderpalli village switched from paddy to irrigated dry (ID) crops for arresting the depletion of groundwater.

3.3 Soil fertility related interventions

3.3.1 Introduction

Soils of the Indian semi-arid tropics (SAT) are poor in fertility due to their inherent properties traceable to their origin and formation, and are exposed to degradation due to unfavourable climate and inappropriate use. They are low in organic matter and deficient in nitrogen, phosphorus, sulphur and zinc (Srinivas et al., 1999). While privately owned lands can be impoverished by poor management, common lands degrade due to overexploitation, resulting in unproductive soils, consequently leading to declining livelihood support. In the project, it was hypothesized that this situation could be prevented or reversed by promoting sustainable use and management of soils in both PPRs and CPRs, which would eventually lead to improved livelihoods of the people dependent on them. This hypothesis is also based on the findings of an earlier project (NRSP R 7974, 2002) which showed that farmers of the Indian SAT have an active interest in managing their soils, and that there are markets for organic matter, from which poor people can benefit.

Improvement in the organic matter status of the soils was construed as a generic solution to the problem of poor soil fertility. Although soil samples from several farmers' fields were tested, there was no specific attempt to correct nutrient deficiencies through strategic fertilization, because chemical fertilizers are expensive and unlikely to be used by poor farmers. The major approach used in the project to improve the fertility of the soils was to promote biomass yielding tree species. The biomass produced in PPRs could be used as fodder and as organic manure for soil application, while in the CPRs, it could be used as fodder for livestock and for composting. . The manure/compost produced by the landless, using inputs drawn from the CPR plantations, could be sold by them to landowners and used to improve the fertility of the PPRs, while the fertility of the soils of the CPR lands would be improved by the trees planted and raised on them. This approach is schematically shown in Figure 3.2 below. Other approaches were introduction of legumes in the cropping systems, promotion of bio-fertilizers and soil test based fertilization, where nutrients are used in excess of the crop requirement.

The cluster-wise achievements relating to these approaches except introduction of legumes in the cropping system, which is discussed under Output 3 (see Section 4.3.3.1.3) are described hereunder.

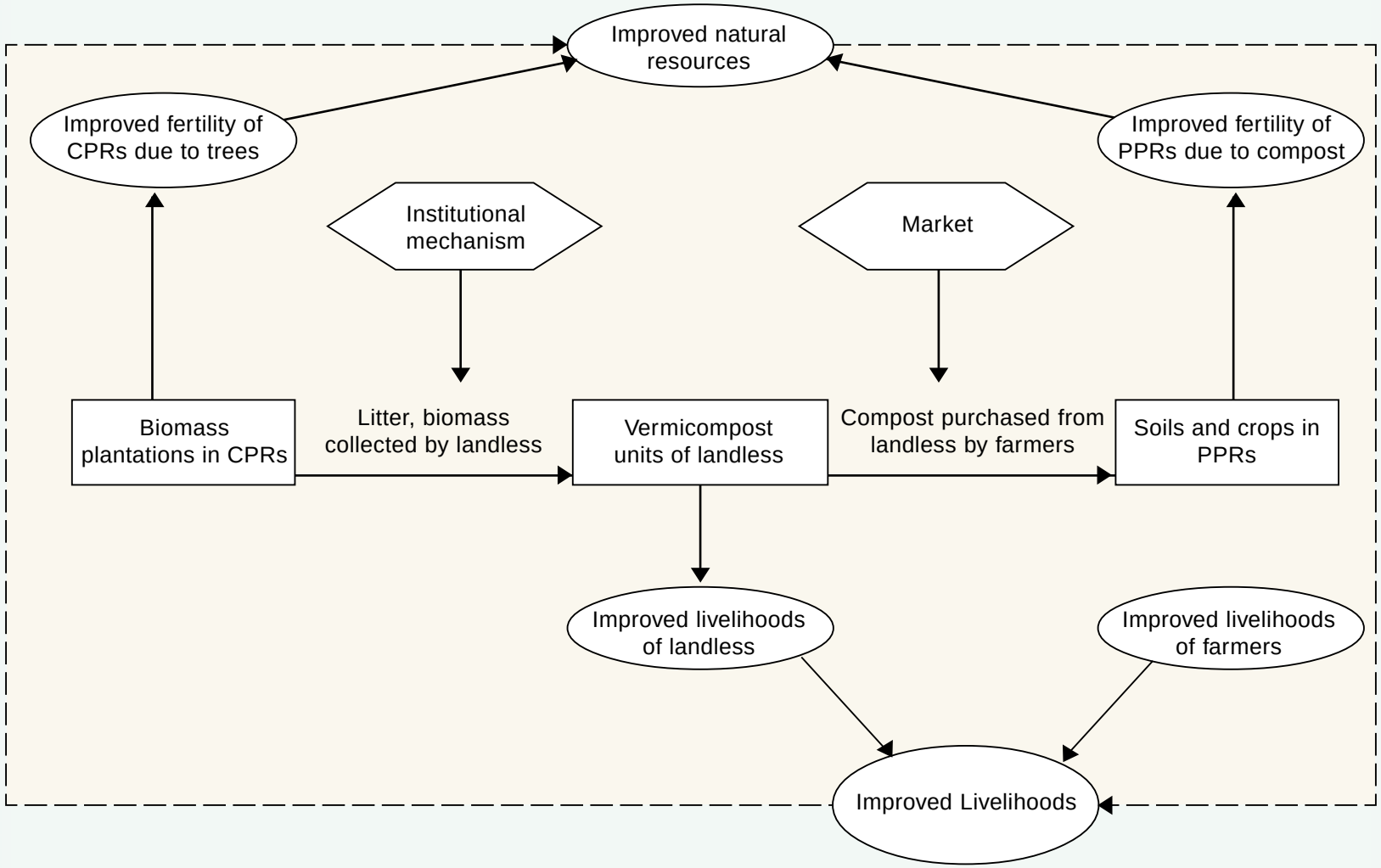


Figure 3.2 A framework for improving natural resources and livelihoods through biomass plantations and vermicomposting.

3.3.2 Anantapur cluster

3.3.2.1 Biomass plantation

In September 2003, 62 families from the three villages in the cluster took up plantation of around 2300 mixed seedlings of neem, pongamia, custard apple, casuarina, eucalyptus, gliricidia, etc., in their backyards and fields. Women played an active role in the plantation. The following year, on world environment day (5 June 2004), with the active involvement of the SS members, a plantation programme was taken up in the temple endowment land at Pampanur that was converted into CPR. About three hundred people participated in the programme and 250 seedlings of soil improving green manure yielding, leguminous tree species, [gliricidia (100), sesbania (25), pongamia (100), dalbergia (25)], along with 85 mango, 25 emblica and 25 casuarina seedlings were planted. A landless person was appointed to take care of the plantation, thus creating a livelihood opportunity for his family. As the trees grow, the soil of the temple lands will improve. Green biomass is expected to be available for livestock and composting. Biomass plantations were also taken up in the trenches of trench-cum-bunds. The perception of the farmers is that the survival of the saplings is good. Harvestable biomass from the trees could be expected from 2006 onwards.

3.3.2.2 Vermicomposting

Vermicomposting was proposed as an income generating activity for the landless, but the SS members opined that landless people might not be able to find a market for the product. The SS proposed that the activity be given to small and marginal farmers, who would have the option to sell the compost or to use it on their own farms. The SS identified 12 small and marginal farmers for vermicomposting. The project supported the construction of vermicompost tanks and supply of earthworms, all of which cost up to Rs. 2000 per unit. Three farmers constructed cheaper vermicompost units on their own. The participating farmers successfully produced between 100 to 500 kg of vermicompost, mainly using cattle and farmyard waste. Since the raw material used for composting was from the participating farmers' own farms and households and the labour was their own (roughly about an hour a day), there was no paid-out cost in the production of vermicompost. The farmers produced and applied the vermicompost to their crops, which included groundnut, papaya and other horticultural crops.

The farmers noted bigger size of groundnut pods when compost was applied in their fields. The farmers felt that the compost produced was insufficient to meet the requirements of their farms. The vermicompost units promoted in the project were intended to expose the participants to the technique of vermicomposting, and not to produce enough vermicompost to meet the requirements. The size of vermicomposting unit would need be optimised to suit the farmers' requirements and resources.

3.3.2.3 Soil testing and advice

From each of the three villages in the cluster, soil samples from 20 farmers' fields were collected and tested at ICRISAT. Soil test based fertilizer recommendations were provided. The soils were acidic to neutral in pH; non-saline; medium to high in potassium; low to medium in organic matter, nitrogen and phosphorus; and low in sulphur, zinc and boron. It was found that some farmers were applying more than required phosphorus to groundnut crop. Simple experiments were conducted on eight farmers' fields to demonstrate the usefulness of soil test based fertilizer application, which not only reduced the cost of fertilizers by Rs. 110 per hectare but also increased the pod yield of groundnut by 200 kg per hectare (Table 3.5).

Table 3.5. Comparison of farmers' practice and soil test based fertilization.

Fertilization	Fertilizer applied (kg/ha)		Cost of fertilizer (Rs/ha)	Pod yield of groundnut (kg/ha)
	Diammonium phosphate	Muriate of potash		
Farmers' practice	62.5	62.5	825	2111
Soil test based	50.0	62.5	715	2311

3.3.3 Mahabubnagar cluster

3.3.3.1 Biomass plantation

In 2003, before the start of the monsoon, farmers in the cluster were explained the benefits of growing green biomass yielding trees on field bunds and boundaries. The farmers showed little interest and no plantation was undertaken except on a small piece of PPR wasteland in Chowderpalli village, where 100 leucaena saplings were planted. After soil and water conservation work began and trench-cum-bunds were laid, farmers showed more interest in planting trees in the trenches. 5140 seedlings of teak, cassia, dalbergia, leucaena and gliricidia were planted in farmers' fields and backyards in Chowderpally and Bukkalonipally villages in 2004. The saplings were sourced from the nursery units promoted in the project (see Section 4.3.5). Biomass plantation was also taken up in the tank bed CPR of Zamistapur, where 350 gliricidia and 350 pongamia seedlings were planted in trenches around the boundary on three sides of the land allotted to the two women entrepreneurs.

3.3.3.2 Vermicomposting

In this cluster too, the SS's inclination was to select only farmers for vermicomposting, but the project team was keen to promote the activity among the landless to see whether they can successfully produce vermicompost and sell it. The SS indicated that it would be a good idea to select landless persons owning cattle, so that availability of raw material for compost would not be a constraint. Vermicomposting was readily accepted and adopted in the cluster, where it was promoted among small and marginal farmers as well as landless with cattle. Eighteen units (14 farmers and 4 landless cattle owners) were established in the cluster initially. Five more farmers came forward to take up the activity and they were supported by the project, taking the total number of participants to 23.

Vermicompost unit at Chowderpalli in Mahabubnagar

The participants successfully produced 2–3 batches of vermicompost and applied it to their paddy, fruit and vegetable crops. Venkatamma, a small farmer of Zamistapur village, produced 4 quintals (1 quintal = 100 kg) of vermicompost. She used two quintals on her own farm, sold one quintal to the project, and sold one quintal to another farmer at a price of Rs. 3 per kg.

The farmers who applied vermicompost to vegetable crops reported better crops. All the landless participants and some participating farmers felt that there was no internal market for vermicompost in the villages, and therefore stopped producing it. Thus, promoting vermicomposting among landless people appears to be unsustainable unless external markets are explored and market linkages are established.

3.3.3.3 Biofertilizers

The farmers were not aware of the use of bio-fertilizers. An effort was made in the project to create awareness among them regarding the use of bio-fertilizers. The potential benefits of bio-fertilizers were explained to the farmers and the methods of their use were demonstrated. Subsequently samples of bio fertilizer were provided to farmers, but they showed very little interest in using them on their crops. Recognising that this might be due to the unfamiliarity of the farmers with bio-fertilizers, in 2004, simple field experiments were laid out in farmer's fields to allow to assess the benefits of bio-fertilizers. However, due to the poor monsoon, the crops failed and the objective was not fulfilled.

3.3.3.4 Soil testing and advice

Soil samples were collected from 20 farmers' fields in each of the four villages and analysed at ICRISAT. The analysis revealed that soils are acidic to neutral in pH with a few samples being alkaline; non-saline; medium in potassium; low to medium in organic matter, phosphorus and zinc; and low in nitrogen, sulphur and boron. The results of soil analysis and generalized fertilizer recommendations were provided to the farmers. Demonstration experiments, one in each of the four villages, with improved varieties, soil test based fertilization, use of vermicompost and bio-fertilizers were planned in 2004 in a maize-pigeonpea intercrop, but due to the poor monsoon, the experiments could not be carried out.

3.3.4 Tumkur cluster

3.3.4.1 Biomass plantation

Mass plantation involving the community was taken up during 2003 and 2004 by creating awareness among the people regarding the potential benefits of planting and growing trees in PPRs and CPRs. The planting was done for two years and 49,000 seedlings were planted, 36,000 in PPRs and 13,000 in CPRs. The nursery units promoted through the project (Section 4.3.5) supplied 4200 seedlings of gliricidia and 1800 seedlings of cassia for the Green Festival. The plantation process was institutionalised by celebrating the planting programme as '*Hasiru Habba*' (Green Festival). The species planted were jointly chosen by the village community and the project team and included casuarina, silver oak, gliricidia, leucaena, pongamia and teak, and a diverse group of species each with its own specific utility such as fodder, timber, green manure, aesthetic value, etc. Existing self help groups (SHGs) in the villages were active in the plantation and at present they are taking care of the seedlings. Biomass plantation was also taken up in the trenches of trench-cum-bunds (TCB) @ 120–160 plants per ha of different species. An average of 85% survived.

3.3.4.2 Vermicomposting

In Tumkur cluster also, vermicomposting was identified as a potential livelihood activity for the landless, but as per the suggestion of the SS, only small and marginal farmers were

selected for the intervention. Nine units of vermicompost were initiated and all the participating farmers successfully produced a total of 1650 kg of vermicompost. The farmers applied the vermicompost to chilly, tomato, coconut, and other commercial crops in their farms and were unwilling to sell the compost to others although the price of vermicompost in the market was Rs. 2.50 per kg. Mr. Shanthaveerappa, who applied vermicompost to gherkin, tomato, chilly and napier grass reported an estimated 25% increase in the yields of these crops with vermicompost. The vermicomposters were selling earthworms at a price of Rs. 250 per kg to others, who were intending to start their own vermicomposting units. Farmers with cattle are finding it easier to produce vermicompost because of the availability of cow dung, which is a key input in vermicomposting.

The activity was a big hit and many farmers started vermicomposting on their own, using the cheaper pit method (the method promoted in the project was the tank method). As the farmers themselves were multiplying the earthworms and sharing the earthworm culture, there was no need for external supply of the worm culture. Farmers with vermicompost units cut down their chemical fertilizer use.

3.3.4.3 Soil testing and advice

Soil samples were collected from 42 farmers' fields in the cluster villages and analysed at ICRISAT. The soils are acidic to neutral in pH; non-saline; medium in potassium; low to medium in phosphorus with a few samples being high; and low in organic matter, nitrogen, sulphur and boron. The results of soil analysis and nutrient recommendations were provided to the farmers.

3.3.5 Synthesis: Soil fertility related interventions

Four activities were taken up in the project to maintain/improve soil fertility in the target areas – biomass plantation, vermicomposting, soil testing and advice with soil test based fertilization in Anantapur, and legumes in the cropping system and bio-fertilizers in Mahbubnagar.

Biomass plantation was promoted in all the three clusters, and participants were encouraged to plant multipurpose biomass yielding plants in both private and common lands. Biomass plantation yielded more success in Tumkur cluster, where it was institutionalised as a green festival, and it is therefore likely to be continued in the future. This success is a testimony to BIRD-K's strong advocacy and leadership in the area of tree growing and village greening and demonstrates the community mobilization that can be achieved. In Anantapur, biomass plantation was taken up in temple endowment land and in private lands. In Mahabubnagar, people's response to biomass plantation was lukewarm initially, but once soil and water conservation measures were implemented, farmers took up plantation in trenches of TCBs. The nursery units promoted in the project had a positive influence on the plantation activity.

Although it was hypothesized that biomass could be generated on CPR lands and utilized by the landless for improving their livelihoods and the fertility of the private lands through, e.g., the production and sale of vermicompost, this did not happen to any significant extent. This was primarily due to the absence of large areas of common land in the project villages, which became a common phenomenon, due, among other reasons, to the government's policy of distributing land to the landless.

In all three clusters, some plantation did take place on common lands. Temporary arrangements for access to the CPR land and care of the trees (SHGs in Tumkur, landless person employed in Anantapur and poor women cultivating the tank bed in Mahabubnagar) but no regulatory mechanism for long term care and maintenance of the CPR or usufruct rights was instituted through the project.

Once the field crops and trees begin to yield economic products, the need for a regulatory mechanism would become evident. Had the project been of longer duration, and/ or more CPRs been available for the poor to access, situations warranting a regulatory mechanism would have arisen. Due to the short duration of the project, and the scarcity of productive CPRs, the issue did not justify being made a primary focus of project support.

Vermicomposting was promoted in all the three clusters. Initially, the activity was intended for the landless, but considering the non-availability of CPR lands and the concern of SS regarding the lack of market for vermicompost within the villages, the SS in Anantapur and Tumkur directed the activity towards land owning farmers. In Mahabubnagar, project staff negotiated with the SS to include four landless cattle owners among the participants. While the farmers produced and utilized vermicompost on their own farms, the landless had problems disposing of their product and they stopped producing the compost. Vermicomposting was more successful in Tumkur cluster where farmers were growing commercial crops, which could give better returns on the money and labour invested for vermicompost production and application.

Through the continuous interaction between the cluster communities and project staff during intervention planning, implementation and evaluation, the agreed interventions represent the outcome of the combined knowledge of project staff and the indigenous (technical) knowledge of the community members. Specific examples are the advice of the SS not to prioritise the landless poor for vermicomposting, adaptation of vermicompost method to pit composting; the use of farm ponds for fish farming, the uptake by farmers of biomass planting on TCBs.

3.4 Key learnings

- The farmers responded well to extension messages. They were willing to take up technological interventions for sustainable use of NRs, if convinced about their usefulness.
- The exposure visits and farmer-to-farmer interactions played an important role in changing the mindset of farmers.
- The rainwater harvesting structures were capital intensive and need external funding for their adoption through government programmes and others forms of support.
- Participatory groundwater level monitoring is a tool with potential to be used by communities to assist their water management. Any further support to its use should assist its institutionalisation and application within the community structures [PRI, SS, User Groups (UGs)].
- All the technological interventions of rainwater harvesting and soil conservation had beneficial effects as perceived by the farmers, but they could not be quantified due to short duration of the project.
- CPRs, wherever available, can be made accessible to the poor through dialogue with the concerned PRIs and the village communities. However, the extent of the contribution that CPRs can make to improving the livelihoods of the rural poor is uncertain in the project areas

because of the scarcity of productive CPRs.

- By properly interacting with and convincing the village community, PPRs can also be used as CPRs for construction of check dams, etc., which will benefit the farmers.
- Bunds and biomass plantations have a functional and interdependent relationship. The formation of bunds creates the scope for biomass plantation and the plants strengthen and stabilize the bund. The two should be promoted together.
- Vermicomposting is not always an appropriate livelihood opportunity for the rural poor. It is likely to be more successful in locations where large areas are planted to fruits, vegetables, flowers and other commercial crops that create a demand for compost. In such areas, even landless persons can take up vermicomposting to meet the demand from the farmers, possibly even through a purchase contract.
- When the output of an activity is a saleable commodity, such as vermicompost, nursery seedlings, the activity should be promoted only after scoping for markets. In other words, the activity should be preceded by a market linkage, preferably a forward market arrangement.
- A group of people within the village, already existing or newly formed (e.g., the SS), should be identified for implementation of development activities during and after project/programme support. The beneficiaries of the development activities should contribute to the groups by creating a fund and carrying forward the activities. The group and the fund available with them should be made accountable to the participants and the whole village community. This arrangement can significantly enhance post-project sustainability of activities.

References

CRIDA. 1997. *Vision – 2020 CRIDA Perspective Plan*. Hyderabad, India: Central Research Institute for Dryland Agriculture,.

Srinivas K., Vittal KPR and **Sharma KL**. 1999. "Resource characterization of drylands soils". *in Fifty Years of Dryland Agricultural Research in India. Hyderabad, India:* Central Research Institute for Dryland Agriculture. PP 41–55

All India Coordinated Research Project for Dryland Agriculture. 2003. *Annual Report 2002–03,* Hyderabad, India: Central Research Institute for Dryland Agriculture.

Section 4

Farming System Diversification and Enterprise Promotion

4.1 Introduction

Traditionally the farmers were growing crops such as sorghum, pigeonpea, castor, finger millet and groundnut under rainfed conditions depending upon the quantum and distribution of rainfall in the specific areas. Depleting natural resources (NRs), labour scarcity during peak periods of farm operations, socio-economic and cultural conditions force farmers to diversify the existing cropping systems (Singh et al., 1999). The diversified cropping systems are also emerging due to the changed dietary pattern from millets to rice over the past two decades, quick and timely availability of the seed material, a reduced irrigation source due to the increased incidence of poor monsoons, and the demands of the local markets. Rice is available at highly subsidized rates in Public Distribution System. The nearness and presence of poultry feed firms near Mahabubnagar enthused the farmers to grow maize, as sale in the local market is a viable option.

The livestock production systems in the selected clusters are based on the availability of crop residues, grazing resources, and low opportunity cost of family labour. The traditional production system rapidly underwent change in recent years. Although the organization of livestock production in small units persists, household production systems are increasingly getting integrated into input as well as output markets (Misra et al., 2004). Because of gradual transition from subsistence to marketisation, the economic dimensions of livestock keeping assumed increasing significance in household behaviour. The growing pressures of human as well as livestock population on land and NRs, crop residues and grazing lands have increasingly become a binding constraint. Changing consumption pattern, increasing incomes, growing urbanization and population growth are likely to influence the demand for food of animal origin. Consumers in urban areas have more options to diversify their diets and are, therefore, likely to consume more meat and milk products. The occurrence of frequent droughts due to monsoon failure has also made the farmers to have livestock enterprises to support their income. Besides, the crop diversification to grow produce suitable to livestock such as paddy straw and maize created a conducive atmosphere for raising dairy animals. These changes bring both opportunities and challenges for the farming and livelihood systems in the region. NR-based livelihood diversification and enterprise interventions, if appropriately designed and introduced, can improve the stability and sustainability of NR-based rural livelihoods.

4.1.1 Rationale of Output III

The changes in the quantity of rainfall received and in its distribution pattern at the project location are leading to intermittent droughts during the crop period resulting in crop failures. This is further aggravated by the poor yield potentials of the prevailing crops and local cultivars. Both agricultural drought and the poor yield potentials of the crops can

be managed by increasing the awareness of the farmers about improved farming practices, the improved cultivars of crops and cropping systems.

In the project sites, irrigated crops, mostly paddy, are grown during *rabi*. With low groundwater levels due to poor monsoons, farmers reduced the area under paddy and other irrigated *rabi* crops leaving fields fallow during *rabi* and consequently reducing the land productivity per unit area. By introducing Irrigated Dry (ID) crops such as chickpea, maize and fodders, the productivity per unit land area and per unit of irrigation water can be increased.

Livestock is also an important component of farming systems in the project area as elsewhere in India, and livestock production offers opportunities for improving the livelihoods of the rural poor. Traditionally, livestock rearing has been closely integrated with crop production. Livestock supports livelihoods of the poor in many ways:

- source of food, and the livestock owning populations are expected to consume more of milk, meat and eggs than others
- an important source of cash income for the poor. Livestock products such as milk and eggs are easily sold on a regular basis
- an important renewable natural resource. The resource can be accumulated through natural reproduction in times of plenty and can be sold in times of crisis
- an important source of draught power for cultivation, and transport for inputs and outputs
- the source of dung-manure for soil fertility maintenance in the mixed farming system
- a cushion against income shocks arising due to crop failure. This function assumes significant importance in drought-prone areas
- fuel for cooking for the poor household.

Rearing of milch animals provides supplementary income to over 70% of rural households. Milk production contributes on an average 27% of the household income; its contribution varies from about 19% in the case of large farmers to about 53% in the landless category in India (Shukla and Brahmankar, 1999). Apart from the monetary benefits provided by milch animals, small ruminants such as goats and sheep serve as a lifeline during drought years by providing income and sustenance. This is especially true for areas like Anantapur and Mahabubnagar where in drought years the problems of water scarcity are multiplied by the low fertility of the soil. Such regions tend to have a large number of small ruminants, which are not dependent on crop residue for fodder and are able to more easily migrate to areas where edible vegetation is available in common grazing lands. Backyard poultry is also, in many cases, an important source of supplemental income for small and marginal farmers.

Technologies to improve livestock productivity and its contribution to the livelihoods of the rural poor do exist: however, the rate of adoption of livestock-related technologies in smallholder mixed (crop-livestock) farming systems worldwide is consistently low (Francis and Sibanda 2001; Parthasarthy Rao et al., 2005). In order to solve this problem, approaches that guarantee effective linkages among researchers, NGOs, extension workers, decision-makers and farmers, who have a complex knowledge base and widely dispersed expertise, are needed (Misra et al., 1997; Conner et al., 1998; Reddy et al., 2005). Since members of farming households have access to most of the vital information, the local circumstances, culture and real goals of farming, they appear to be better equipped than outsiders to optimally design their farming systems. This implies that any interventions in smallholder crop-livestock systems should be properly tested and gradually introduced, focusing on economic viability and social acceptability.

For all interventions of farming system diversification and enterprise promotion, emphasis is placed on farmer-led, farmer-to-farmer extension, with volunteer farmers serving as resource persons. This strategy serves to empower the farmers so that they can select and adapt technologies most appropriate to their agro-ecological and socio-economic situations. This adaptation to suit their situation is expected and encouraged, facilitated by project staff-farmer and farmer-farmer discussions about the possible interventions.

For this purpose, exposure visits and dialogue are used as a guiding principle, involving open discussion among farmers, NGO workers and researchers. Apart from this, focused group discussions and diagnostic surveys are undertaken in order to obtain full information at various stage of implementation. Making available several intervention options allowed the farmers to choose what was most appropriate in their circumstances. All stakeholders benefited from each other's accumulated experiences, skills and observations, resulting in the socialisation and sharing of knowledge.

Through these livestock and crop-based interventions to improve the rural poor livelihoods, it was hoped to reduce the seasonal urban migration which many of the cluster farmers practice. When the drought situation prevails continuously for 4–5 years, migration to cities takes place by small and marginal farmers and landless poor. Increasing livelihood options based on local resources by diversifying and introducing less risky enterprises can reduce this migration.

For ease of compilation, reporting in the remainder of this section is structured largely by main activities such that crop related issues are contained in the Section 4.3, with most livestock interventions in the Section 4.4. This hides the project reality of multi-and inter-disciplinary teamwork in the field with both crop-based and livestock-based interventions integrated within land use systems and enterprise diversification.

4.2. Farming system characterization

The initial PRA in each village was designed to elicit information and understanding about the local farming systems (Section 2). Where further information or clarification was needed, subsequent and focused PRAs were carried out (Section 4). The characterization of the farming systems guided the planning and implementation of all interventions (See Sections 3, 4 and 5).

In Anantapur cluster, agriculture + cattle is the dominant farming system. The scarcity of fodder during summers suggested that an appropriate intervention could be cultivation of fodder, with farmers choosing whichever fodder crop they liked to grow. Consequently, farmers realize the gaps in managing livestock and they grow fodders for lean/summer season. In Mahabubnagar cluster, the dominant sheep based farming system, suggested the "Silvipasture system" of pasture-based interventions as an alternate and supplementary land use in addition to their shepherding. This enables the shepherds to be self-reliant during drought. Agriculture dominates the Tumkur cluster farming system: consequently, varied options of cultivars, vermicompost application, etc., were offered.

In all clusters, issues of livestock productivity, livestock feed and livestock health arose from the PRA and farmer resource groups. Interventions on each of these issues seemed to be relevant.

4.3 Diversified Farming

The crop-based farming systems interventions carried to achieve project Output 3 are presented cluster wise. Under each cluster, crop interventions are discussed first, followed by alternative land use systems (Section 4.3.2-4.3.4). Other non-crop based diversification options (forest nurseries and

bee keeping) are presented in Section 4.3.5–6). Livestock-based interventions are presented and discussed in Section 4.4.

4.3.1. Process: alternative land use systems and enterprise diversification

Climatic and soil conditions, prevailing crops/cropping systems, local/improved cultivars of each cluster and issues of concern to the farmers were brought out through PRA. (Table 2.5). Two to three meetings and interactions with groups of farmers after the PRA [but without the *Salaha Samithi* (SS)] to discuss with them the available interventions and find out their interest did not result in farmers committing themselves to any of the interventions. This is because many are shy to share their experiences/problems in the group. Consequently, the interventions were not carried to the fields.

Ground interventions such as introduction of improved varieties or crops during *kharif* or *rabi*, individual interaction with the farmers were found to be helpful. One-to-one interaction gave the specialists insight into the real individual situation and the constraints. It has enabled the farmers and, importantly, the household women who were usually absent from the public meetings, to understand the practices of the proposed intervention – its potential and limitations, including the source and availability of seed, and the marketability and market location of the produce.

The crop interventions were carried out at individual farm level in Anantapur and Mahabubnagar clusters. In Tumkur, the farmers preferred laid out interventions as a trial-cum-demonstration on the farm of one interested individual. The farmers suggested this approach rather than many individuals testing the interventions separately as they were apprehensive about crop failures. The project had no compensatory mechanism for crop failures. Even so, at individual farm level, every farmer was informed and trained about the practices. For promotion of enterprises as livelihood options for landless poor, discussions were held with the target groups and the SS members. Training and exposure visits to livestock farms and training centres at Tumkur cluster were arranged to hone skills for handling the enterprises such as nursery raising and ethno-veterinary practices.

4.3.2 Anantapur Cluster

The soil is red sandy loam with black soil in some patches (Table 2.1). The soil depth is approximately 30 to 50 cm with moderate nutrient status. As per Vittal et al., (2003), the general recommendation for groundnut is 20-40-40 N, P_2O_5 and K_2O kg ha^{-1}. If the soil test value is medium or moderate, 50% of recommended nutrients may be applied. Average rainfall is about 520 mm and the rainy season starts from April and ends in December with a peak rainfall between September and October. The major crops grown in this area are cereals (sorghum, paddy), pulses (green gram, horse gram, red gram, and cowpea) and oilseeds (castor, groundnut). Papaya is a commercial crop as is groundnut, the most extensively cultivated crop of the cluster. Pigeonpea, cowpea and castor are grown as intercrops ranging from 8:1 to 20:1 proportion.

4.3.2.1 Crop Interventions

4.3.2.1.1 Introduction of improved varieties

Improved varieties were introduced in place of existing local cultivars to realize the potential and excellence over the performance of existing ones. A variety called Vemana (K-134) in groundnut was grown in seven farmers' fields, ML-267 in green gram and SPV-462 in sorghum were introduced and their performance evaluated (Table 4.1).

Table 4.1. Average productivity and yields of improved cultivars of crops in Anantapur cluster.

Crop	Existing cultivar		Recommended cultivar		
	Name	Average productivity (kg ha^{-1})	Name	Average productivity (kg ha^{-1})	Yield % increase over local
Groundnut	TMV-2	800–900	Vemana (K-134) (7 farmers)	1200	50
Castor	Kranthi	314	Kranthi (Research station seed) (41 farmers)	430	37
Pigeonpea	LRG-30	150	LRG-30 (Research station seed) (41farmers)	250	67
Green gram	Local	356	ML-267	410	15
Sorghum	Local	1100	SPV-462	1400	27

(Source: Project experimental plots; figures in parentheses are number of farmers)

Introduction of improved cultivars on an average increased the yields by 15–30%. Cultivation of groundnut (popular variety of TMV-2) in this cluster costs around Rs. 8310/-ha^{-1} (with family labour not factored in) and the gross returns from Rs. 11000/- to 14400/-ha^{-1}.

4.3.2.1.2 Seed cost reduction in groundnut cultivation through use of shrivelled seed

Anantapur cluster is dominated by monocropped groundnut, which is also intercropped with pigeonpea, cowpea and castor at 20:1, 8:1 and 8:1 , respectively.

The groundnut seed is expensive and seed per unit area is high because of the seed boldness. About 100 kg kernels ha^{-1} costs around Rs.3000/ha. Generally, the farmers store the previous year's seed (variety TMV-2) for the coming season, but during continuous drought years, the small and marginal farmers are forced to sell the entire crop without retaining the produce for seed purpose. Besides, local production of bold seed is less. The seed from any other source is costly and often not available(Reddy, T.Y., personal communication). Therefore, promoting shrivelled seed as a substitute for the bold seed may help farmers, because of the inexpensive seed cost (25/-kg^{-1}) and lower seed rate (85 kg ha^{-1}). Eight male farmers tried this technology and their average yields obtained using shrivelled seed are given in Table 4.2, which also shows that the use of shrivelled seed has given almost equal yield as compared to using assorted/bold/medium bold and small seed. Rs. 2300/- per hectare (cost of bold seed is Rs. 3500/- per hectare) was saved without affecting the yields. This technology was promoted especially to the small and marginal farmers to save the seed cost.

Table 4.2: Effect of seed size on growth and yield of groundnut in Anantapur cluster (No. of farmers:8)

Category of seed	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Cost of seed (Rs. ha^{-1})	Net returns (Rs. ha^{-1})
Assorted	1097	2135	3125	6105
Bold	1180	2302	3500	7032
Medium	1169	2229	2300	8014
Small	1001	1801	1440	7100
Shrivelled	987	1958	1200	1211
SEm ±	105	89		
CD 5%	NS	267		

The farmers were forced to adopt this technology during drought years, even though priority was given to bold seed only.

Although micro-credit is burdensome during drought, it might help farmers to procure bold seeds.

Further, some improvements in the existing intercropping were advocated. For example, pigeonpea is generally grown with groundnut at 8:1 to 20:1 proportions. Increasing the pigeonpea rows could improve the yield even under drought conditions. Pigeonpea is one of the major pulse crops.

4.3.2.1.3 Fodder production

Commercial crops and orchards are the priority crops. Moreover, the initial project PRA was conducted when green fodder scarcity would not be felt due to its availability in plenty at that time. The necessity for fodder arises during *rabi* when the rainy season ends, and the green fodder availability cease. At that time, whatever little irrigation source is available may not suffice to grow a paddy crop, which yields fodder as well as grain. Some farmers feed nutritious fodder of groundnut haulms to only 1 or 2 animals. Therefore, the livelihood strategy is to purchase animals during rainy season because of fodder availability and sell them during summer season because of fodder shortage, when the farmers may migrate away. Further, the daily milk yields realized from local breeds are low (1–2 L/cow). If green fodder was available during *rabi*, cattle sales and human migration might be reduced, milk yields could be increased and the farmers' livelihoods could be improved. Therefore, the idea of fodder production was introduced to the farmers to encourage productive livestock management even during *rabi* and summers.

To overcome all these problems, it was proposed to introduce Napier hybrid CO 1, which is a highly nutritious perennial and multi-cut fodder, under irrigated conditions in a smaller area alongside the farmers' priority of their staple crop of paddy under irrigated land. However, many farmers initially refused to spare their land. One women farmer came forward to take up Napier planting in her field. She was supplied with the cuttings for 1/10th of an acre, which she grew successfully and started feeding to her milch animals.

Woman farmer showing her fodder crop, Anantapur

This has resulted in increased milk production and quality of the milk (Case study-1; Section 6.4). Consequently, more farmers came forward to take up fodder cultivation. About 60 farmers representing all socio-economic classes grow CO1 fodder. The yield and economic benefits accrued from growing fodder is furnished in Table 4.11. The seed material (cuttings) was shared freely among the fellow farmers – a unique phenomenon. Two farmers increased the fodder cultivation area from 0.02 to 0.2 hectare owing to increased milk yield and they also purchased additional milch animals.

Farmers opined that fodder from 0.12 hectares and staggered cutting is sufficient to feed 5–6 animals throughout the year. Due to high nutrient content of fodder, animals gave more milk (average increase of 1.5 litres/day with a maximum increase of 3 litres/day) and thicker milk, earning an extra amount of Rs. 5–15/day/animal (net) or Rs.10–35/household.

Furthermore, the milk supply was for nine months instead of six months, because with staggered cuttings the availability of fodder was regular. Consequently, stall-feeding was encouraged. The farmers were happy with this intervention and their livelihood was maintained for nine months in a year. In these dry land tracts, with meagre land and minimum irrigation resources, the farmers realized that integration of growing fodders and rearing milch animals provides a better livelihood (see Section 4.3.1.9).

4.3.2.2 Alternate land use systems

Due to intermittent drought, the monocropped area under groundnut leaves the farmer without reliable income support. To overcome the instability in income, risk of crop failures and labour scarcity, alternate land use systems such as agri-horticulture were promoted.

About seven men and two women farmers initially came forward to take up horticulture plantation in their groundnut fields. Most of the farmers preferred mango under rainfed situation. The farmers planted mango (225 numbers) and tamarind (505 numbers) plants in their fields along with groundnut and red gram crop (groundnut + red gram + mango/ tamarind).

Groundnut + mango + pigeonpea in Anantapur

Farmers with irrigation facilities (about 21 men farmers) came forward to take up pure horticulture plantations of sweet orange, acid lime and papaya (1520 plants) as there is a good market demand for these crops.

Sweet orange plantation in Anantapur

The alternative land use of agri-horticulture system is expected to produce five-fold income compared to the traditional cropping system. The tamarind and mango plantations yields from 4th and 5th year, respectively. However, production of economic yield begins from 7th year onwards. A net income of Rs. 10,000–15,000 per ha was then expected from the tamarind plantation, depending upon the age of the plant, with an annual maintenance of Rs. 5000/- per ha (personal communication from BAIF). In the case of mango, annual maintenance per ha ranged from Rs. 15,000 to 25,000 during the initial years and the net returns from year 9 onwards were in the range of Rs. 30,000–45,000/ha (Sujatha, 2004). During the early years, and depending upon rainfall, the farmers can sustain on the income from annual crops in the plantation. Due to low rainfall, seedling survival was disappointing at about 30% survival. Given the continuous years of drought, survival of plants during summer is of great concern to the farmers.

The agri-horticulture system was also promoted with the help of SS members in CPR land i.e., unutilised temple endowment land. 85 mango and 20 tamarind plants were planted together with some vegetables and flowers sown in a small area near the farm pond that was dug out in the CPR. This land was managed by a landless labourer.

Mostly the spread of area under alternate land use systems especially agri-horticulture system was nearer to the hillocks which harbour wild boars. These wild boars in search of food attack the groundnut crop, which is relished by them. Since killing wild boar is against the rules of Forest Department, the incidence of crop damage appears to be larger. Farmers adopt measures such as electrifying the field fence, but that does not prevent crop damage. Therefore, alternative crops not favoured by wild boars becomes a researchable issue.

Besides the agri-horticulture system, horticulture (sweet orange) and forestry plants (1979 seedlings of Glyricidia, Subabul, Neem and Pongamia) was on farm boundaries, bunds, embankments, etc., covering approximately 107 acres.

4.3.3 Mahabubnagar Cluster

The soils in this cluster are red sandy and black clay. The soil depth is 30 to 50 cm with moderate nutrient status. Average annual rainfall in these villages is about 600 mm and the rainy season starts usually from June end or early July with 15–20 rainy days. Major crops are castor, sorghum, maize, pigeonpea, groundnut and paddy in *kharif*, groundnut, paddy and vegetables in *rabi*. Farmers in cluster villages grow castor with pigeonpea, sorghum with pigeonpea/green gram.

4.3.3.1 Crop interventions

4.3.3.1.1 Contingent cropping

As a contingent crop, pearl millet was suggested to the farmers to grow in this cluster. However, farmers refused to grow this, because it was neither a cash crop nor a staple crop. It ceased to be a staple crop due to shift in the dietary pattern (which had moved towards rice). It was used in preparing livestock feeds and fodders but only in small quantities. Pearl millet is certainly an interesting subject for researchers.

4.3.3.1.2 Introduction of improved varieties

Sorghum and castor are grown as major rainfed crops in Mahabubnagar cluster. Traditionally farmers were following this practice for the past 3-4 decades. Sorghum is grown for both grain and fodder for which the dryland farmer invests around Rs. 2,800 to 3,000/- per hectare and may come out with gross returns of around Rs. 8,000 to 8,500/- per hectare. Therefore, a dual-purpose cultivar such as SPV-462 was introduced in which case the farmer can reap good quantities of fodder. For the existing crops like castor, which is cash crop, Kranthi was introduced. With castor, the farmer invests about Rs. 4,000-4,500/- per hectare for gross returns of Rs. 8,550-9,000/- per hectare. Similarly for pigeonpea (LRG-30), maize (DHM-107), chickpea (Annegeri and ICCV-2), etc. the high yielding varieties were introduced to enhance the harvest potential. The potential yields of these improved cultivars were unable to be realized, due to drought and unbalanced rainfall distribution.

However, through the provision of improved cultivars for the on-farm trials and information on source of availability of seed material, awareness about the new varieties was created among the farmers. Despite farmers not realizing their potentials, the improved cultivars increased the yields from 20–30% as is mentioned in Table 4.3. Except in some cases such as maize, the introduced cultivars are open pollinated varieties. With this there is hope of varietal continuation in these cluster villages even after withdrawal of the project.

Table 4.3. Average productivity levels and yields of crops under improved cultivars in Mahabubnagar cluster.

Crop	Existing cultivars		Improved Variety		
	Name	Productivity (kg ha^{-1})	Name	Yields (kg ha^{-1})	% increase in yields
Castor	Jyothi	220	Kranthi (74)	340	55
Sorghum	Local	800	SPV-462 (7)	1000	25
Pigeonpea	LRG-30	150	LRG-30 (40)	210	40
Maize	Private Hybrid	1600	DHM-107 (6)	1700	6
Groundnut	TMV2	400	TMV-2 (7)	540	35
Paddy	Tella Hamsa, Sona Mahsuri	1500	Not introduced	-	-

(Figures in parentheses are number of farmers adopted the intervention)

4.3.3.1.3 Low water requiring crops as irrigated dry (ID) crops

Traditionally people raise paddy as irrigated crop during *rabi.* Continuous and regular drought the past five years led to reduced groundwater resource resulting in a large paddy land area being left fallow during *rabi*. ID crops were introduced to increase per unit area productivity and increase water use efficiency. Chickpea (ICCV-2 and Annegeri), maize and fodders (PC 23, Co-1, Para grass, Lucerne) were tried as alternative crops to paddy as they require less water. Chickpea has a good market potential. Farmers adopted this crop because it has minimum stored soil moisture. Maize and fodders were also good.

Fodders require more irrigation water. With water from 1-hectare paddy, 3–4 hectares chickpea could be raised using the water efficiently *(Policy brief-III)*. Many farmers were interested in growing chickpea and fodders during *rabi* (Table 4.4). Further, the wild boars do not relish chickpea, which is a blessing.

Maize as intercrop in groundnut in Mahabubnagar

Chickpea crop – Alternative to paddy in Chowderpalli, Mahabubnagar

Table 4.4. Farmer uptake of alternative *rabi* crops to paddy

Crop	Number of farmers growing		Average yields obtained (kg ha^{-1})
	2003	2004	
Chickpea	8	10 (25 farmers requested)	350
Maize	2	3	640
Groundnut	7	10	350
Fodders	3	82	**Green**
Co-1/Paragrass			200 t
PC-23			50 t

Lucerne, which was grown as a palatable and nutritious ID fodder crop, attracted the attention of wild boars. Project staff concluded that lucerne may be promoted when the wild boar deterrent practices are standardized. However, farmers identified it as a promising fodder crop, and on their own initiative planted it during second year and started to develop improved practices for wild boar deterrents. This is an example of farmers using their own indigenous knowledge and blending it with that of the scientists to adapt the technology.

4.3.3.1.4 Fodder production

Initially the farmers were reluctant to grow green fodder crops in their fields as paddy is the staple crop. During *rabi* 2003, only one farmer grew fodder crops in his paddy fields. After an exposure visit to Anantapur and farmer-to-farmer interaction, the farmers' initial reluctance was weathered as they realized that with minimum land, depleted water resources and prevalent drought conditions, it is really difficult to continue livelihood with only agriculture.

Para grass-in paddy fields in Chowderpalli, Mahabubnagar

They realized that integration of livestock and fodder production within their land and water resources could improve their livelihoods. A large number of farmers came forward to grow fodder crops rather than paddy. Thus during 2004, 82 farmers grew fodder crops (see Section 4.4.10).

4.3.3.2 Alternate land use systems

Silvi-pastoral system

This system was promoted in the marginal lands, which were not used for crop growing. Two male farmers with marginal lands wanted to take up pastures along with trees such as Subabul, which had only 33% survival while establishment of *Cenchrus* was not successful due to prevailing drought conditions.

Co-1+Teak on bunds - Ramulu in fodder park at Zamistapur, Mahabubnagar

Though the farmers realized the value of this system, the long-term gestation and the off-season attention of protecting the plants from grazing as well as the water required made this intervention less adoptable. For such interventions, it is important to sustain the interest of the farmer through continuous follow-up and monitoring even after the project period.

In addition to this, plantation of horticultural plants (acid lime) and forestry plants – teak (275), subabul – (230) and Gliricidia (210) – was carried out in 19 farmer fields.

4.3.4 Tumkur Cluster

In this cluster, finger millet was grown as a major dryland crop under both rainfed and irrigated conditions. Many regions in the cluster were under coconut plantations, and were totally rainfed. The soil type is red sandy. Finger millet ranked first in terms of cropping area, whereas horse gram, dryland paddy, small millets and Niger (*Guizotia abyssinica*) occupied a smaller area.

During early *kharif*, green gram and black gram were grown as sole crops, and niger and field bean were grown as mixed crops with finger millet. During late *kharif* and *rabi* season, finger millet, cowpea, small millet crops were grown in this area. Crop rotation methods were traditionally followed by most of the farmers, who were not using the improved varieties because they were not aware of new technologies.

4.3.4.1 Diversified crops/cropping systems

4.3.4.1.1 Improved varieties

Most of the farmers were found growing local varieties of crops such as finger millet, sorghum and red gram. Observation plots were planted by a farmer with improved varieties of these crops.

Red gram variety TTB-7

The yields obtained and presented in Table 4.5 show on an average 30–50% increase. Therefore, many demonstration-trials are suggested for the future.

Table 4.5. Existing local cultivars and improved cultivars yield comparisons of different crops in Tumkur.

Crop	Existing cultivars		Improved variety		
	Name	Yield (kg ha^{-1})	Name	Yields (kg ha^{-1})	% increase in yield
Finger millet	Local	600	MR-1 (5) GPU-28 (9)	1000	67
Sorghum	Local	800	CSH-14 (33)	1250	56
Pigeonpea	Local	700	TTB-7 (5) Hy-3c (5)	950	36

(Figures in parentheses are number of farmers planted improved cultivars)

4.3.4.1.2 Fodder production

The major source of fodder is crop residues of the finger millet (*ragi)*, sorghum (*jowar)*, green gram and horse gram. During off-season, their scarcity and exorbitant price (Rs. 5,000/- per cartload) made them unaffordable to most farmers. The village milk co-operative society provides mineral mixtures (@Rs. 30/- per kg) and seeds of fodder crops at a subsidized price. Therefore farmers gave no importance to growing fodders. After the involvement of the project staff, 20 farmers cultivated fodders (Appendix 2.1). Napier grass Co-1 and Co-2 cultivars were introduced in the coconut orchards and on bunds. Co-2 (210 tonnes ha^{-1}) performed relatively better than Co-1 (190 tonnes ha^{-1}).

4.3.4.2 Alternate Land Uses

Each family was provided with horticultural plants (total 3850 seedlings) viz., mango, cashew, tamarind and jackfruit, which were planted on bunds, borders and in trench cum-bunds (TCBs). The periphery of the land was planted with more than 15 varieties of forestry plants (Cassia, Subabul, Glyricidia, etc).

4.3.5 Nursery raising

Nursery raising and maintenance in the cluster villages is a new intervention being carried out in the villages. In the clusters, most of the people are small, marginal farmers and landless people. To improve the livelihoods of the landless poor, landless poor persons including women were identified for nursery training. Five men in Anantapur, two women per village in Mahabubnagar and 10 women in Tumkur were trained. During the training at Lakkihalli farm in Tumkur, the participants were taught grafting techniques, propagation methods and the techniques of nursery raising. After training, four nursery units (one per village) were started in Mahabubnagar cluster. Three men in Anantapur cluster, and ten women in Tumkur raised a nursery in their backyards.

Inputs such as seeds, polythene bags, were supplied with a buy back system, from the project @ Rs. 2/- per live seedling. The cost and returns from nursery raising is presented in Table 4.6. The women could obtain more than Rs. 10,000/- by utilizing free (and not factored in) labour. This has also enabled some of the women to obtain some capital assets and investment. One landless woman who had raised nursery informed that she has purchased some gold ornaments and invested in a small grocery shop. This activity can be sustained for developing women entrepreneurship. The women were willing to continue this nursery activity but were uncertain of where to market their produce. Facilitating linkages with State departments like Forestry and also local big nurseries in the nearby district headquarters could be a solution; or diversifying their nursery production to meet local needs for example vegetable seedlings.

Nursery of Thirupathamma at Chowderpalli in Mahabubnagar

Table 4.6 Cost and Returns of Nursery Raising
(Mahabubnagar cluster)

Total No. of Plants: 7500		
A. COSTS		**Rs.**
i)	Labour for filling the polythene bags with soil 20 women labour @ Rs. 30/day	600.00
ii)	Cost of material (FYM, soil & sand) **	2400.00
iii)	Cost of polythene bags (7500) @ 0.25/bag **	1875.00
iv)	Cost of seed **	500.00
	Total cost	5375.00
B. GROSS RETURNS: 7500 plants @ Rs.2/plant		15000.00
C. RETURNS for family labour*		**9625.00**

* Watering was done by the landless women who raised the nursery
** Supplied by the project

For two women of Chowderpalli village in Mahabubnagar cluster, water availability was a problem. But with the intervention of SS members, water at the site was arranged from nearby farmers with water sources.

Community members participated in larger number on the day of Green Festival (*Hasiru Habba*) in Shankarnhalli, and planted 49,000 seedlings that were supplied by the nursery activity participants. One farmer was motivated to start a commercial nursery with 10,000 seedlings with varieties of forestry and horticultural seedlings that were in great demand at Shankarnhalli. Through this enterprise, the gender issue was taken into consideration.

The participants can utilize the profit obtained from nursery as "Seed Money" for further development of nursery. They can try for loan from banks for nursery development with the support of SS, Bank, Forestry Dept., VSS and others.

Nursery raising as a group activity is not recommended, because the returns are unlikely to be sufficient to maintain interest of group members. This activity is best promoted at the individual level.

4.3.6. Bee keeping

Bee keeping was introduced in the Tumkur cluster to 21 farmers. However, the yield from the honeycomb was poor due to frequent migration of bee colonies, which was thought to be due to intensive pesticide application for gherkin cultivation. Therefore, bee keeping may be a potential livelihood option under the circumstances of non-pesticide intensive farming.

4.3.7 Sheep rearing

Sheep rearing was offered as a livelihood diversification option for the poor and landless villagers in all clusters (Section 4.4.10).

4.4 Improved livestock production

4.4.1 Process adopted

The project introduced a participatory approach to developing livestock technologies with stallholder farmers in selected clusters. The approach takes advantage of indigenous knowledge and the capacity of farmers to experiment and solve their own livestock feeding problems. It uses many of the principles of Participatory Rural Appraisal

(PRA), but extends the active participation of farmers well beyond the initial stage of appraisal to technology development and evaluation on farms. The approach begins with in-depth participatory diagnosis by a broad cross section of the farming community, including farmers from different wealth groups. This helps the community to define, group and prioritise their main problems.

After identifying the major problems, various interventions, mostly in the form of observation trials-cum-demonstrations, were planned and discussed in the SS (farmer advisory committee) meetings. Several interventions were brought to the doorsteps of farmers in the form of a 'basket' of technologies, so that they could select those interventions that they felt could assist them in producing optimal farm management systems. Then, a comprehensive schedule for implementing the technical interventions was discussed and finalised in the SS meetings. An 'open door policy' was adopted for the interventions, implying that all interested farmers in the community were free to participate in them. The SS facilitated implementation and monitoring of interventions. Volunteer farmers served as advisory persons. The evaluation process was monitored and assessed by the SS members and necessary changes were made to any technology that is being developed or adapted. The core principle of the process is active, decision-making involvement of farmers at all stages of technology development with technical input and facilitation by project staff. Attendance of community members at the SS meetings and the number of farmers willing to introduce the technologies into their farming systems were regarded as indicators of acceptability.

4.4.2 Livestock resources in selected clusters

The population of small ruminants (sheep and goats) was highest in Mahabubnagar and Anantapur cluster whereas local cattle dominated Tumkur cluster (Table 4.7).

Table 4.7. The livestock population of the selected clusters.

Sl. No.	Particulars	Ananta-pur	Mahabub nagar	Tumkur
	Livestock resources, No's (%)			
1	Cows	730 (15)	310 (7)	550 (58)
2	Buffaloes	402 (8)	500 (10)	25 (3)
3	Bullocks	450 (9)	270 (5)	210 (22)
	Large Ruminant	**1582 (33)**	**1080 (23)**	**785 (83)**
4	Sheep	2590 (54)	1850 (39)	80 (8)
5	Goat	620 (14)	1850 (39)	85 (9)
	Small Ruminant	**3210 (67)**	**3700 (77)**	**165 (17)**
	Total	4792	4780	950
	Poultry	1650	5700	65

4.4.3 Major traditional livestock production systems in selected clusters

The livestock production systems are rather complex and generally based on traditional and socio-economic considerations, mainly guided by available feed resources. (Misra et al., 1997; NRSP Project PRA 2003; Reddy et al., 2005) The traditional livestock production can be described as low input system. These traditional production systems are designed to be self sufficient at the household level and are dependant on the low-cost agro-by-products as nutritional input to animals for producing quality food of high biological value. This kind of livestock production system is very common in rural areas and practiced by small and marginal farmers or landless people. Low technology uptake, insufficient market facilities, infrastructure, and small economies of scale are common. Keeping livestock in rural areas is treated a means of security and sometimes of status, whereas in peri-urban areas, milch animals are primarily kept for production of milk. The characteristics of various kinds of production systems are given below:

4.4.3.1 Cattle and Buffalo

Predominantly local buffalo and cattle were largely kept for production of milk for direct consumption and occasional sales in

rural areas. The animals are maintained mostly on open grazing and locally available feed resource. In peri-urban areas, mostly graded or pure bred Murrah buffalo and occasionally high blood crossed Jersey/Holstein Friesian were maintained. Most of the feed and fodder was procured from outside and the enterprise was profitable because of the closeness of a quality-appreciating market and the resulting high value of milk.

The productivity of animals depends on many factors, such as genetic potential, quality of feed, availability of animal health and breeding services, and management practices. Production traits of milk animals play a crucial role and have a profound influence on the cost and returns of dairy enterprise. Milk production in the selected clusters is a low-input, low-output farm activity with a smallholder production system. The average milk productivity per year per cattle is about 1,124 kg. The available data on milk yield indicate that average productivity of cows went up substantially during last 2 decades. There is an increase in the yield of buffaloes also, but it is less sharp than that of cows. A key factor accounting for the sharper increase in cow milk yield is the increasing proportion of crossbred cows (NRSP Project PRA, 2003) due to government supported AI facilities. In general, buffaloes give higher yields than indigenous cows, but crossbred cows are more productive than either indigenous cows or buffaloes. The average productivity of local cows, crossbred cows and buffaloes are 3.08 kg/day, 5.73 kg/day and 4.15 kg/day, respectively.

4.4.3.2 Sheep and goat

In Anantapur, Nellore sheep were kept in mostly stationary flocks, whereas, in Mahabubnagar, mainly Deccani, partly stationary and partly migratory flocks were maintained. In Anantapur, farmers purchased lambs and fattened them for 4 to 5 months. The lambs were then ready for sale. Flock size fluctuates from a few to 30. In Mahabubnagar, most villagers have few goats that utilise the available fodder trees. The concentration of goats is higher in Mahabubnagar than in Anantapur. Farmers of Andhra Pradesh (A.P.) consider sheep and goats as a working capital and opt for a zero-input system of production.

4.4.3.3 Backyard poultry

Keeping a few chickens for eggs and meat for direct consumption is a widely spread practice in Anantapur and Mahabubnagar. By contrast, in Tumkur cluster poultry is a less preferred species of animal because of the dominance of *Lingayat* community who are mostly vegetarians.

4.4.4 Problems related to livestock production in different clusters

In Anantapur, serious fodder and water scarcity in summer threatens livestock. Accentuated by the drought in the last four years, livestock population declined sharply.

In the Mahabubnagar cluster a similar situation prevails. Fodder availability is maximum between August and November with acute shortages between March and June. Foot and Mouth Disease (FMD), Black Quarter and Haemorrhagic Septicaemia are the major diseases among cows and buffaloes. Among sheep and goats, FMD and Blue Tongue are common. Livestock diseases occur mostly between November and February. Similarly in Tumkur cluster, heavy morbidity due to FMD was reported with shortage of fodder in summer as the main problem.

Thus, low productivity of livestock due to inadequate availability and poor quality of feed and fodder; high incidence of diseases; and inadequate knowledge on appropriate management of livestock was identified as the major problems facing smallholder farmers in the selected cluster villages.

Table 4.8 presents the suspected causes of low productivity of livestock in selected clusters and strategies adopted to solve the problem by NRSP project.

Table 4.8. Identified constraints to low livestock productivity, suspected causes and adopted strategies.

Problem	Suspected Causes	Adopted strategies
Inadequate quantity and poor quality of feed resources	Lack of fodder production efforts and inadequate knowledge on how best to utilise locally available feeds	Promote fodder production and chopping of fodder
Low milk yield in cows and buffaloes	Poor genetic potential of native breeds and imbalanced nutrition	Up-gradation of native animals with improved breeds and supplementary feeding of mineral mixture and urea molasses mineral blocks (UMMB)
Poor health particularly in dry months due to high incidence of infectious diseases	Heavy worm loads, compounded by poor nutrition and irregular de-worming/ vaccination	Promote regular de-worming and timely vaccination
Poor management practices	Inadequate knowledge on appropriate livestock management practices	Reinforce farmer training on all aspects of livestock management

Table 4.9 is a summary of the technical interventions carried out to address the problems. As indicated in 4.1.1, adoption of livestock-related technologies by smallholder mixed (crop-livestock) farmers is usually slow. Farmers need to be able to test such interventions taking into account their economic viability and social acceptability. The project assisted the farmers to do this, with back-up from appropriate specialists.

Table 4.9 shows the number of farmers who participated in the intervention trials. The detailed outcome of the various interventions undertaken is given in the following sections.

Table 4.9. Summary of technological interventions and number of farmers taken the interventions.

Technological intervention	Number of participants/units			
	Anantapur	Mahabubnagar	Tumkur	Total
Animal health camp	-	2	2	4
Animal treated	-	3200	670	3870
A.I. Centre established	-	1	-	1
A.I. done	-	411	-	411
P.D. Confirmed	-	187	-	187
Calves borne	-	76	-	76
Training in A.I. to youth	3	3	3	9
Training in ethno-vet.	-	4	3	7
Fodder production (perennial / annual)	61	82	20	163
Chaff cutter (manual + power operated)	3+1 = 4	3+1 = 4	3+1 = 4	12
Demonstration of UMMB feeding	-	20	-	20
Demonstration of mineral mixture supplementation	-	200	28	228
Sheep rearing	45	20	8	73
Backyard poultry	19	70	2	91

4.4.5 Integrated animal health camp

Almost 90% of the farmers in the cluster villages did not follow the de-worming and vaccination calendar recommended by the veterinary staff. Most of the farmers lacked confidence in applying the extension advice and cited cash constraints as a compounding problem. This problem was discussed in the SS meetings along with the local veterinary staff of the respective clusters. As a result and in conjunction with the local Animal Husbandry Department, animal health camps were conducted in Mahabubnagar and Tumkur cluster. Promotional campaigns were launched in these clusters that encouraged farmers to adopt a regular vaccination and de-worming schedule as a preventive measure and to provide mineral supplements to animals so as to overcome the problem of infertility in case of buffaloes and crossbred cattle. In Anantapur, camps were not conducted because of the regular availability of Government veterinary staff in the village. Initially, the cost of medicines was met from the project funds. Afterwards, the SS mobilised the funds from the farmers.

In Mahabubnagar cluster, two animal health camps were conducted during November and December 2003, in which 2500 sheep and goats, 700 cows and buffaloes were de-wormed against intestinal parasites. Three hundred cows and buffaloes were vaccinated against FMD; 150 animals were examined for infertility and six artificial inseminations (AIs) were performed. Besides this, a kilogram each of mineral mixture was given to 200 dairy farmers for use in concentrate feed. Another castration camp was organized in the cluster in which 184 calves were castrated to prevent unwanted breeding.

Similarly in Tumkur cluster, an animal health camp was organised during January 2004 at Shanakarnahalli village, in which more than 500 animals were treated. Irrespective of the species, all the animals were de-wormed. About 165 sheep and goats and 30 poultry birds were vaccinated and about 100 crossbreed cows, fifty local cows and fifty buffaloes were given gynaecological treatment and supplementary feed (mineral mixture).

Another, follow up animal health camp was conducted in February 2004, in which 170 cattle and sheep were treated for de-worming and vaccination for FMD. Most of the animals suffered from malnutrition. Therefore, 50 kg of mineral mixture were supplied to 28 participants to improve the nutrition of the cows and buffaloes.

The impact of the animal health camps on livestock productivity was monitored by recording the farmers' observations on mortality, growth and health of the animals at regular intervals among the selected households. Implementation of scheduled prophylactic health measures reduced mortality from 17 to 8% in small ruminants and from 12 to 7% in large ruminants. Many farmers reported an increase in growth rate of 25 to 30% in the animals between 6 and 12 months of age in their flocks. The treated cows recovered from mastitis. About 30% of the animals, which were suffering from the gynaecological problems, become pregnant after treatment (Tumkur cluster). Further, farmers reported immediate recovery of animals from recurrent attacks of gastro-intestinal parasite infestation. Animal health camps created awareness among farmers regarding the adoption of better livestock practices. Farmers demand more number of such camps in the clusters. The more progressive farmers are following the recommended livestock management practices at their own cost.

4.4.6 Ethno-veterinary training

From each cluster, 3–4 persons who are already involved in the livestock treatment of diseases were identified and were trained at BIRD-K Shankar Lakkihally in order to hone their skills and capacity. All the trained persons render good service as para vets in their

respective clusters. They help the farmers in identifying the health problems, providing information on husbandry practices and treating the sick animals. They became a good link between the Animal Husbandry department and farmers. The department seeks their help during vaccination and de-worming camps.

4.4.7 Artificial insemination centre: breed improvement and capacity building

The project staff encouraged farmers to breed indigenous cows and buffaloes with improved breeds, particularly Jersey and Murrah, through A.I. This was done in order to combine the hardy characteristics of indigenous cattle (namely tolerance to poor nutrition, heat stress and tropical disease challenge) with high milk-producing qualities and hence the higher income potential of the improved breeds.

To support this, an AI centre was established in Chouderpally village of Mahabubnagar cluster to provide door-to-door AI service and to serve as a training centre to promote entrepreneurship among the unemployed youths in the project villages.

An unemployed youth of Mahabubnagar cluster was trained in AI at Tumkur for three months to enable cattle for breed improvement in the project area and to train the other interested persons. The AI trained another three persons at their centre successfully. An average earning per month was Rs. 3000. The farmers were charged Rs. 20 per AI. In addition, an incentive of Rs. 50 per calf born was received from "Farmer's Corpus Fund" of BIRD-K.

The performance of the AI centre since its inception in November 2003 until project closure (31 March 2005) is presented in Table 4.10. This shows that the conception rate achieved by the centre is considerably higher than the usual Veterinary Department AI conception rates (GOI, 2004; 2005).

Table 4.10. Performance of Artificial Insemination Centre at Chowderpalli, Mahabubnagar cluster.

Particulars	Cattle	Buffaloes	Total
AI Done	77	334	411
Pregnancy diagnosis performed	38	149	187
Calves born	23	53	76
Male	10	34	44
Female	13	19	32
No. of services per conception	1.4	2.0	1.7
Conception rate (%)	71.4	50.0	68.75
Animal Husbandry department conception rate			20-45%

More than 300 farmers from all sections of the community (Rich/Poor; Forward / Backward caste; SC/ST)/ used the AI service for breeding their cows and buffaloes. Farmers from the surrounding villages (apart from project villages) also used the services of AI centre for crossbreeding local cows and buffaloes.

Many cattle/buffalo owning farmers suggested that the AI manager should be provided with a mobile phone for easier and prompt contact. However, the absence of stall-feeding makes it more difficult to control breeding when cattle are in the field during grazing.

4.4.8 Chopping of crop residues

In all the clusters normally the farmers offer fodder without chopping whereas in case of sorghum and maize they cut it by sickles into large pieces (50 cm length). In this kind of prevalent practice, wastage of the fodder is very high. In order to reduce the wastage of feed resources, the chaffing of fodder was promoted. The advantages of feeding chaffed

feed are that it avoids wastage and prevents selective consumption. Feeding of chopped roughage reduces the energy wasted while chewing, increases the feed intake and improves digestibility. Farmers observed that cutting the fodder into small pieces is a laborious task but good feed to the animals.

Two kinds of chaff cutter: manual and power operated, were promoted in all the clusters (Section 5). Cutters reduce fodder wastage substantially (up to 30%). For personal use, villagers preferred the manual chaff cutter rather than the powered chaff cutter, because of its low cost as well as easy operation. Only two persons are required to cut the fodder by manual chaff cutter, whereas for the power operated chaff cutter, a minimum of three persons are needed to perform the task satisfactorily. The power chaff cutter is generally fixed in one place to which people have to bring their fodder for cutting, which is not preferred by some social groups. However, one advantage is that it can provide a livelihood option: because of its output capacity, the owner or operator charges a cutting fee (Rs. 0.70/crop residue bundle of about 10 kg) to villagers those wishing to cut their fodder.

4.4.9 Improved feeding practices

A focused group discussion and formal topical survey showed that the farmers were mixing different feed (concentrate) ingredients such as wheat bran, rice bran, cakes, broken grains, *chunies* (broken grains of pigeonpea/ black gram) before offering them to their animals as supplements or in a few cases, as complete diets. However, the quantities of individual feed ingredients included in the concentrate mixtures seemed to depend on their relative availability rather than on the farmers' conscious desire to supply better quality feed to their animals. Only lactating cows and bullocks during work were allocated the supplementary feed. This existing farmer practice appears to be a good example of strategic supplementation. Lactating and work animals require extra nutrients to meet the requirement and farmers use their limited available resource (concentrate feed) based on the priority of the animals. Thus, the existing practices seem to be good. Nonetheless, future research to assess the nutritive value of the feed ingredients used by the farmers in the area for diet formulation could enable recommendations for improved formulation and nutrient balance to be made.

The farmers reported that repeat breeding was a serious problem in their herds particularly in buffaloes and crossbred cows. Probably, this was the major cause of the long calving intervals. Mineral deficiencies were suspected to cause this problem. Use of mineral mixture in concentrate feed was demonstrated to the farmers of Tumkur cluster to overcome this problem. Farmers' response was very encouraging: they observed an improvement of 0.5 to 1.0 litre/animal in milk yield due to supplementation with mineral mixture. They also reported that mineral supplementation was helpful in increasing the appetite of animals. Now farmers from all wealth groups have started purchasing the mineral mixture from the local market, and mixing in the concentrate.

In order to improve the productivity of milch animals, supplementary feeding of mineral mixture through urea molasses mineral blocks (UMMB) was demonstrated to the farmers in Mahabubnagar cluster. The main objective of UMMB supplementation is to provide a constant source of degradable nitrogen throughout the day and promote growth of rumen microbes in ruminants fed poor quality forage. The UMMB contains soluble and fermentable nitrogen from urea, highly fermentable energy from molasses, and essential minerals. Natural proteins source such as groundnut or cottonseed extract were added to provide preformed peptides and amino acids, increasing the nutrient content.

Twenty local lactating buffaloes were selected for demonstrating the benefit of supplementing UMMB. The feeding was done during March–April 2004. The buffaloes were managed as per the farmers' own practice. Based on the traditional feeding practices, animals were grouped into two groups: T_1 – farmers practice (10 animals) and T_2 – farmers practice + UMMB *ad lib* (10 animals). The feeding of selected animals consisted of dry and green forage, plus a small amount of dairy concentrate varying from 1.0 to 3.0 kg/animal per day, with grazing for 4–6 hours. The forages consisted of mixed species grasses, paddy straw and green fodder. The UMMB was in front of animals in a wooden dispenser to allow optimum licking. The farmers recorded intake of block and milk production on pre-designed data sheets. These sheets were checked at each visit for accuracy and consistency.

The intake of UMMB ranged from 200 to 275 g and the average intake observed was 250 ± 49.5 g/buffalo/day. An average increase in 1.25 litre/day in milk yield was observed due to supplementation of UMMB during summer. Besides the increase in milk production, all the animals of supplemented group showed symptoms of heat at the proper time and conceived at first service. In the un-supplemented group, one cow did not conceive even after third service/insemination. On average 1.7 services were needed for conception. No symptoms of mineral deficiency and disease were observed in the supplemented group whereas animals of un-supplemented group showed symptoms of mineral deficiency. The cost-benefit ratio was 2.83. Further, farmers reported that by supplementing UMMB, buffaloes consumed more roughage, maintained good health and productivity even during summer months when green fodder scarcity was acute. All the farmers readily accepted the practice of using UMMB supplementation and were willing to purchase it. However, they were apprehensive about the quality of UMMB supplement in the local market.

4.4.10 Impact of adoption of improved forage production on livelihood of farmers

The survey was conducted on a pre-tested format to study the impact of feeding green forage on milk production and income of the farmers during February–March 2005. Fifteen farmers were selected from each cluster for this purpose. The details of survey are summarized in Table 4.11 and given in full in Appendix 4.2.

All farmers profited from producing and feeding green fodder. Livestock farmers of Anantapur cluster received the highest return (Rs. 44/day) compared to Mahabubnagar (Rs. 40/day). The minimum return was in Tumkur cluster. The reasons for this difference are as follows: (i) wide variation in milk animals (ii) variation in price of milk. Response of feeding green fodder was more visible in Anantapur and Mahabubnagar cluster than Tumkur. Perhaps the animals of Mahabubnagar and Anantapur cluster were underfed with unbalanced diet, whereas the farmers of Tumkur cluster were using a balanced concentrate mixture supplied by the milk cooperatives.

Table 4.11. Impact of adopting improved forage on milk production and income of the farmers in selected clusters.

Particulars	Anantapur	Mahabubnagar	Tumkur	All
No of households adopted improved forage species	61	82	20	163
No of household surveyed	15	15	15	45
No of buffaloes/household	3.80	6.27	1.07	3.72
No of cattle /household	1.40	1.07	2.40	1.62
No. of milch animals/ household	3.00	3.73	1.73	2.82
Area under improved forage crops/ household (ha)	0.19	0.16	0.13	0.16
Percent of total area under improved forage	4.42	4.56	2.77	3.92
Milk yield, litre /animal/day	4.07	4.77	6.28	5.04
Feeding schedule of milking animals				
Grazing (hrs)	6.07	5.80	4.33	5.40
Green fodder (kg/day/animal)	9.60	11.13	8.67	9.80
Dry fodder (kg/day/animal)	8.47	8.67	7.87	8.33
Concentrate (kg/day/animal)	2.10	2.37	2.30	2.26
Impact of feeding green forage				
Increase in milk yield (litre/day/animal)	1.47	1.16	0.97	1.20
Milk rate (Rs./litre)	12.93	13.33	9.54	11.94
Gross return (Rs./day/animal)	19.01	15.46	8.97	14.33
Cost of green forage (Rs./day)*	2.40	2.78	1.73	2.30
Cost of additional labour (Rs./day)**	2.0	2.0	2.0	2.0
Total cost (Rs./day/animal)	4.40	4.78	3.73	4.30
Net return (Rs./day/animal)	14.61	10.68	5.24	10.03
Net return (Rs./day/household)	43.83	39.84	9.07	30.91

*Cost of fodder production: Rs. 20/100 kg of sorghum,
Rs. 25/100 kg of Hybrid Napier/Lucerne/guinea grass.
**1/2 hour/day in cutting, transportation, chopping, etc Rs. 2/day

Through farmer-farmer interaction, realizing the economic benefits of feeding green forage to animals, many farmers cultivated improved forage cultivars (Section 4.3).

4.4.11 Sheep rearing

Sheep rearing was promoted as a source of income generation and self employment for the poor and landless households. Two models of sheep rearing are (i) lamb fattening (ii) breed multiplication. An attempt was made to evolve a practical model for replication elsewhere and to identify the potentials and constraints of wider uptake of sheep as a livelihood enterprise.

The project staff approached the poor and landless people and asked them to choose different alternatives to uplift their standard of living. The options offered to them were: sheep rearing, goat rearing, poultry farming, nursery raising, vermicomposting, depending upon caste and social customs. Majority of the poor people selected sheep rearing to improve their livelihood mainly because of easy maintenance and availability of ready-made market throughout the year.

A focused PRA was conducted and survey was made in order to have an idea about the sheep production system prevalent in the cluster villages. Several groups of 4–5 sheeps in Mahabubnagar and Tumkur for breed improvement and multiplication purpose and units of three (later reduced to two) sheep in Anantapur for fattening purpose were given to improve the livelihoods. The project had planned for all sheep units to contain five animals, but the Anantapur farmers were not certain of accessing sufficient fodder, neither did they have the labour resources to herd the sheep. With three animals, they wanted to work on the fields and leave the sheep for grazing. They later decided that they could not manage more than two sheep under this system and this became the size of their fattening unit.

Sheep unit of Chowderpalli village in Mahabubnagar

The conditions for provision of sheep agreed with the SS and intending sheep owners were as under:

- The animals should be bought from the local market.
- The owners should rear them with care and responsibility.
- The owners should supply feed using local feed resources as advised by the project staff during lean period.
- The animals should not be sold or slaughtered before lambing in case of multiplication or before attaining the body weight of 25 kg in case of fattening.
- The owners should inform the project staff before sale or slaughter of the animals and in case of any illness or theft.
- The field staff will supervise the activity and arrange insurance of animals and should collaborate with the owners.

The numbers of sheep given in different clusters are mentioned in Table 4.12. The SS proposed 10–40% contribution of total cost from the participating farmers, on a sliding scale based on the owner's capacity to pay. In Mahabubnagar and Tumkur, the contribution was 10% whereas in Anantapur it was 40%. The contribution became a part of the revolving fund managed by the SS (see Section 2).

Sheep rearing participants

The important demographic characteristics of sheep rearing participants are presented in Table 4.12. About 70% of the landless poor works as agriculture labour. The main reason, which forced them to work as labourers, is poverty. Lack of credit worthiness, confidence and know-how may be other reasons. In the villages, the landless poor obtain jobs during the crop season only. Approximately 40% of the poor people migrate in search of work to other places, preferably to nearby city/towns (Table 4.12). In the majority of cases, only male members of the family migrate from the village and provide livelihood to other family members.

Table 4.12. Demographic characteristics of selected households.

Particulars	Anantapur	Mahabubnagar	Tumkur	All
No. of HH	16	15	9	40
Male	50	53	22	45
Female	50.00	46.67	77.78	55.00
Family size	4.4	5.6	4.9	4.9
Social group				
Forward caste	6.25	0.00	0.00	2.50
Backward caste	43.75	73.33	33.33	52.50
Scheduled caste & scheduled tribes	50.00	26.67	66.67	45.00
Average age of respondent (yrs)	31.13	35.53	40.89	34.98
Occupation				
Crop production	0.00	13.33	0.00	5.00
Small ruminant	6.25	13.33	0	7.50
Wage labour	56.25	66.67	100	70.00
Others*	37.50	6.67	0	17.50
Education status of respondent				
Illiterate	56.25	80.00	33.33	60.00
Read & Write	0.00	13.33	33.33	12.50
Primary	31.25	6.67	33.33	22.50
Secondary	12.50	0	0	5.00
Migration				
Yes	43.75	33.33	44.44	40.00
No	56.25	66.67	55.56	60.00
Kind of migrants				
Male	85.71	80.00	100	87.50
Both	14.29	20.00	0	12.50
Period of migration				
< 1 month	42.85	20.00	100	50.00
1-3 month	28.57	20.00	0	18.75
3-6 month	14.29	40.00	0	18.75
> 6 month	14.29	20.00	0	12.50
Frequency of migration				
Every year	100	60.00	75.00	81.25
Alternate year	0	40.00	25.00	18.75

Traditional sheep production system

Sheep farmers obtain forage from a combination of crop residues, private land and common gazing land. Thus, a sheep rearer obtains benefits from both common lands and framers' filed. In Anantapur and Mahabubnagar cluster, some farmers graze their animals on forestland sometimes illegally, as community managed forests ban grazing to regenerate the woody vegetation, and prevent the mishappening of fire. Farmers' cultivated lands become common grazing lands for poor peoples' animals after harvesting the crop. Grazing norms do exist, but lack of institutional support and the disintegration of community management structures have contributed to the uncontrolled and illegal grazing on common lands. In Mahabubnagar district, fallow lands contribute 25–51% of total dry matter requirement for livestock through free grazing (ISPA, 1997). The owners also migrate along with their sheep flocks in search of grazing lands during summer. Thus, more research is needed to understand the extent of grazing on private/forest land and the implications for herders' livelihoods and sustainability.

In a few cases, old members of the family, who are unable to go for labour with no other opportunity cost, generally look after the sheep. They themselves opt and prefer to take animals for grazing while collecting fuel wood, as they cannot perform heavy work. Families also think that grazing of animal is an appropriate productive activity for old people. Slowly, it is becoming the social norm. In some cases, agricultural labourers bring the sheep along with them and tether them in the field for grazing. They also offer the weeds or tree leaves that are available in the private lands.

Assessment of sheep rearing intervention

In Anantapur cluster, 16 participants in 2003 increased to 54 in 2004. The individuals sell the sheep after 4–5 months of rearing/ grazing and purchase the sheep with the balanced amount after repaying the loan to the SS. Three cycles of lamb fattening were completed. It is interesting to mention that in Anantapur cluster, all poor families are covered under this intervention and now every individual in the group has a minimum income of Rs. 4,000/- per year only from lamb rearing as subsidiary livelihood interventions. The contribution of sheep rearing to family income ranges between 20 and 35% with an average of 25%.

The performance of the sheep breeding units of Mahabubnagar and Tumkur cluster is presented in Table 4.13.

Because of more grazing and common lands, the performance of sheep-breeding unit was better in Mahabubnagar than in Tumkur. Farmers in both the clusters sell lambs at an early age due to economic concerns. Almost all sheep in Tumkur cluster are sold in local market whereas in Mahabubnagar cluster 60% farmers sold sheep within the village itself. The location of marketing had significant influence on earnings of the farmers.

After realizing the economic benefit, many families from the forward community in Anantapur and Mahabubnagar came forward to take a loan from the SS to start sheep rearing.

Experience showed that funding or stock animals are good tools in starting the livelihood programme. In addition, basic knowledge of sheep keeping should be provided directly. Through sheep rearing, the poor increased their income, improved the nutrition of the family, the stability of the households and their self-reliance. Sheep rearing by women to improve the economic status created an immense interest among other people.

Table 4.13. Performance of sheep breeding units in Mahabubnagar and Tumkur cluster.

Details	Mahabubnagar	Tumkur	Average
No. of households 2003	15	9	
No. of households 2004	23	9	
No. of sheep given	5	5	5
Nos of lambs born	9	6.7	7.8
Single birth (%)	80	78	79
Twins (%)	20	22	21
Male (%)	43	53	47
Female (%)	57	47	53
Total sheep sold (nos)	14.0	5.0	9.5
With in village (%)	60	0	30
In local market (%)	40	100	70
Av. No of sheep sold/household	2.5	2.0	2.3
Av. age of sold sheep (months)	8.6	7.0	7.8
Amount earned from sale Rs.	2,850	3,356	3,103
No of sheep existing/households			
Adults	8.7	6.3	7.5
Lambs	3.4	2.6	3.0
Estimated value of sheep (Rs.)	16,143	12,178	14,161

Some specific points emerging from this intervention are as follows:

- Institutions (particularly those for watershed development) should provide training on small ruminant production technologies to rural poor women.
- Efforts should be made by both research and development institutions to link up rural poor/women with funding agencies.
- Government and development institutions should undertake routine vaccination and de-worming exercise for small ruminants. Farmers are ready to pay for the medicines and this would contribute to improved herd productivity and livelihoods for the sheep owners.
- Rearing sheep requires less capital and therefore it is appropriate where capital is scarce.
- Sheep rearing can provide part time self-employment without affecting the main occupation.
- Sheep rearing is an enterprise that does not demand a special skill as compared to other agricultural enterprises.

4.4.12 Backyard poultry unit

Backyard poultry was promoted through the project as a livelihood option for the landless poor in all the clusters (Table 4.8). Improved strains of birds, Giriraja and Vanraja, were provided to landless poor people @ 5 birds/unit to rear in the backyard. The purpose behind this intervention was that the poultry would be a laying unit that could be managed by the landless and the poor, with eggs sold at three times the price of local eggs generating good income.

The success rate of poultry was very low (10–30%) in most of the clusters. Farmers reported the following reasons for failure of poultry:

- The birds die in summer due to high temperature. The chicks are very vulnerable to the heat.
- The birds are not able to move quickly or fly due to their heavy weight. Because of this, the dogs and wild cats caught the birds and ate them.
- Meat of the birds was used in festivals and was offered when some guests arrived as a part of meals.

Vanaraja in the Backyard Poultry

Experience shows that the poultry unit as livelihood intervention did not achieve its purpose in any of the clusters. However, people just preferred to have them in their plate and palate. Some of the causes for the poultry failure might have been avoided if the recipients were taught how to manage the birds and protect them from heat, predators, etc. A technical factor, which needs re-examination, is the vulnerability of small chicks during summer. This intervention is an example of where there is a gap between an improved technology and the resources of the (poor) farmers to manage it. An alternative approach might be to work with a group of farmers and an improved management system of looking after the birds.

4.5 Synthesis

The project had an ample effect not only on the farming community but also on the landless. The project experiences suggest that a continuous dialogue is essential for promoting the interventions, which requires time. Unfortunately, the time was too short for both the community and project staff to confidently assess the long-term benefit, impact and sustainability of the NRM interventions, monitoring and evaluation. Promotion of ID crops helped the farmers to manage their water resources productively. Two crops, namely groundnut (with adequate water and no wild boar) and chickpea (with little water and not susceptible to wild boar) hold promise in *rabi*. Groundnut and chickpea being legume fit well in the cropping system in place of paddy during *rabi* season and will reduce pressure on ground water and nutrient requirement, mainly nitrogen. A satisfactory policy support is needed to promote ID crops in the context of subsidized or free power supply. Of late, maize is becoming popular but it is a risky crop in dry lands lacking supplemental irrigation although market is favourable for yellow varieties as poultry feed. ID maize is prone to wild boar menace.

Contingent crop planning is the need of hour, but it should be based on food habits and market availability. An attempt of promoting pearl millet in Mahabubnagar cluster during the delayed monsoon situation failed as people forgot the crop. Similarly, horse gram, for which the profit is marginal, was not well accepted. A favourable market and buy-back arrangement was found to be an important incentive. Farmers are ready to grow even a new crop such as gherkin in Tumkur cluster.

As an alternate land use option, farmers of Anantapur cluster were inclined towards the agri-horticulture system followed by the silvi-pastoral system in Mahabubnagar cluster and horticulture and forestry plantation in Tumkur cluster. The presence of wild boar prevented large-scale uptake of agri-horticulture system

as the cost of fencing was too high and live fence (agave) is not effective in its early stages. Similarly, the *rabi* groundnut was not grown in Bukklonipally (Mahabubnagar) or Shankarnhalli (Tumkur) just because of damage by wild boar (now protected by the Forest Department Act) which forces farmers to lose a crop and season. There is a need of either policy legislation or removal of wild boar from the list of protected wild life or encouraging the cultivation of alternate remunerative crops like chickpea or lucerne as leguminous fodder.

The potential of new varieties and crops could not be demonstrated adequately due to drought in 2003 (Tumkur and Anantapur) and 2004 (Mahabubnagar). However, varieties such as Annegeri (chickpea), SPV-462 (sorghum), Kranti (castor), Vemana (groundnut), GPU-28 (ragi), Hy-3c and LRG-30 (pigeonpea) were introduced. Intercropping systems such as sorghum/maize + pigeonpea, groundnut + pigeonpea were successfully demonstrated.

Animal health camps created awareness among farmers regarding the adoption of better livestock practices such as supplementation of mineral mixture in the concentrate ration. Farmers are demanding more number of such camps in the clusters. Through farmer-farmer interaction, many farmers realized the economic benefits of feeding green forage to animals and came forward to take the cultivation of improved forage cultivars. The landless were benefited in several ways, sheep rearing was found quite beneficial across the clusters while poultry had mixed results.

The weavers (SHG organization for managing a wool carding machine) and washer women/men communities [through improved water storage (Section 3)], although less directly related to NRM, for the first time in their life received help through this project that greatly reduced their drudgery, saving them time and money. Nursery raising and vermicomposting was both found to be feasible and potentially beneficial enterprises for the poorer households but their uptake as income generators depends on the existence of a market. Lastly, the community members understood that integrating livestock within their farming or livelihood systems is an answer for the drought prone areas while landless improved their skills.

4.6 Key learning's for livelihood diversification

- Crop interventions were effective in creating awareness about improvements regarding seed, seed source and practices.
- Timely availability of seed/seedlings and one-to one communication with the farmer at his/her field can convince the farmer to test new crops/cropping practices/land-use practices.
- Contingent crops, to meet the future needs of the farmers, should be marketable through, e.g., value addition. This prevents the contingent crop being relegated to minor status. The SSs can take a lead in convincing the farmer to take up the contingent crops and/or in maintaining a seed bank for future.
- Small and marginal farmers target only local markets. Therefore, they need to be able to sell their produce in the nearby local markets.
- For nursery raising, buy-back arrangements with local commercial nurseries would make it more successful as a livelihood for the landless.
- Seed interventions are self-replicating but farmers should be encouraged to replenish the old seed with pure seed to avoid genetic degradation after every 3-4 years.
- Alternate land use interventions are slow to demonstrate their benefits and need a long gestation. Further, they should be introduced as a package that includes

arrangements for water availability during the dry months and for some appropriate fencing even if it is from local materials.

- As seeing is believing, exposure visits should precede interventions and the visits should be arranged relevant to the interest of the participating villagers.
- The routine PRA exercises provide an overview of NRM management in communities but are not adequate for detailed planning of NRM interventions. This needs focused interactions with small groups or households.
- Even when technologies are relevant, extra forces such as market, wild boar, food habits, customs, etc., limit the choice and uptake by farmers. Previously, this was sometimes difficult for researchers to comprehend.
- Most developmental agencies treat crop and tree interventions as secondary and give preference to soil and water conservation works, farm tools and implements, AI, etc, which are visible and take away the lions' share in the budget. These interventions will only yield their maximum impact if they are supported by interventions in crop and livestock management.
- The adoption of improved livestock technologies (AI centre, sheep rearing, fodder production, establishment of silvi-pasture, poultry etc.) requires medium to long-term investment. Livestock interventions need to be attempted as part of a total package of interventions including watch and ward, protection from wild animals and resources to research into problems that arise (e.g., summer mortality of poultry).
- The adoption of livestock technologies tends to be slow and limited, especially during the initial phase of the project. The reluctant farmers are able to assess the performance of the interventions taken up by early adopters, and realized their suitability, uptake accelerated.
- Establishing some compensatory mechanism for the farmers in case of intervention failure could be taken up as policy issue.
- Integrated watershed management with a farming systems approach is key to natural resource management, and benefits both landed and landless.
- A researcher-NGO-extension worker-farmer partnership is possible for research to test, develop and promote technologies under a participatory mode.

Reference

Conner, J. R., Hamilton, W.T., Sheehy, D.P., Smith, J.W. and Kreuter, U.P. 1998. Grassland based livestock production in Temperate zones. *World Animal Review* 90: 6-13.

Department of Animal Husbandry and Dairying 2004. *Basic Animal Husbandry Statistics-2004,*. New Delhi, India: Government of India. Ministry of Agriculture

Department of Animal Husbandry and Dairying 2005. *Annual Report 2004-05*. New Delhi, India: Government of India . Ministry of Agriculture

Francis, J and Sibanda, S. 2001. Participatory action research experience in smallholder farming in Zimbabwe. Livestock Research for Rural Development. 13:3.http://www.cipav.org.co/lrrd/lrrd13/3/fran133.htm

Indo Swiss Project Andhra Pradesh 1997. Livestock feeding situation in Andhra Pradesh: Options for improvement. *Report No.22/97*. Andhra Pradesh, India : Indo-Swiss Project,

Misra, A.K., P.N. Dwivedi, V.S. Upadhyay, Bhag Mal and M.S. Dhanoa 1997. Socio-economic analysis of livestock

production in smallholder rain-fed farming systems in India , pp.157-158 *In: Proc. of an International Conference on Food, Land and Livelihood*, January,1997 Nairobi, Kenya : KARI,

Misra, A.K., Osman, M and Singh, H.P. 2004. Contribution of common grazing lands and forage resources to livestock production in Semi-arid India. pp 225 *In: Proceedings of National Conference on Resource Conserving Technologies for Social Upliftment. December 2004, New Delhi. India:* IASWC and CSWCRTI, Dehradun.

Parthasarthy Rao, P., Brithal P.S. and Ndjeunga, J. 2005. *Crop-Livestock Economies in the Semi-arid Tropics: Facts, Trends and Outlook.* Patancheru 502 324, Andhra Pradesh, India. ICRISAT. 68pp.

Reddy G.S., Reddy, B.M.K., Misra, A.K., Prabhakar, M and Sambrajyam, A. 2005. TAR-IVLP: On-farm assessment and refinement of technologies in Southern Telangana Zone of Andhra Pradesh. NATP. 54pp. Hyderabad, India:Central Research Institute for Dryland Agriculture,

Shukla R.K. and Brahmankar, S.D. 1999. Impact evaluation of operation flood on rural dairy sector pp.58-60.. New Delhi , India: National Council of Applied Economic Research

Singh, H.P., Y.S. Ramakrishna, K.L. Sharma and B. Venkateswarlu (eds.)1999. Challenges and opportunities p 629-632. *Fifty Years of Dryland Agricultural Research in India.* , Hyderabad, India: Central Research Institute for Dryland Agriculture

Sujatha, S. 2004: Effect of nutrient management on groundnut in mango based agri-horti system and different levels of drip irrigation and nutrition on mango in rainfed alfisols. Hyderabad, India: Unpublished Ph.D. thesis submitted to ANGRAU.

Vittal K.P.R., Singh, H.P., Ravindra Chary, G., Maruthi Sankar G.R., Prasad Y.G., Srinivasa Rao M., Samra J.S. and Gurbachan Singh 2003. Improved agronomic practices for Dryland crops in India. , pp62-63. Hyderabad, India : All India Coordinated Research Project for Dryland Agriculture, Central Research Institute for Dryland Agriculture, Indian Council of Agricultural research.

Appendix 4.1. Socio-economic characteristics of a sample of livestock intervention participants

The important socio-economic characteristics of sample households (who tried fodder intervention) are presented in Table 4.1.1.

Table A 4.1.1. Demographic characteristics of selected households by cluster

Particulars	Anantapur	Mahabubnagar	Tumkur	Av. of all
No. of households	15	15	15	45
Family size	4.9	5.7	4.7	5.1
Social group (%)				
Forward caste	27	40	20	29
Backward caste	46	53	73	58
Scheduled caste & scheduled tribes	27	7	7	13
Age of respondent (years)	47	41	44	44
<25 (%)	7	7	7	7
25-49 (%)	33	67	47	49
>50 (%)	60	26	46	44
Education status of respondent (%)				
Illiterate	53	20	7	26
Read & Write	7	7	7	7
Primary	7	13	40	20
Secondary	7	53	33	31
Higher secondary and above	26	7	13	16
Farmers categories (%)				
Landless	7	7	7	7
Marginal	20	32	7	20
Small	40	27	13	27
Medium	13	27	53	30
Large	20	7	20	16
Land details, ha				
Irrigate	1.0	0.9	1.4	1.1
Dryland	3.3	2.6	3.3	3.1
Total	4.3	3.5	4.7	4.2

The average family size of the surveyed households was 5.13 members per household and did not vary much across clusters. About 29% of the respondents belong to forward caste, 58% to backward caste and only 13% to scheduled caste (SC) and scheduled tribe (ST) community. The age structure of households indicates that the average age of head of household was lower in Mahabubnagar cluster than other clusters. About 55% of the population was in the age group of less than 49 years. The education level was higher in Tumkur cluster. Education plays an important role in the adoption of innovations/new technologies, and young farmers are expected to be early adopters. About 90% of households in the Tumkur cluster and 80% in the Mahabubnagar cluster were literate.

The concentration of landless and marginal farmers was more in Mahabubnagar cluster (40%) than Anantapur (27%) and Tumkur (13%). The majority of respondent belongs to small and medium categories.

Land is an important asset of farmers, although in the case of dairy production, purchased or exchanged feed and fodder can be substituted for land holdings. The average size of land holdings was smaller (3.50 hectares) in the Mahabubnagar cluster than Anantapur and Tumkur cluster. It ranged from about 0.30 hectares in the case of marginal farmers to about 8.23 hectares in the case of large farmers. The landless farmers are dependent on market-purchased feeds and fodder, and leased land for fodder production.. Nearly seven per cent of households had taken land on lease from other farmers for growing of food and forage crops. The terms of lease were mainly a fixed amount per unit of land and varied depending on the availability of water resource and quality of the land.

Appendix 4.2 Impact of adoption of improved forage production on livelihood of farmers

The survey was conducted on pre-tested format to study the impact of feeding green forage on milk production and income of the farmers during February–March 2005. Fifteen farmers were selected from each cluster for this purpose. The details of survey are given in Table 1 below.

The average number of animals per household varies with the size of the farm; however, there were striking differences in terms of composition of animal population across clusters and categories of households. Buffalo was a main source of milk production in the Anantapur and Mahabubnagar cluster, while crossbred cattle in Tumkur cluster. Among marginal- and small-scale farmers, about 90% of milk animals were buffaloes, while large farmers kept both buffaloes and crossbred cows for milk production. Buffaloes constituted about three-fourth of milk animal population; the rest were cattle.

The average number of milk animals kept by farmers were 2.83, ranging from 1 to 20. The average area allocated for improved forage crops ranged from about three per cent (Tumkur) to about six per cent (Mahabubnagar). The area under improved fodder crops ranged from 0.09 hectare on marginal and small farmers to 0.25 hectare on large farmers, with an average of 0.16 hectare for all categories. Maize, *jowar* (sorghum) (PC-23), hybrid napier (Co-1), guinea grass and lucerne were important fodder crops.

The quantity of milk production on a dairy farm does not depend on the total number of animals in the herd but on the number of milk yielding animals. The higher the proportion of animals giving milk, the lower the cost of milk production. The proportion of animals giving milk was generally higher in Anantapur (67%) than in Mahabubnagar (56%) and Tumkur (57%). The productivity of milk animals is of vital importance to livestock owners because it has a direct influence on costs and returns. Thus, the average milk yield of lactating animals was worked out.

Milk is an important source of nutrition in rural areas. Dairy farming system provides a variety of outputs, such as milk, organic manure, draft power, and cash income. The farmers retain part of the milk for home consumption (liquid milk and milk products) and sell the rest in the market to get cash income. The average milk production per household has a direct relationship to farm size. The average share of milk sold is higher in the Mahabubnagar cluster than in Anantapur and Tumkur. In Tumkur cluster more than 95% farmers sell their milk to dairy cooperatives where as in Anantapur and Mahabubnagar cluster farmers sold milk directly to consumers and milk/sweet shops.

The average per capita availability/consumption of milk was higher in Mahabubnagar cluster (279 g/day) than Tumkur (220 g/day) and Anantapur (209 g/day). The average per capita consumption ranged from 217 grams per day for marginal farmers to 262 grams for small farmers.

Table A 4.2.1. Impact of adopting improved forage on milk production and income of the farmers in selected clusters.

Particulars	Anantapur	Mahabubnagar	Tumkur	All
No of households adopted improved forage species	61	82	20	163
No of household surveyed	15	15	15	45
No of buffaloes/household	3.8	6.3	1.1	3.7
No of cattle /household	1.4	1.1	2.4	1.6
Total cattle & buffaloes/household	5.2	7.3	3.5	5.3
No. of milch animals/ household	3.0	3.7	1.7	2.8
Area under improved forage crops/household (ha)	0.19	0.16	0.13	0.16
Percent of total area under improved forage	4.4	4.6	2.8	3.9
Milk yield, litre /animal/day	4.1	4.8	6.3	5.1
Milk yield, litre /household/day	12.2	17.8	10.9	13.6
Milk sold, litre/household/day	11.2	16.2	9.8	12.4
Milk consumed/day/household	1.0	1.6	1.0	1.2
Milk consumed/capita/day (g)	209	279	220	238
Feeding schedule of milking animals				
Grazing (hours)	6.1	5.8	4.3	5.4
Green fodder (kg/day/animal)	9.6	11.1	8.7	9.8
Dry fodder (kg/day/animal)	8.5	8.7	7.9	8.3
Concentrate (kg/day/animal)	2.1	2.4	2.3	2.3
Impact of feeding green forage				
Increase in milk yield (litre/day/animal)	1.5	1.2	1.0	1.2
Milk rate (Rs./litre)	12.9	13.3	9.5	11.94
Gross return (Rs./day/animal)	19.0	15.5	9.0	14.3
Cost of green forage (Rs./day)*	2.4	2. 8	1.7	2.3
Cost of additional labour (Rs./day)**	2.0	2.0	2.0	2.0
Total cost (Rs./day/animal)	4.4	4.8	3.7	4.3
Net return (Rs./day/animal)	14.6	10.7	5.2	10.0
Net return (Rs./day/household)	43.8	39.8	9.1	30.9

*Cost of fodder production: Rs. 20/100 kg of sorghum, Rs. 25/100 kg of Hybrid napier/Lucerne/Guinea grass.
**1/2 hour/day in cutting, transportation, chopping, etc Rs. 2/day

The average price received by the household for buffalo milk was higher in all clusters. In general, price received for milk was higher in Anantapur and Mahabubnagar cluster than in Tumkur cluster. The reason for this is that in Anantapur and Mahabubnagar, farmers sold milk directly to the sweet shops and consumers, whereas in Tumkur cluster most of the milk was sold to dairy cooperatives where price was based on fat and solid-not-fat (SNF) content.

Realizing the economic benefits of feeding green forage to animals, many farmers came forward to take the cultivation of improved forage cultivars.

Section 5

Improved Tools and Implements

5.1 Introduction

Indigenous tools and implements are frequently less efficient compared to specialized, improved tools and involve men and women in drudgery. A PRA conducted in the cluster villages (Section 2) identified the clusterwise need and priority of the community for farm tools and implements (Table 5.1). These were procured as an intervention for this output. Since some of the implements were costly, they were organized on a community basis through cluster level or village level (for Mahabubnagar) custom hiring centres (CHC).

Agricultural Implements Interventions

These centres were piloted in selected states in India under the National Agricultural Technology Project (NATP) (2001–2005) and CRIDA successfully introduced three centres in Mahabubnagar and Anantapur district of Andhra Pradesh. Under a CHC, the implements become an asset of the community and available for hire by community members. The hire charge is used to cover the implement repairs and replacements as well as the living costs for the CHC manager. In this way, implements generate income, create an employment opportunity and are available to benefit all categories of farmers. Table 5.1 shows that all the implements procured, excepting the sprinkler and sprayers, addressed agricultural operations that were traditionally undertaken by women: their use therefore reduces women's drudgery.

The PRA findings showed that acute shortage of human labour and deficit of animal power occurs during the peak operation period of sowing and weeding. This leads to prolonged and delayed operations and hence inability to efficiently utilize the early season rainwater and nutrient resources. Use of improved implements should allow quicker completion of crop operations, reducing drudgery for women and men, better exploitation of natural resources (NRs) and hence better productivity. Labour deficits also occur at harvesting and threshing, which can lead to substantial postharvest losses. Interventions to improve this situation were proposed in the project log frame and were implemented in all the three clusters. The process and outcomes of the interventions are discussed clusterwise in the following sub-sections: the "Major learnings" within each cluster report are compiled from interactions with farmers. Details of CHCs are given in Section 5.3.

Table 5.1. Implements distribution to clusters and hire charges.

Implements requested and provided	Work of women?	No. items Rs.	Cost of machine Rs.*	Charges cost saved Rs.	Operation
I. Anantapur cluster					
1. 9-Row planter	Yes	1	29500	350/acre	200/ha
2. Groundnut thresher	Yes	1	35000	20/quintal	20/qu
3. Power sprayer	No	1	19000	50/day	125/ha
Foot sprayer	No	1	2500		
Knapsack sprayer	No	1	2000		
4. Chaff cutter-power	Yes	1	3500	0.10/bundle	
Chaff cutter - manual	Yes	4	250		
5. Sprinkler set	No	1	8000	150/day	
II. Mahabubnagar Cluster					
1. Tractor planter	Yes	2	25500	350/acre	
2. Bullock drawn planter	Yes	4	15000	150/acre	50/ha
3. Plough planter (1-row)	Yes	4	1400	50/day	50/ha
4. Interculture hoe (oxen)	Yes	4	1200	100/acre	
5. Manual weeder	Yes	20	550	20/day	215/ha
6. Maize sheller	Yes	1	32000	15/quintal	2.5/qu
7. Castor sheller	Yes	1	25000	15/quintal	3/qu
8. Paddy reaper	Yes	2	80000	300/acre	150/ha
9. Wool carder	Yes	1	25000	50/hr	55/blanket
10. Groundnut stripper	Yes	1	11500	20/quintal	2.5/quintal
11. Chaff cutter (power)	Yes	1	5500	0.10/bundle	
III. Tumkur Cluster					
1. Multi crop thresher	Yes	1	30000	15/quintal	20/quintal
Manual weeder	Yes	5	550		
Manual chaff cuter	Yes	5	250		
Coconut dehusker	Yes	5	850		

*Hire charges were set by each *Salaha Samithi* (SS), in consultation with project staff, and considering the replacement and running costs of the implement.

5.2 Cluster wise interventions

5.2.1 Anantapur cluster

Groundnut is a major crop in Anantapur cluster. Major operations such as timely sowing, spraying, life saving irrigation during dry spells and stripping/threshing of the pods, needed an intervention of appropriate implements to enable increased efficiency in NR. Based on the priority that the community expressed during the PRA, a 9-row planter for timely sowing; a power operated groundnut thresher; back mounted power sprayer; foot operated sprayer; knapsack sprayer, power chaff cutter; manual chaff cutter and an irrigation sprinkler set were procured and placed with the newly formed community operated CHC.

5.2.1.1 Nine-Row Planter:

Traditionally, groundnut issown using a 4-row bullock-drawn implement, which is slow and prolongs the operations. Rainfall in Anantapur is erratic and scarce leading to hardly 1–3 days being available for sowing. With the traditional implement, only 30–40% of the area can be sown in time and the balance 60–70% of the area is often badly affected due to non-availability of sufficient moisture during the crop growth period.

Demonstrating the nine row planter at farmers field

The PRA indicated that there are some tractors available in the village but no tractor-drawn sowing implement. The nine-row planter placed in the CHC was hired by the tractor owners. This increased operational speed by three times, making timely sowing possible with a uniform crop stand. However, there are some limitations of tractor planter use: some field area was left unsown where the tractor turns; and on stony fields seed distribution was irregular.

Major learnings (a) Modification of the planter's furrow openers was needed to suit rocky soils by replacing the rigid opener that jumps out of the soil when it hits a stone with a spring tine (this modification was made). (b) Smallholder farmers were concerned about the "lost" or unsown turning area. However, the planter does suit the larger fields found in Anantapur and ensures timely sowing and uniform crop establishment. These benefits outweighed its disadvantages and both small- and medium-scale farmers hired it.

5.2.1.2 Power thresher

Traditionally, groundnut is manually harvested and stacked until human labour is available for manual stripping of pods. During harvesting and threshing period acute shortage of human labour occurs. Severe delays in threshing groundnut of up to 4 months often prevent it from fetching the better early season price in the market (at current prices around Rs. 18/kg vs. Rs. 15/kg during the later season). The delays also result in post-harvest yield and quality losses. The power-operated groundnut thresher was introduced through the CHC, and it could thresh 60–80 bags per day as against one bag per day per person, at 1/3rd of the cost (Rs. 20/- vs. Rs. 60/- per bag manually). Quick availability of quality marketable produce was a major gain to the producer.

From hire of the thresher, the CHCs earned Rs. 18,000 during the season, which created a financial resource base for the

running and maintenance of the community organized centre and the implements. Farmers could market produce at a better price due to the good quality of the seed threshed through the machine.

Major learnings

(a) No postharvest storage losses

(b) Saving in labour cost

(c) High market price of grain

(d) Easy adjustment of the thresher and good quality threshing of other crops

(e) Loss of some employment opportunities for agricultural labour

(f) Technical skill needs to be imparted to the operators before equipment use to ensure operator safety and correct adjustment of the machine.

5.2.1.3 Power sprayer

Back mounted, hand operated knapsack sprayers are traditionally used for pest and disease control but these are more inefficient and take a longer time, which increases the workload and drudgery. The power sprayer covers a larger area more quickly and reduces the drudgery. A foot sprayer and knapsack sprayer were also made available for hiring through the SS.

Major learnings:

(a) Foot sprayers are not very useful for groundnut: they are too slow and require two persons to operate them.

(b) Hand operated knapsack sprayers are suitable for small farms but not for larger crop areas.

(c) Power sprayers are effective for large areas, save time and labour cost and reduce human drudgery.

(d) Hands-on training is essential for the power sprayer operators.

(e) The CHC created easy accessibility to the power sprayer for users.

5.2.1.4 Chaff cutter

Manual and power chaff cutters were given for efficient utilization of fodder. The power chaff cutter was easy to operate and could reduce women's workload compared to the manual chaff cutter. Fodder loss was reduced from 50% to 10% by using a chaff cutter. Power chaff cutters provide self-employment to educated youths.

Major learnings. The power cutter performed well. However, Anantapur is a predominantly groundnut area and does not have enough dry fodder from sorghum and other crops to fully utilize a power chaff cutter. Hence, power chaff cutters may not be very suitable for this cluster.

5.2.1.5 Sprinkler set:

Dry spells in Anantapur are very common and one life-saving irrigation system can save groundnut crop. Rain-harvested water from ponds could be recycled using a sprinkler set for life-saving irrigation. A sprinkler can irrigate four times more area than flood irrigation from the same volume of water. The SS fixed a low rental charge for using sprinkler set for members and non-members without consultation with technical staff. Farmers who had stored water could hire the sprinkler set and engine and save their groundnut crop.

Major learnings:

(a) Training in handling and maintenance of an irrigation set is essential

(b) Many farmers were able to use the sprinkler because of the (too) low rental charges set by the SS

(c) Sprinklers reduce the cost of irrigation, save water and irrigate more area in a short time.

5.2.2 Mahabubnagar cluster

Mahabubnagar cluster has been facing a drought since 1973. The cattle population is going down and fodder is becoming scarce.

Due to shortage of draught animal power, some farmers purchased tractors through bank credit. The PRA exercise in the villages indicated that the major crops are paddy, castor, sorghum, pulses, oilseeds and that farmers need equipment for sowing, interculture, groundnut stripping, castor and maize shelling, paddy harvesting and chaff cutting. Small farmers preferred bullock-drawn and manually operated tools and all farmers preferred power-operated machines on custom hiring for paddy harvesting, castor and maize shelling and groundnut stripping. Based on the PRA, the sets of implements were procured and placed in the villages with a trained group of youths for running the CHC. In Mahabubnagar, each of the four villages had a CHC. Most of the implements introduced are new to this cluster and proved acceptable because of their easy availability at low rental charges.

Traditionally, the landless and small holders from this cluster migrate during the off-season in search of jobs and better livelihood opportunities in nearby towns. They return during the cultivation season but during peak operation periods, there is a deficit of human labour. Therefore, the implements were perceived to be appropriate, as they reduce the labour deficit. Experience of mechanization projects implemented by CRIDA at ten locations indicates increased cropping intensity by 15–20%. Additional employment opportunities for local agricultural labour shot up by 10–20%. The custom-hiring concept was readily acceptable in this cluster. Fifteen youths trained at CRIDA could successfully run the CHCs and earn good revenue for the CHC and for the youths themselves.

5.2.2.1 Six row tractor-drawn planter

Traditionally castor and sorghum are sown using the country plough for making the furrow: seed and fertilizer are then dropped manually into the furrow. The operation is slow and no precision in seeding depth and spacing is achieved. Timely sowing holds a key to successful crop production in this area. Hence, the villages with tractors were given two tractor-drawn planters to be available through the CHCs. The tractor owners could use the planters efficiently on their large plots but the planters could not be effectively used by smallholders, due to their small plot sizes and the land wasted (unplanted) for tractor turnings. The planting operation was much faster with the tractor-drawn planter but its use was constrained by the non-availability of a tractor with the CHC operators and also the limited custom hiring demand. Hence, the farmers revised their demand and requested instead a 2-row bullock drawn planter. Two 2-row bullock-drawn planters, of equivalent total cost, were supplied by the project in place of each tractor-drawn planter.

Major learnings

(a) Most farmers do not own a tractor and neither does the CHC. The tractor-drawn planter would be useful if the CHC owned a tractor.

(b) Most small landholders were not willing to use the tractor-drawn planter due to wastage of land in turning.

(c) After testing the planter, the cluster farmers changed their perception and decided that a 2-row bullock drawn planter may be most suitable.

5.2.2.2 Four row bullock-drawn planter

One of the planters was given to each of the CHCs in Mahabubnagar cluster. The general perception of the farmers as expressed during the PRA was that the 4-row bullock-drawn planter would be workable as bullock pairs are available in the villages. Hence, the planters were procured and placed at the CHCs. On testing the 4-row planter, the farmers were happy with its technical performance as it gave precision in seed placement and better crop stand. However, in practice, farmers found the 4-row planter a little heavy for their small size of bullocks. They detected some operational difficulties

due to their smaller plots. The heavy weight of the planter (150 kg) posed a difficulty in manoeuvring it while turning. Hence, farmers preferred a smaller machine. Since the option of 2-row planters was available, the 4-row planters were replaced with 2-row planters.

Major learnings

(a) Precision of the machine in seed placement was appreciated.

(b) Bullock-drawn machines should be chosen as per the size of the bullock power available.

5.2.2.3 Plough planter

Single row bullock drawn precision planters were included as they match the smallholder farms sowing needs. The seed fertilizer drill unit is mounted on the local country plough and operated similarly to the local sowing method except that seed and fertilizer is metered and placed by a mechanical unit behind the country plough. This implement was readily acceptable to individual farmers and was used effectively. However, the number of units available was much less than the demand during the sowing season. More number of machines should be made available by the CHC during the peak sowing period.

Major learnings

(a) The plough planter is acceptable to most smallholder farmers.

(b) The CHC should keep more number of units as supply is far short of demand during peak sowing period.

5.2.2.4 Interculture hoe (bullock-drawn)

Interculture in these villages is mostly done by running the country plough between the crop rows. One advantage of this practice is that the country plough makes a deep furrow, which conserves moisture. However, using the country plough consumes more time and energy by making several passes through wide row-spaced crops. The bullock drawn interculture hoe makes shallow tillage between rows and covers the complete row width in one pass. It also creates a shallow concave surface, which serves as a moisture conservation zone, and a soil mulch. This unit was most acceptable to the farmers and was extensively used.

Major learnings

(a) This is most useful and acceptable tool for interculture.

(b) More number of units should be made available by CHCs.

5.2.2.5 Manual weeder

Hand weeding with a local tool called *khurpi* (a small sickle) is the common weeding practice and is mostly done by women. It involves adopting a sitting posture while moving forward and using the *khurpi* to remove weeds between and within the crop rows. Hence complete weed removal is possible. However, the women are put to discomfort and continuous operation results in physical fatigue. The weeding practice is also slow and costly. Hence, the most preferred choice of the villagers for weeding was a manual weeder. The weeding operation using this weeder is most comfortable as it is done in a walking posture, moving forward, with weeding done by the tool mounted on wheeled frame. The manual weeder improves work capacity in weeding by 10 times. Five units were supplied to each CHC in four villages, but this could not meet the demand. More number of units needs to be kept by the CHCs.

Farmer operating Rotary weeder in his field

Major learnings

(a) The improved manual weeder removed the drudgery for women in weeding and improved work efficiency.

(b) More numbers of the manual weeder are needed to meet the demand at CHC.

5.2.2.6 Maize sheller

Maize shelling is done by manual removal of grains from cobs, which is time consuming, costly and causes drudgery to the women, who are mostly involved in this operation. Since the area under maize is increasing in this cluster, the availability of human labour for manual operation is a major constraint. Therefore, during the PRA, members expressed the need for a power operated maize sheller for efficient shelling of maize, which, through accelerating the shelling and producing a high quality (clean) product, can capture a premium in the higher early season market prices. One maize sheller unit was given to the cluster to cover all four villages in the cluster. This was charged at Rs. 15/quintal for all categories of farmers. This was acceptable to all and there was a demand for one machine in each village.

Major learnings

(a) Power operated machines reduce the drudgery of women in shelling operation.

(b) The shelling is quick and efficient and the clean grains fetch a better price in the early season market.

5.2.2.7 Castor sheller

Castor is a major cash crop in this cluster and is mostly shelled by manually beating and cleaning. The job is usually done by women with about 40 kg output/day. Since about 60% of area is covered by castor, the labour requirement is heavy and costly during the peak shelling period. The PRA suggested the need for a castor-shelling machine and one unit was supplied to cover all four villages in the cluster. The machine was most acceptable and shelled the crop at a much faster rate, giving an output of about 700 kg/hr. This benefited all categories of farmers and particularly the smallholders as they could avail the rental machine at a cost of Rs. 15/quintal, freeing their labour for alternative employment.

Major learnings

(a) Power operated castor sheller remove the drudgery of women.

(b) Small holder farmers were benefited due to faster castor shelling and early marketing at higher prices.

(c) More machines should be provided by CHCs.

5.2.2.8 Paddy reaper

Paddy is the most popular irrigated crop in the cluster as it gives better returns to the farmers. Although the area planted depends upon the irrigation water available, most farmers, irrespective of their size of landholding, cultivate paddy. The crop is harvested, mostly by women using a *khurpi* (local sickle). Women walk in muddy paddy fields, bending over to cut the rice stems close to the ground which causes fatigue and great drudgery to women. Moreover, due to migration of the work force in the off-season, labour availability during peak harvesting period is a major constraint and hence, during the PRA, a paddy-harvesting machine was demanded as a necessity. Two units were given to cover four villages in the cluster on a custom hiring basis and were kept with the CHCs. This was accepted and became popular, because paddy was efficiently harvested and drudgery of women was eliminated. It made paddy farmers independent of the labour availability status.

Major learnings

(a) The paddy reaper was a most acceptable machine due to efficient and faster harvesting.

(b) It saved women from drudgery.

(c) Mechanical harvesting reduced the cost of the harvesting operation.

(d) Availability of the machine from the CHC benefited small farmers, as they cannot afford to own such a costly machine.

5.2.2.9 Wool carding machine

At their strong request, the weaver community was provided with a wool-carding machine, which was run by a youth from the shepherd community on a custom hiring basis. Until that time, 70 weavers were traveling a distance of 25 km to clean wool. The Weavers Association, a self help group (SHG) that formed with project support (Section 2.4.1), was responsible for maintenance and management of the machine. This intervention enhanced the income of the landless poor shepherd community, saving the weaver's time and lessening cost in getting the wool cleaned.

5.2.3 Tumkur cluster

The majority of farmers in this cluster are small and marginal. As in the other clusters, frequent droughts mean that many families migrate to other places in search of work. This leads to a shortage of human labour for agricultural operations. Consequently, the labour cost shoots up. Due to the short span of sowing period, conventional tools were found inadequate to meet the demand for timely operations. The drudgery of labouring with these tools is one reason why youths are unwilling to engage in agriculture. During the PRA exercise, when the existing tools were identified, the point on drudgery was prominently brought out by the participating agricultural workers. The major equipment requested by and provided to the cluster was a multi-crop thresher. In addition, a manually operated chaff cutter, coconut dehusker and manual weeder were provided. The idea of custom hiring of implements was found most acceptable in this cluster and the SS agreed to manage and operate the CHC. The SS identified some youths whom the project then trained in repair and maintenance of the equipment.

5.2.3.1 Multi crop thresher for ragi

Ragi (finger millet) is a major food crop of this cluster and covers about 30–40% of the cultivated area. Traditionally, threshing of the ragi is done by manually beating and cleaning. This requires a large number of labourers, mostly women. Owing to large hectarage under coconut and other plantation crops, most of the labour force was diverted to the irrigated areas and therefore was not available for *ragi* harvesting and threshing. The *ragi* thresher was introduced as requested and as agreed during the PRA, it was made available through the CHC to predominantly small farmers @ Rs. 15/quintal. There was a good acceptance of this machine.

Multi Crop Thresher

Major learnings

(a) The *ragi* thresher overcame the crisis of labour shortage during the threshing season.

(b) It removed the drudgery of women

(c) It was cheaper than manual threshing.

(d) Most small farmers benefited due to its availability on a custom hiring basis.

5.2.3.2 Manual weeder, manual chaff cutter, coconut dehusker

These implements were relevant for the Tumkur farming operations and were supplied to the CHC. Manual weeder did not perform well on stony soils and needed modifications while the chaff cutter handle was found to be too short for easy operation. Both these problems were rectified by local blacksmiths. However there was little demand for either the

weeder or chaff cutter, since they were low cost items and hence are affordable to farmers. The coconut dehusker was introduced to growers to assess its usefulness in saving drudgery and cost. Many farmers could buy this tool.

Major learnings

(a) The CHC generates self-employment opportunities and is economically feasible.

(b) Manual weeder is not useful in soil with pebbles.

(c) The implements reduce drudgery for women and saves time and energy.

(d) The chaff cutter minimizes fodder wastage.

(e) Local modification to the chaff cutter handle is needed for comfortable operation and is done locally.

5.3 Capacity building through custom hire centres

5.3.1 Custom hire centres

Custom hire centres (CHCs) are centres in the communities, where agricultural implements are kept for hire by villagers, and are a recent innovation in India (as outlined in Section 5.1). If successful, they function as a service provider. They have the potential to be financially viable and hence a business or self-employment opportunity for entrepreneurs. The concept of CHCs was discussed within each cluster and was supported by the villagers.

Within each cluster community, youths who were interested in managing the CHCs came forward. Among these, the SS nominated some for preliminary training as CHC managers, based on their capabilities (e.g., some experience of machinery), education (had completed at least 10th class) and aptitude for mechanical work. CRIDA provided a one-week training to 15 youngsters at CRIDA Research Farm, Hyderabad, that covered both machine operation and maintenance, and accounting and managerial skills. After the training, the youths were assessed by CRIDA project staff, and 2–3 persons for each CHC were chosen as the CHC managers/operators. In addition to running the CHCs, the youths provided technical and operational back-up to the farmers who hired the implements.

The implements, as agreed clusterwise during the PRA exercise, considering local needs, were procured and placed at the disposal of the SS, which was entrusted with the overall responsibility of running the CHC. The implements were then handed over to the nominated CHC manager(s). The rental charges for each implement were fixed by the SS members in consultation with project technical staff, considering the implement cost, depreciation, running costs and capacity of user to pay. (For the Anantapur sprinkler set, the SS itself fixed the rental charges for members and non-members: In this case, the charge was uneconomically low.)

Table 5.2 Implements hire by wealth category of farmers (CHC records)

Cluster	CHC income Rs.	Category of farmer users	Percentage %	No. farmers (operation area)
Anantapur	21,000/-	Small Medium Large	40 25 35	21 (26 ha)
Mahabubnagar	18,225/-	Small Medium Large	60 20 20	28 (83 ha)
Tumkur	11,655/-	Small Medium Large	70 20 10	33 (28 ha)

5.3.2 CHC performance and outcome

Interventions of tools and implements are expected to enhance the income of the farmers through reduction of the cost of the different crop operations and enhanced yield due to better utilization of nutrients and moisture. The utilization and income generation for the farmers through hire of the CHC implements in each cluster is discussed below:

5.3.2.1 Anantapur

In the single CHC in Anantapur, five major items of equipment and some smaller items (Table 5.1) were supplied and made available through the SS on custom hiring to the different categories of farmers. About 21 farmers hired implements from the CFC, which accumulated Rs. 21,000/- income from implement hire. Individual users of the machinery gained by saving labour costs of Rs. 200/- per ha on sowing groundnut, Rs. 20 per quintal for threshing, and Rs. 125/- per ha in crop protection spraying (Table 5.1). They also gained by saving their groundnut crop by one life saving irrigation using the sprinkler set during a dry spell, which enhanced crop yield by 30–40%. The chaff cutter saved 50% fodder losses. Individuals increased their income by 20–30% through saving on labour costs and from the enhanced groundnut yield (Final report, NATP-MMP on Dryland Mechanization, CRIDA 2005).

The implements also reduced drudgery. For example, manual sowing after the country plough involves women labour walking 30–60 km/ha in the field, while hand stripping of groundnut pods required long hours of work by women in a sitting posture. The men who operate a back mounted handle pump sprayer must carry the weight on their back for many hours walking in the field. Since power sprayers cover a larger area at each pass, the spraying time and distance walked are reduced, saving the men from drudgery. Additionally, the CHC provided skill training and employment to one person for machine operating, record keeping and running an enterprise and provided him a livelihood.

5.3.2.2 Mahabubnagar

In Mahbubnagar cluster, each village has a CHC; whereas Anantapur and Tumkur had a lesser number or single unit of more expensive machinery, which was centrally located in the cluster. Mahabubnagar had requested lower cost items. This meant that more number of the items was provided which could thus be placed in the different villages. The four CHCs were not equipped identically but the villages were close together and farmers were able to hire them from any CHC. The implements provided were seed planters, interculture hoe, a groundnut stripping machine, castor and maize shellers, paddy harvester, chaff cutter and wool carding machines (Table 5.1). Except the power chaff cutter (held as an income earning enterprise by a nominated individual) and the wool-carding machine, held by the Weavers User Group, all other tools and implements were made available through the CHC run by a group of 2–3 trained youths in each village. The communities initially requested large multi-row planters, but after testing these, they decided that single row and double row planters were preferable due to the small operational holdings and bullock size of the farmers. The project replaced the multi-row planters by single and double row planters.

Demonstration of Groundnut stripper

Saving on the crop operation cost (Table 5.1) through the use of the different implements is as follows:

- single row planters save Rs. 50/ha on operation cost
- manual weeders saved Rs. 215/ha
- the groundnut stripper saved Rs. 2.5/ quintal
- the castor sheller saved Rs. 3.0 per quintal
- the maize sheller saved Rs. 2.5 per quintal
- the paddy reaper/harvester saved Rs. 150/ acre.

The power chaff cutter provided livelihood to one youth who earned Rs. 1200/- per month by chaffing fodder at Rs. 0.10/ bundle.

Chaff cutter at Chowderpalli in Mahabubnagar

The wool-carding machine saved Rs. 55 per blanket and increased the income of shepherds. The CHC implements were used by 28 farmers for operations covering 83 ha in four villages and accounted for an income raise of 15–18% by way of saving operational costs and increasing crop yields of castor, sorghum and groundnut. The women were saved the drudgery of the work in the field for planting (the traditional practice requires walking approximately 70-80 km/ha sown), weeding, manual harvesting of paddy, groundnut stripping, and maize and castor shelling by hand beating. This allowed them to look for other productive employment or spend more time at home and caring for their children.

5.3.2.3 Tumkur

In Tumkur cluster the predominantly smallholdings and conventional hand tools discouraged the youth to pursue agriculture. Implements such as the multi-crop thresher for *ragi* (finger millet), chaff cutter, coconut de-husker and manual weeder (Table 5.1) improved the income of the farmers by 15–20%, removed the drudgery of women in weeding, threshing and coconut de-husking operation, and made agriculture more attractive to the youth.

5.4 Synthesis

All the three clusters had different rainfall, crops and soils, and consequently needed slightly different approaches to the introduction of tools and implements. Anantapur cluster is predominantly groundnut based system with frequent dry spells and required major interventions relevant to improving livelihoods based on the groundnut crop. Hence, the implements chosen were those that enable the timeliness demand of the groundnut crop to be met; life saving irrigation; and quicker marketing of a quality product through mechanical threshing.

In Mahabubnagar, due to frequent drought situations, a large number of male family members migrate creating a shortage of labour during the peak operation periods. Implements were mostly required to fill this deficit of human labour. In addition, dryland crops such as castor, sorghum, maize, and the small area under pulses and oilseeds required a commodity based approach of selecting some crop specific tools and implements. Rice is the major irrigated crop, which suffered most due to labour shortage during harvesting. Overall, the interventions were essentially required to meet labour shortages and improved efficiency

of small-scale farming by facilitating easy accessibility of costly machines through CHCs.

Tumkur cluster is predominantly a small-scale farming area and mostly required an intervention that suits small farms. A large capacity machine, the multi-crop thresher, was considered and provided for custom hiring.

All the three clusters clearly indicated that interventions of tools and implements were most appropriate due to their impact on reducing the drudgery of men and women during the concerned agricultural operation, improving efficiency of operations, reducing cost and improving profitability. One feedback from the clusters farmers was that due to interruptions in electrical power supply, engine powered machines were more suitable than electrical ones.

The flexibility of the project, including in budget allocation, enabled the project to respond to the on-going joint learning of villagers and project staff. For example, when Mahabubnagar farmers decided that the multi-row planter that they had initially prioritised did not match their resources and needs, the project replaced this with more appropriate single and double row planters. Again, when farmers suggested some modifications to the implements, the project made the modifications, using local craftsmen where possible. The combination of the knowledge and ideas of villagers and project support staff contributed to the appropriateness and adoptability (as indicated by demand for) the implements held at the CHCs.

The concept of custom hiring was widely appreciated. It was a most acceptable mechanism for maintaining a selection of implements within the community for use by the community. By developing the capacity (including skills) of the community and the CHC managers to successfully maintain the CHC, the CHCs provided improved livelihood options to the entrepreneurial managers (who were unemployed youths). Through the implements hire, the CHCs enabled improved production efficiency of inputs like labour, water and nutrients and thereby improved the livelihoods of the rural farmers. The CHCs demonstrated that they could manage and mobilize a good amount of revenue from implement hire. In the clusters, this provides resources for further village development but also suggests that CHCs could be viable as a private business elsewhere in the region.

5.5 Key learnings

- Interventions of improved tools and implements have improved the efficiency and economics of crop operations.
- Small tools, and particularly the manual weeder, plough planter and manual chaff cutter, proved to be significant contributors in reduction of the drudgery of farmwomen.
- The wool-carding machine provided better livelihood opportunities to the most poor and poorer rural households. It also provided an opportunity for capacity development through the weavers self-help group that managed the machine.
- The concept of a CHC for implements proved to be a boon to all categories of farmers, landless and poor people due to its effect on improving productivity, profitability, employment opportunities etc. The project team is confident that the CHCs will sustain in the post-project period due to their economic feasibility and benefit to users.
- Individually owned large capacity implements for which there is a local demand can also provide livelihood opportunities to the landless poor e.g. the power chaff cutter given to a nominated individual in Mahabubnagar cluster.
- Capacity building of rural unemployed youths, *e.g.* through training and on-the-job back-up, is an essential factor for

successful interventions through tool and implement hire and CHC management.

- Farmers do not always choose appropriate implements e.g., the multi-row planter in Mahabubnagar. This may be due to lack of experience of the machines. Assessment by project staff during PRA of the draught power resources and operational land holding size of the rural households may help the communities to select appropriate implements, avoiding later stage replacements.
- The flexibility of the project enabled the implements to be provided according to the different cluster needs and enabled the project to actively respond to the new learnings of the farmers by replacing implements that the farmers had found to be unsuitable with those that were better suited.
- Creation of rural infrastructure for capacity building of youths as service providers, and the financial constraints to initiate CHCs and also during the different phases of tools and implement based interventions in dryland agriculture, require greater attention of policy makers in order to achieve better results.

Section 6

Reaching to Stakeholders

6.1 Introduction

The project aims to communicate the project learnings/(research) products to its stakeholders. The main intention of Output V is to ensure that this happens and that the findings of the project are made available to concerned stakeholders – policy makers or implementers; at local, national or international level. Any learning or recommendations from the project will then have the potential to impact beyond the project area.

6.2 Project Communications

In the project, emphasis was laid on open communication to different stake holders through a variety of appropriate means: workshops, reports, policy briefs, case studies, photo exhibitions and folders. To assist with the planning of this communication, and so that appropriate information would be sent to the relevant stakeholders using an effective method, the project held an internal workshop to consider a series of communication planning questions (Box 6.1).

Box 6.1 Communication Plan Question

i Who are the communication stakeholders for the project?

ii What are the project (research) products and other issues that the project team needs to communicate about with the communication stakeholders?

iii What are the objectives of communicating about the products to the communication stakeholders (i.e., what might the stakeholders want to be able to do once the project team have communicated with them)?

iv What media and channels might be used to communicate the project (research) products with the various communication stakeholders (e.g. what media and channels are accessible to the various stakeholders, what are their preferences, what can be sustained)?

The project identified five main groups of stake holders in the project and three main groups of project findings ((research) products and issues) that it would need to communicate about (Box 6.2): these were updated as the project developed. The main communication interventions that the project undertook to maintain effective communication with these stakeholders on the project learning, products and issues, are presented in the remainder of this section.

Box 6.2 Project communication stakeholders and products to be communicated

Main stakeholder groups: Andhra Pradesh (A.P.) and Karnataka (Ktk)

- District Collectors or Deputy Commissioners (DCs)
- Project Officers (POs) of District Water Management Agency (DWMA) (A.P.) and Drought Prone Area Program (DPAP) in Ktk
- Selected Non-government Organisations (NGOs) working in rainfed areas
- Community based and farmers organizations (CBOs and FOs)
- Division of Natural Resource Management (NRM) in ICAR, and the research institutes under this division, State Agricultural Universities (SAUs)
- Line departments (Agriculture. Forestry, Horticulture and Animal Husbandry)

Project (research) products or issues to be communicated

Products

- Options for achieving greater equity between the landed and the landless poor while facilitating NRM
- Enabling processes that improve access to CPR/PPR by the poor
- Policy guidelines to facilitate institutional arrangements for NRM leading to better livelihoods of the poor

Issues

- Equity
- Sharing of assets created e.g., harvested rainwater
- Availability of quality inputs;
- Sustainability of alternative institutions

6.2.1 Workshops/ Group interactions

6.2.1.1 Interactive meetings with primary stake holders in target areas

To sensitise the community, CBOs and other rural institutions about the project activities, cluster or village level focus group interactions and *grama sabhas* were organized at the project inception stage. Besides this awareness programmes such as cycle rallies, green festivals and *kala jathas* (local festivals) were also conducted One of the most efficient ways to learn about primary stakeholders viz., farmers and village institutions is by interacting with them about different aspects of the project. The PRA interactions are presented in Section 2. To truly obtain a well-rounded view of stakeholders' needs and expectations, it is necessary to involve them right from the inception of the project, through its implementation, until withdrawal from the project. Project partners achieved this through the participatory planning, implementation and review of project-supported interventions (Sections 3-5).

Adequate sensitisation of the rural institutions through consultations facilitated smoother conduct of project activities aimed at better use of NRs. Regular interaction was maintained with PRIs and other SHGs through both formal and informal interaction meetings at the village/cluster level. The PRIs and SHGs were in fact represented in *Salaha Samithis* formed at cluster level.

6.2.1.2 Regional workshops for compiling the lessons learnt:

Three regional workshops were conducted at the project sites in late 2004 and early 2005 to share the experiences and learnings of the project with the district level authorities concerned.

Regional workshop held at Anantapur

A regional workshop for stakeholders, i.e., Development Department officials of the Anantapur district, was held during 24–25 September 2004 at the Agricultural Research. Station (ARS), Anantapur, A.P. The meeting was attended by the Joint Directors of Agriculture and Animal Husbandry departments, Project Director, District Water Management Agency DWMA, Professors of the Department of Rural Development, SK University, farmer representatives from selected clusters, project staff and ARS Staff.

A regional workshop for sharing the project findings from Mahabubnagar cluster with stakeholders i.e., Development Department officials of the Mahabubnagar District, was held during 18 December 2004 at Adarsh Mahila Resource Centre, Moosapet (Mahabubnagar). The meeting was attended by the District Collector, the Joint Directors of Agriculture and Animal Husbandry departments, farmer representatives from selected clusters, *Salaha Samithi* members and project staff.

The regional workshop for Tumkur was conducted at S. Lakkihalli, Tiptur, on 6 January 2005 to share the experience and learning of the project with Government, Non-government and research institutes and farmers, to suggest appropriate policy issues on natural resource management, for dissemination of information to a wider section of the farming community and to document feed back from development organizations, research institutes and the farming community to fine-tune the technology/practices.

Women participants sharing their experiences in regional workshops

The different development departments involved and policy makers like District Collectors participated in the workshops. The policy makers were impressed with the project work and showed keen interest to take up similar activities in their on-going development programs.

The findings of the regional workshops were as follows:

- District level authorities appreciated the role of the SS.
- Enabling process is slow and takes time to understand the dynamics of change in the rural communities. . Hence, the project duration was found to be not sufficient. A need was felt for extending the project.
- Projects involving NRM should be at least 5-6 years duration to allow the real impact to be known.
- Women and youth were found to be more receptive to new ideas.
- Development departments and policy makers were positive in their response and expressed their willingness to take the learnings forward.
- Utility and effectiveness of the SS institutions have been brought to the notice of the stakeholders (policy makers at district level) through the regional workshops.
- Target group expressed their satisfaction towards exposure visits to see new and different situations: this helped in changing their mindset and outlook towards the improved practice. Examples of this for Mahabubnagar are the functioning of other district *Salaha Samithis*, fodder cultivation etc.

6.2.2 Efforts for beyond the project (international promotion)

The experience of the project implementation process was shared with international institutes and delegates from developing countries by arranging visits to the project sites. A team from International Livestock Research Institute (ILRI), Nairobi, Kenya, including the Director General of ILRI, the ILRI Asia Regional Representative and an ILRI Project Manager visited Mahabubnagar cluster and appreciated the project work, specially on livestock interventions and promotion of fodder cultivation in the cluster. Similarly, a five member Ethiopian delegation from the Government of Ethiopia AMAREW Project, also visited Mahabubnagar cluster and appreciated the work done under the project in improving the livelihoods of poor people.

There is a good scope for an ILRI-ICRISAT project being implemented in this cluster by the project NGO partner, BIRD-K. Thus the project through its communication activities is attracting the interest of foreign development staff and donors for continuing the efforts to improve the livelihoods of poor people in India and internationally.

6.3 Reflections/learnings from project partners

The regular discussions and contacts with project stakeholders through workshops and communication products enabled their reflections and learning to keep pace with project progress. The reflections summarised below were an output of the pre-FTR workshop in March 2005.

Reflections of CRIDA

- Focus of CRIDA NRM research projects made a shift to livelihoods instead of productivity issues, which is duly reflected in its perspective plan 2025.
- Established effective partnerships outside NARS, which will be continued in future.
- Enhanced people (including rural poor) to scientist interaction.
- Social aspects of technology development and transfer have come in forefront.

- Based on experience of CRIDA, ICAR NRM division may shift their focus on livelihood aspects of NRM development.

Reflections of BIRD(K)

- In future the project experience will help us to involve all partners in selection of project villages
- Flexible approach of the project allows project objectives to be achieved
- Involvement of scientists motivated us to implement activities with a strong scientific analysis
- Linking of CPRs for improving livelihoods of poor people is possible
- Checklist based documentation was focused
- Using and analysing field implementation experiences to bring out policy briefs is a completely new process to us, and very relevant in our work.
- Introduction of improved implements and establishing custom hiring centres (CHCs) as one of the rural livelihood interventions is new to us and an intervention that we should consider supporting in future.

Reflections of University Scientists

- Farmers are capable of organizing themselves for community livelihood improvement as shown by the *Salaha Samithi.*
- Relevance of social problems and issues for livelihood improvement and technology uptake is now apparent.
- NGOs by staying in villages establish a relationship of trust with the villagers: this facilitates successful introduction of development interventions.
- Working with community based organizations (CBOs) has facilitated uptake of interventions for testing by the village.
- Confidence building measures are necessary to gain villagers' trust that the outside professionals have come to help the villagers.
- Working with village organizations (SS, PRI, etc.) as the local decision makers for the development "programme" or interventions is a mechanism to avoid conflict (and build up trust).

Reflections of International Institutes, viz. ICRISAT, NRSP

- ICRISAT can use the action research result of this project in the national and international projects executed by them.
- CAPRI- (Collective Action and Property Rights) (CPR-PPR) [with BIRD-K as a partner] can use project findings.
- Recognition of pro-poor systems (wool cording, washer-woman, sheep units) is possible in NR focused projects.
- Opportunities exist to scale up the project approach and findings through the linkage of SS with the government programmes.
- The Final Technical Report (FTR) will have potential to influence ICRISAT/ CGIAR.

Influence on ICAR

- ICAR should adopt the flexible approach of this project.
- ICAR should make use of the opportunity to monitor and extract further learning from the project locations post-project.
- ICAR should adopt the project's integrated (livelihood and multi-partner) approach.

6.4 Communication materials

To reach many target groups quickly and simultaneously in a time-effective and cost-effective manner, communication materials such as policy briefs, folders, project flyers and case studieswere prepared in the project and distributed in hundreds. They not only supported other extension methods but also provided accurate, credible and motivating information to the target audience.

Policy briefs are designed for the policy makers, extension functionaries and media persons for communicating the project findings. Folders give essential information about a particular topic, and are distributed free of cost to end users as and when required during awareness programmes, exposure visits, group meetings and workshops. Policy briefs, folders, case studies and other communication materials used in the project are mentioned below:

Project Flyer

CRIDA. 2004. Project Flyer Hyderabad, India: CRIDA.

Policy briefs

CRIDA. 2004. "Ground Water Management: Decision Support System with People's Participation" Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (Policy brief I).

CRIDA. 2004. "Institutionalization of Farm Mechanization: Innovative Promotional Methods for Successful Implementation in Rural Areas and Policy support"Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (Policy brief II).

CRIDA. 2004 "Efficient Water Use: Policy for Promotion of ID Crops" Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (Policy brief III).

CRIDA. 2005. "Improving Access of CPRs to poor. Lessons from Tank bed cultivation in Zamistapoor" Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (Policy brief IV).

Case studies

CRIDA. 2004: Rediscovering the Value of Green Fodder – The story of Pampanur Farmers Hyderabad, India: CRIDA; Anantapur, India : ARS(ANGRAU) and Karnataka, India: BIRD-K. (Case study 1).

CRIDA. 2004: Rainwater Management for Drought Proofing Farm Pond Technology for Sustaining Groundnut Production in Anantapur, Hyderabad, India: CRIDA; Anantapur, India : ARS(ANGRAU) and Karnataka, India: BIRD-K. (Case study II).

Folders

CRIDA. 2003. *Bio fertilizers in rainfed farming.* Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in English).

CRIDA. 2003. *Cultivation of Maize crop.* Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in English)

CRIDA. 2003. *Groundwater recharge techniques.* Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in English)

CRIDA. 2003. *Preparation of vermicompost.* Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in English).

Shankar, M.A., Manjunath, A., and Premalatha, B.R. 2003. *Preparation of vermicompost.* Bangalore, India: University of Agricultural Sciences (UAS-B); Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in English).

Shankar, M.A., Manjunath, A., and Premalatha, B.R. 2003. *Preparation of compost.* University of Bangalore, India: University of Agricultural Sciences (UAS-B); Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in local language -Kannada).

CRIDA. 2004. Bio-fertilizers in rainfed farming, Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in local language -Telugu).

CRIDA. 2004. *Ground water recharging techniques.* Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in local language -Telugu)

CRIDA. 2004. Efficient water use by growing alternative ID crops instead of paddy cultivation Hyderabad, India: CRIDA and Karnataka, India: BIRD-K. (folder in local language -Telugu).

Project web site and/ other project related web addresses

http://www.crida.ernet.in/DFID brochures/ DFID.html

Newsletter articles

Ramakrishna Y.S., Subrahmanyam K.V. and Nagasree K. 2005. " Enabling Rural Poor for better livelihoods through Improved Natural Resource Management in SAT India " AgREN Newsletter no-51, pp9-10, ODI Network, U.K

Central Research Institute for Dryland Agriculture, 2005. Improved NRM for better livelihoods, CRIDA Newsletter January-June, 2005, Hyderabad, India**.** Central Research Institute for Dryland Agriculture

Workshop Papers, Display of Exhibits and Posters

Ramakrishna Y.S, and Subrahmanyam K.V. 2004. "Ongoing Efforts and NRM related livelihood issues" in brainstorming workshop on *Rainfed agricultural technologies for different agro-eco regions of Andhra Pradesh (A.P.)*, held at CRIDA on August 24, 2004.

Display of Project communication products such as policy briefs, case studies and folders where project findings were shared with the participants of NRSP Workshop on *Realizing Potential: Livelihoods, Poverty and Governance* held during 3-4 August 2004 in New Delhi

A photo exhibition was organized during the one-day brainstorming workshop on *Rainfed agricultural technologies for different agro-eco regions of Andhra Pradesh (A.P.)*, held at CRIDA on August 24, 2004

Poster Presentation and discussion of the project learnings with Dr Christian Roth, Project Manager, Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia who was accompanied by Dr. Lex Cogle, Principal Scientist, Queensland Department of natural Resource Management and Mines, Cairns, Queensland during a visit to CRIDA during 25-26 August 2004.

Section 7

Perceptions and Prospects

The project with its log frame focused on process as well as product outputs resulted in many useful reflections and lessons learnt. The most important outcome has been that participatory planning of the interventions in three clusters has resulted in complete ownership of the intervention programme by the people. In addition to the process documentation (PD) and terminal reporting from each of the outputs, the project partners made a number of observations during the implementation of the project, which will be useful for any future initiatives to replicate the project outputs in a larger target area. The collective experiences of the project team members and villagers also resulted in a number of policy briefs which catalyse institutional and policy changes at the state and central level, provided there is an effective follow-up by the partner institutes.

7.1. Project typology

One key issue that determines the effectiveness of the project and its outcome is the approach followed in the project design and implementation. Normally, the projects run by the Government institutions lay more emphasis on the so-called "approved technical programme" which may be without the participation of the stakeholders. Such projects have fixed interventions and precisely determined budget allocations within the overall project budget. On the other hand, the projects run by the NGOs are often "wide open" with no clearly defined work plan, poor linkage between the "start" and "end," making the output evaluation a little difficult. Such projects lay greater emphasis on motivating communities. The R 8192 project followed a different typology. A well-defined log frame listed the expected outputs, but the typology allowed adequate room to accommodate the requirements and opinions of the stakeholders. The project was implemented with a prescribed area of emphasis viz., NRM. However, along the way, the constant dialogue with the villagers, that started from the initial PRA, helped in "dynamic programme planning" which took into consideration the farmers' own preferences and the experiences that were gained during the process of project implementation.

This flexibility in approach was one of the key factors in generating successful outputs and drawing several lessons even in a short project like this. The villagers in all three clusters who have been exposed to the state department programmes, which are quite monolithic and rigid, experienced and expressed this difference. In other words, adoption of a "flexible yet well planned approach" in itself is one of the important achievements of the project, and an important contribution to improving the development process.

7.2. Institutional arrangements

Facilitating the communities to develop and put in place appropriate institutional arrangements in each of the clusters played an important role in implementing the project, and achieving the project intention of improving NR based rural livelihoods. There are many existing village level formal and non-formal institutions and organizations in each