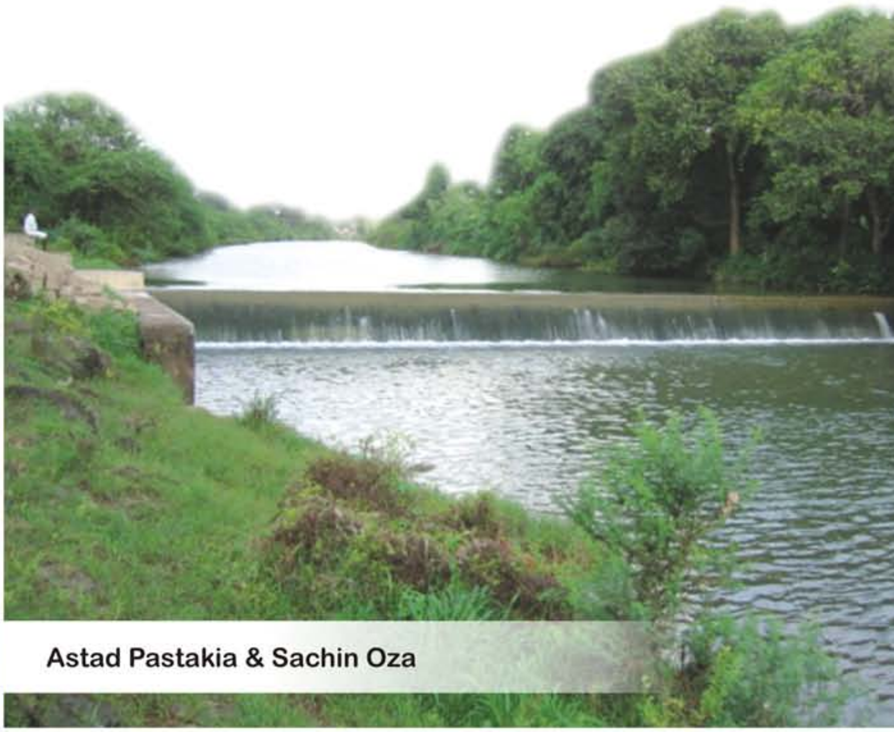
A Strategy Handbook for the Practitioner

Livelihood Augmentation in Rainfed Areas

1 Strategies Based on Natural Resource Management



Astad Pastakia & Sachin Oza

dsc Development Support Centre

AGA KHAN FOUNDATION

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Volume I

Strategies Based on Natural Resource Management

Astad Pastakia & Sachin Oza

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Ahmedabad

Livelihood Augmentation in Rainfed Areas: A Strategy Handbook for the Practitioner

Volume I: Strategies Based on Natural Resource Management

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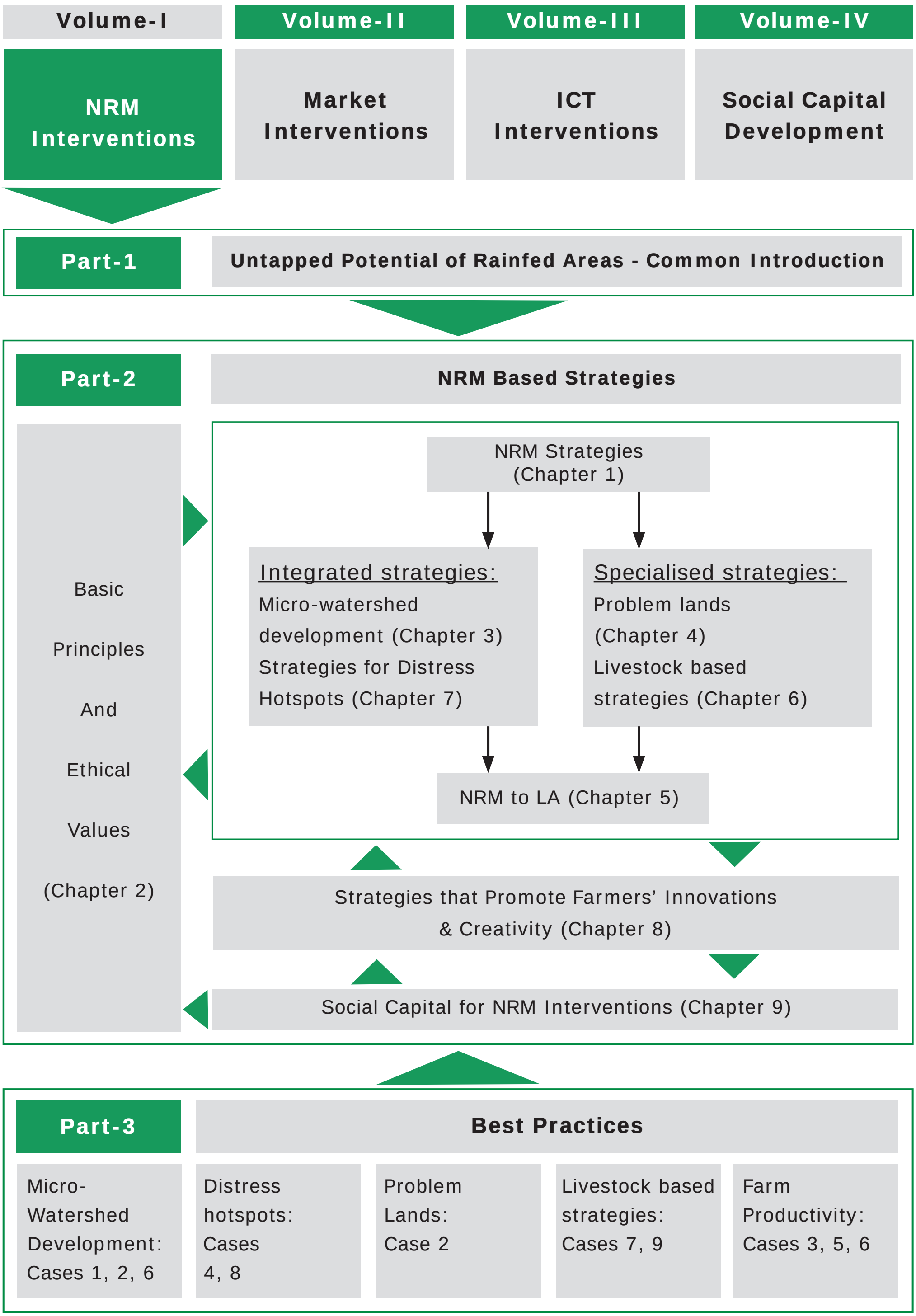
Navigation Chart



Foreword

Removal of poverty and hunger is the first of the eight Millennium Development Goals (MDGs) adopted by the United Nations. About 400 million rural poor reside in about 200 poorest districts of the country that constitute rainfed areas.

If one looks at the overall agricultural pattern across the country, almost 85 million ha, that is, about 60% of the 142 million ha of cultivable land is under rainfed conditions. These make a significant contribution to the production of pulses, oil seeds and cereals in the country. Public investment in irrigation has steadily declined. In addition, even if the entire irrigation potential of the country is developed, 50% of the arable land is likely to remain rainfed. There is, therefore, an urgent need to give attention to improving the agricultural productivity and diversifying the economy of these areas.

The government, research institutes, NGOs and the private sector, each in its own manner, has made efforts to enhance the livelihood opportunities for rural communities in rainfed areas. Prime Minister Dr. Manmohan Singh announced a mega assistance plan of Rs 25,000 crores in 2007 to boost agricultural productivity. A National Rainfed Area Authority has also been set up to specifically look into the issues of enhancing rural livelihoods in rainfed areas. The efforts of luminaries such as Shri P.R. Mishra of Sukhomajri Project in Haryana and Shri Anna Hazare in Ralegaon Siddhi, Maharashtra, are well known.

Development Support Centre (DSC) initiated in 1994 by the late Shri Anil Shah, has made a critical contribution in capacity building, research and influencing policies related to participatory natural resource management. The organization was involved in developing the first watershed guidelines brought out by Mr. B.N. Yugandhar, and continues to look at issues related to the effective implementation of the watershed programme. Some of the studies such as 'Longitudinal Study in Sixteen Drought Prone Watershed and Non-watershed Villages of Gujarat', 'Drinking Water Security in Watershed Villages' and 'Cost-benefit Analysis of Watershed Development: An Exploratory Study in Gujarat' have led to policy changes at the state and national levels and better practices at the ground level.

One of the most important contributions of Anilbhai was the formulation of principles for development and management of natural resources in a sustainable manner or 'Bopal Declarations' as they are popularly known. These have been mentioned in the Planning Commission's 'Approach Paper for Rainfed Areas' and also in the new watershed guidelines of April 2008, as guiding principles for implementing the programme. The new guidelines give due recognition to the need for improving rural livelihoods through participatory watershed development, with the focus on integrated farming systems for enhancing income, productivity and livelihood security in a sustainable manner.

As an organization involved in capacity building of practitioners, and also working as an implementing agency, DSC realizes that there is no dearth of literature on watershed management. There are many how-to-do manuals such as how to construct a check-dam or how to mobilize people to form Self Help Groups, etc. However, there are few that focus on broadening the horizon of the practitioner, by providing alternative options that could be tried out in different conditions. Whereas plenty of literature is available on the technical aspects of watershed development and other livelihood strategies, not much has been written on the institutional aspects, entrepreneurial strategies or the role of ICT. Besides, there are many rainfed areas such as flat lands or coastal lands where the typical watershed approach cannot be applied and, therefore, intervention strategies for these areas also need to be developed.

A need, therefore, was felt for a strategy handbook that would focus on livelihood augmentation in rainfed areas, which would draw upon the experiences of field implementation, and cull out the principles and strategies to help a practitioner adapt these in his/her context. Given the breadth of the subject, the authors found it practical to present the material in four volumes.

Dr. Astad Pastakia, a doctorate from the Indian Institute of Management, Ahmedabad, and author of *Locked Horns – Conflicts and their Resolution in Community-based Natural Resource Management*, agreed to anchor the project. Mr. Sachin Oza, Executive Director, DSC and a practitioner for 20 years, has co-authored the volumes with Dr. Pastakia. They were ably assisted by Mr. Virendra Vaghani, who has coordinated the entire project.

The development of these handbooks has not been easy and it has taken well over two years to bring them out in the current form. I am grateful to Aga Khan Foundation and the European Commission for having shown great patience and trust and for extending support to DSC in this endeavour. Needless to say, these volumes would not have been possible without the inputs of several organizations that have been toiling night and day to enhance the livelihoods of the poor. I am sure, that these volumes will make a significant contribution and add tremendous value to the existing literature on livelihood.

Vijay Mahajan

Chairman, Development Support Centre

Preface

With the Green Revolution areas showing signs of fatigue, and public investments in rainfed regions not yielding the desired results, Indian agriculture once again finds itself at the crossroads. The crisis of productivity in agriculture is linked to an impending crisis of food security, reminiscent of the PL-480 days, prior to the Green Revolution. Whereas agricultural growth rates have stagnated, the population is growing at exponential rates. The per capita production of food grains dropped from an all-time high of 207 kg/person/yr in 1995 to 186 kg/person/yr in 2007. The per capita availability of agricultural land has declined from 0.48 ha in 1951 to 0.16 ha in 1991 and is likely to decline further to 0.08 ha by 2035. Looking at the magnitude of the problem and heeding the advice of the Planning Commission, the Prime Minister, Dr. Manmohan Singh, announced in 2007 a mega assistance plan of Rs 25,000 crores to state governments to boost agricultural productivity. However, whether these investments will produce the desired results will depend on how and where these resources are deployed.

It is our contention that a vast untapped potential exists in rainfed areas of the country. this has also been corroborated by a recent comprehensive assessment made by a team of international agricultural scientists (Wani, Rockstrom and Oweis, 2009). The keys to unlock this potential are also available, as demonstrated by the efforts of numerous non-governmental and governmental initiatives in the rainfed areas. However, the knowledge of what strategy works in what kind of situations remains diffused and often undocumented. The need of the hour is to consolidate this knowledge and extract principles and strategies that can be applied in similar situations elsewhere. It is precisely this exercise that led to the development of this handbook.

Although the initial idea was to focus on watershed development, the project widened its scope through an iterative process of search and reflection. The advisory committee of the project suggested broadening the scope to include other strategies being followed in rainfed areas, where watershed development cannot be applied, for instance, in flat lands and in regions with problems of saline and alkaline soils, laterite soils, etc. The committee also recommended focusing on livelihood augmentation, which is the ultimate objective of watershed development and other natural resource management (NRM) interventions. Market interventions came as a natural extension of post-watershed development. However, many market interventions, especially in the non-farm sector, were also 'discovered'. These were initiated from scratch by social entrepreneurs and business houses with a social conscience. The need to consolidate the knowledge about building human and social capital was evident to the editorial team right from the beginning. Most of the watershed manuals reviewed did not do justice to this theme, given the overriding importance of placing people in the centre of all developmental projects and processes. Another issue that was added at a later stage was the role of Information and Communication Technology (ICT) in augmenting livelihoods in the service sector as well as other livelihood interventions. It was soon realized that the team would not be able to do justice to all these issues within the stipulated pages of the volume. In consultation with the Aga Khan Foundation (India), which is supporting the project, it was, therefore, decided to bring out the handbook in four, stand-alone volumes, each covering a particular theme.

The compiling of information and experiences was pursued through multiple routes such as workshops and personal interviews of practitioners, literature reviews, and the Internet. Wherever cases were readily available, the information was updated and then included. Wherever interesting experiences were found but not documented, the authours took upon themselves to document these. As a result of this process of 'muddling through' and also in view of the expanded scope of the handbook, the project took much longer to complete. Progress was often painfully slow because the team depended on various actors to provide information and updates. Nevertheless, the journey has been an enriching one. The authours comprised a practitioner and an academic; this helped to keep the balance between theory and practice. The readability of the manuscript for the practitioner at the programme/project level, for whom the handbook is primarily designed, was under constant review.

Unlocking the potential of rainfed areas needs a conducive policy environment. There are indications to show that the policy for the development of rainfed areas is gradually moving in the right direction.

The National Commission on Farmers (2005) recommended a paradigm shift in the approach and implementation of watershed programmes in the country, and this has remianed the main plank for developing rainfed areas in an integrated manner. The Commission advocated partnerships among public sector, private sector, NGOs, and farmers, particularly the landless and women, through collective action and institutional mechanisms. It proposed a five-point action plan comprising:

i. Improving soil health to increase productivity.

ii. Promoting water harvesting, water conservation, and sustainable and equitable use of water.

iii. Ensuring access to affordable credit for crop and life insurance.

iv. Developing and disseminating appropriate technologies.

v. Improving opportunities, infrastructure, and regulations for marketing.

Taking cognizance of the above recommendations, the National Rainfed Area Authority (NRAA) was set up in November 2006, to focus on these areas. The main responsibilities of the NRAA have been identified as follows:

- Supporting the process of preparing strategic plans for watershed-based development projects at the state and district levels keeping in view specific agro-climatic and socio-economic conditions.
- Assisting in the preparation of state-specific technical manuals.
- Supporting state-level nodal agencies to identify resource organizations, and establishing capacity building arrangements.
- Facilitating action research relevant to watershed development programmes in different agro-climatic regions.
- Conducting evaluation, impact assessment, and thematic studies for improving the quality of watershed projects.
- Facilitating the convergence of different schemes and projects of the Government of India.
- Accessing additional funds from other sources, including private sector and foreign funding agencies to fill up critical gaps in the programme.
- Scaling up successful experiences through innovative organizations at the field level.

Subsequently, Common Guidelines for Watershed Development Projects (2008) were developed to provide a fresh framework for the next generation watershed programmes. The guidelines sought to bring about a unified perspective across all ministries. Unlike previous watershed guidelines, these gave priority to creating livelihood opportunities, productivity enhancement and conservation measures. The focus was on promoting farming and allied activities to promote local livelihoods while ensuring resource conservation and regeneration. The hope was, the new approach would systematically integrate livestock and fisheries management as a central intervention, and encourage dairy and marketing of dairy products. The project duration has been further enhanced to seven years and the financial allocation has been increased from Rs 6000/ha to Rs 12000/ha. The Guidelines emphasize equity and gender sensitivity, decentralization, need for committed and competent facilitating agencies, centrality of community participation, capacity building and technology inputs, regular monitoring, evaluation and learning, and above all, establishing appropriate technical and professional support structures at the national, state, district, and project levels.

Having brought out the Common Guidelines, the challenge for policy makers and practitioners alike will be to see how best these can be executed. Considerable experience has been gained since the implementation of the Watershed Guidelines of 1995. Significant work has been carried out in the field of participatory NRM, rural entrepreneurship development, use of ICT, and institution development. These experiences are documented here to broaden the vision of the practitioner and provide him/her with insights into the *principles, strategies* and *best practices*. We hope that this will go a long way in stimulating and strategizing action while providing key insights for practitioners, policy makers, and researchers.

Some of the cases provided are useful for conducting training programmes. With the passage of time, the cases may become dated; however, the principles and strategies gleaned from them are likely to remain valid until such time that new knowledge is generated from new experiences in the field. It is our fond hope that this compilation will stimulate more action in the field, leading to the unlocking of the vast hidden potential of rainfed areas and the generation of new livelihood avenues for millions of poor in the country.

Astad Pastakia
Sachin Oza

Acknowledgement

Development Support Centre (DSC) has been working in the field of participatory natural resource management since 1994. As an organization involved in capacity building and support services, DSC found that there was a need for a comprehensive strategy handbook that looks at various aspects of livelihood augmentation in rainfed areas (LARA), viz., natural resource management, institution building, entrepreneurship, and the use of information and communication technology (ICT). These four volumes of the LARA handbook represent the culmination of two years of continuous efforts, to which many professionals and voluntary agencies from all over the country have contributed.

An advisory committee guided the project from the beginning. We wish to thank this group comprising Mr. Apoorva Oza, Dr. Sudershan Iyengar, Dr. R. Parthasarthy, Mr. Suneel Padale, and Dr. Indira Hirway for their guidance and encouragement throughout the project. Special thanks to Ms Tinni Sawhney, Mr. Somnath Bandopadhyay, Mr. Suneel Padale and Mr. Vivek Singh of Aga Khan Foundation, India, for their continuous encouragement, guidance and support during the entire process of developing and publishing the handbook.

We are grateful to reviewers of each volume for providing valuable feedback and comments. We are also thankful to professionals from various organizations, who have contributed the case studies, and have given their feedback and suggestions to enrich the handbook. We are equally grateful to the practitioners, who participated in various workshops organized during the course of the project, for volunteering their time, and sharing their valuable insights and experiences.

A large number of organizations extended their support to this initiative by sending representatives to meetings/workshops, and providing information and reports, writing case studies, etc. We would like to thank in particular the leadership and representatives of AGROCEL, AKRSP, ANANDI, APMAS, ARAVALI, ASA, BAIF, BASIX, Community Friendly Movement, Development Alternatives, Ekgaon, FES, IRMA, Jalbhagirathi Foundation, KMVS, MSSRF, MYRADA, N.M. Sadguru Foundation, PRADAN, RANGSUTRA, , Seva Mandir, Source for Change, TCS, The Livelihood School, Utthan, VRTI, and WASSAN among others.

We are thankful to Mr. Vijay Mahajan, Chairman, DSC, for his encouragement and for agreeing to write the foreword. Last but not the least, the handbook would not have been possible without the enthusiasm and unstinting support of the DSC team.

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Abbreviations

AAWS	Aqua Aero Water System
AFARM	Action for Agricultural Renewal in Maharashtra
AKRSP-I	Aga Khan Rural Support Programme-India
APFAMGS	Andhra Pradesh Farmer Managed Groundwater Systems
APRLP	Andhra Pradesh Rural Livelihood Project
ASA	Action for Social Advancement
ATMA	Agriculture Technology Management Agency
BAIF	Bharatiya Agro Industries Foundation
BASIX	Bhartiya Samruddhi Investments and Consulting Services
BIRDS	Bharatiya Integrated Rural Development Society
BPOs	Business Process Outsourcing
CAZRI	Central Arid Zone Research Institute
CBO	Community Based Organization
CDMA	Code-Division Multiple Access
CEC	Cation Exchange Capacity
CEO	Chief Executive officer
CFM	Community Friendly Movement
CGIAR	Consultative Group on International Agricultural Research
CIG	Common Interest Group
CPR	Common Property Resource
CROPS	Centre for Rural Operation Programmes Society
CSIR	Council of Scientific and Industrial Research
CSWCRTI	Central Soil and Water Conservation Research and Training Institute
DDP	Desert Development Programme
DDS	Deccan Development Society
DIS	Drip Irrigation System
DLDB	Dry Land Development Board
DoIT	Department of Information Technology
DPAP	Drought Prone Area Programme
DPIP	District Poverty Initiative Programme
DSC	Development Support Centre
EAP	Externally Aided Project
ENVIS	Environmental Information System
EU	European Union

EV	Extension Volunteer
FAO	Food and Agriculture Organization
FD	Forest Department
FPCs	Farmers Producer Companies
FYM	Farm Yard Manual
GAU	Gujarat Agricultural university
GEAC	Genetic Engineering Approval Committee
GGRC	Gujarat Green Revolution Company Limited
GI	Galvanized Iron
GIAN	Grassroots Innovations Augmentation Network
GIS	Geographical Information Systems
GJBS	Gram Jal Bachavo Samiti
GMC	Groundwater Management Committee
GMOs	Genetically Modified Organism
GoG	Government of Gujarat
GoI	Government of India
GRAVIS	Gram Vikas Vigyan Samiti
GT Sheet	Geographical Topo Sheet
GTZ	German Technical Cooperation
GVT	Gramin Vikas Trust
HOFF	Himachal Organic Farmers Forum
HPPS	High Production Potential System
IARI	Indian Agriculture Research Institute
ICAR	Indian Council for Agriculture Research
ICRISAT	International Crop Research Institute for Semi-arid Tropics
ICT	Information and Communication Technology
IDC	Italian Development Cooperation
IDE	International Development Enterprises
IFFCO	Indian Farmer Fertilizer Cooperative Ltd.
IGNRM	Integrated Genetic and Natural Resource Management
IIMA	Indian Institute of Management, Ahmedabad
IRR	Internal Rate of Return
IIT Kanpur	Indian Institute of Technology, Kanpur
IKSL	IFFCO Kisan Sanchar Limited
IMD	Indian Meteorology Department
IRMA	Institute of Rural Management, Anand
ISO	International Standard Organisation
ISRO	Indian Space and Research Organisation
IWDP	Integrated Wasteland Development Programme

IWMI	International Water Management Institute
JBF	Jal Bhagirathi Foundation
JBJ	Jal Bachavo Juths
KAWAD	Karnataka Watershed Development (Project)
KRAPAVIS	Krishi Avam Paristhitiki Vikas Sansthan
LA	Livelihood Augmentation
LARA	Livelihood Augmentation in Rainfed Areas
LEISA	Low External Input Sustainable Agriculture
LI	Lift Irrigation
LIS	Lift Irrigation Scheme
LLG	Livelihood Learning Group
LPPS	Low Production Potential System
LTK	Local Technical Knowledge
MCX	Multi-commodity Exchange
MMB	Mahyco Monsanto Biotech Ltd.
MoRD	Ministry of Rural Development
MPEDA	Marine Products Export Development Authority
MSP	Minimum Support Price
MSSRF	M.S. Swaminathan Research Foundation
MVIF	Micro Venture Innovation Fund
MWD	Micro-watershed Development
MYRADA	Mysore Resettlement and Development Agency
NABARD	National Bank for Rural and Agriculture Development
NAEP	National Afforestation and Eco-development Project
NAFED	National Agricultural Cooperative Marketing Federation
NARS	National Agricultural Research System
NDDB	National Dairy Development Board
NGO	Non-government Organization
NIF	National Innovation Foundation
NPM	Non Pesticide Management
NRA	Natural Resource Augmentation
NRAA	National Rainfed Area Authority
NRD	Natural Resource Development
NRM	Natural Resource Management
NTFP	Non-timber Forest Produce
NWDPRA	National Watershed Development Project for Rainfed Areas
OBC	Other Backward Classes
PDC	Permanent Disconnection
PGS	Participatory Guarantee System

PIA	Project Implementation Agency
PIC	Prior Informed Consent
PI	People's Institution
PLC	People's Learning Centre
PPB	Participatory Plant Breeding
PRA	Participatory Rural Appraisal
PRADAN	Professional Assistance for Development Action
PTD	Participatory Technology Development
PVSP	Participatory Varietal Selection and Promotion
RAS	Reclamation of Alkali Soils
RBA	River Basin Approach
RGCA	Rajiv Gandhi Centre for Aquaculture
RIN	Rural Innovation Network
RO	Reverse Osmosis
RVP & FPR	River Valley Project and Flood Prone Rivers
SC/ST	Schedule caste/Schedule tribe
SDC	Swiss Agency for Development and Cooperation
SERP	Society for Elimination of Poverty
SHG	Self Help Group
SIDBI	Small Industries Development Bank of India
SMART	Sustainable Multi-species Agriculture Resource-use Trial
SMSS	Soil Management Support Services
SRI	System of Rice Intensification
SRISTI	Society for Research and Initiatives for Sustainable Technologies and Institutions
SURE	Society to Uplift Rural Economy
TBS	Tarun Bharat Sangh
TERI	The Energy and Resources Institute
UAS	University of Agricultural Sciences
UGB	Underground Bandhara
UK	United Kingdom
UNDP	United Nations Development Programme
UP	Uttar Pradesh
VRTI	Vivekanand Research and Training Institute
WASMO	Water and Sanitation Management Organisation
WDF	Watershed Development Fund
WDP	Watershed Development Programme
WDPSCA	Watershed Development Programme for Shifting Cultivation Areas

Conceptual Framework

Our understanding of Livelihood Augmentation (LA) is derived from the overall objectives of development, which have, over the years, come to mean 'growth with social equity and stability'. The notion of 'sustainability' has been included as an equally important goal in the wake of the environmental movement. The idea of equality includes elimination of discrimination on the lines of caste, class, gender, and other social considerations. Hence, LA must lead to the following key outcomes:

i. Increased income of households in target areas / communities

ii. Diversified sources of income for the household

iii. Reduced vulnerability to production and market risks

iv. Increased carrying capacity of the watershed or unit area of land as a result of the above

v. Increased equity and empowerment of the poor and marginalized

vi. Increased participation and empowerment of women

vii. Sustainable use of natural resources

viii. Increased resilience of natural resources and communities to cope with changes in future, including those due to climate change

Figure 1 provides a framework showing how different groups of strategies work towards this common goal of livelihood augmentation in rainfed areas (LARA) viz.:

a) Natural resource management strategies

b) Entrepreneurial strategies

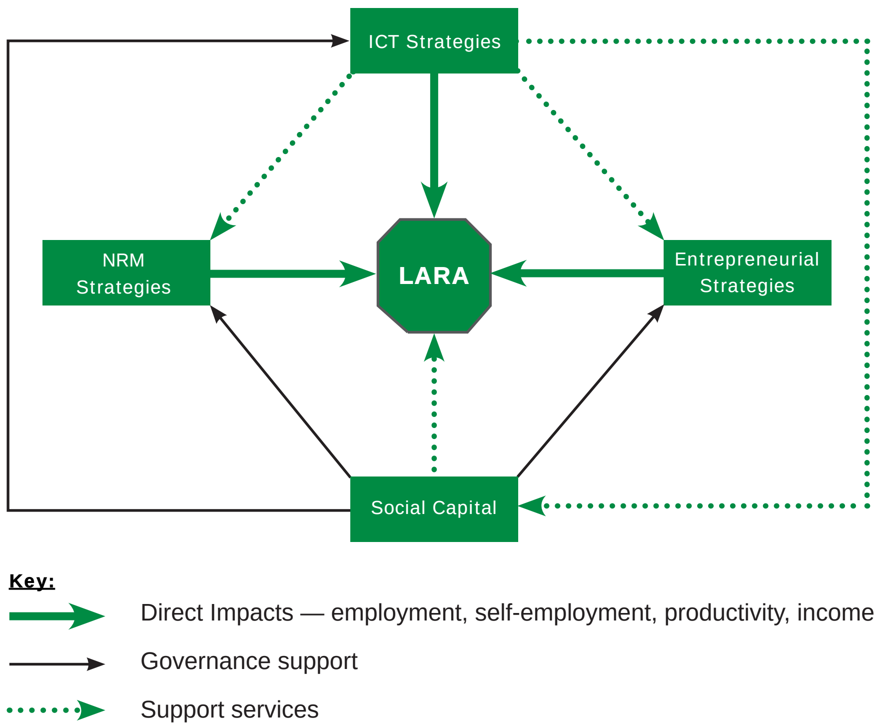
c) Information and communication strategies

d) Social capital development strategies

Natural Resource Management (NRM) Strategies

Both historically and logically, approaches that make investments in conservation and sustainable use of natural resources are the most prevalent and serve as the starting point. The net effect of NRM interventions is to increase productivity leading to better income as well as enhanced quality of life for rural households. NRM strategies could be built around conservation of land, water, and biomass. It would lead to increased productivity of agriculture, forests, pasture lands, livestock, and even non-farm activities dependent on these or other natural resources — such as weaving, fabric making, toy making, embroidery, etc.

Figure 1: Framework for Livelihood Augmentation



Entrepreneurial Strategies

Today helping farmers and rural artisans to secure remunerative prices have spawned a number of market interventions. In some cases, accessing distant markets has been facilitated through the process of collectivization and value addition. In other cases, social entrepreneurs themselves have worked backwards from the markets to build value chains that benefit poor artisans and primary producers. Market interventions lead to value addition and enable the primary producer to get his/her rightful share in the terminal price of the value chain.

Information and Communication Technology (ICT) Strategies

Recent developments in the ICT sector has made it possible to open up new vistas in the service sector in rural areas. Examples include the emergence of rural BPOs and information kiosks that provide a host of e-services to farmers and other villagers. However, ICT is not just about the service sector. Its applications are so widespread that ICT has emerged as a cross-cutting force, helping to improve efficiency of all kinds of development interventions through a variety of support services. ICT provides new tools like Remote Sensing and Geographic Information Systems to enable better planning and monitoring of NRM interventions. It has made it possible to provide farmers in remote villages with farm specific agri-advisories of highly qualified agricultural experts. It has stimulated the self-help and self-employment movement through access to information and knowledge via village kiosks. It has also enabled farmers, traders and nano-entrepreneurs to benefit from access to market intelligence and alternative markets. Lastly, ICT applications have the potential to make government delivery systems more transparent and accountable by placing knowledge and information in the hands of the users.

ICT interventions have worked wherever these have effectively addressed the felt needs of the rural population, and helped cut transaction costs for both the service provider as well as the rural customer.

Social Capital

The above interventions can become effective and sustainable only when the local communities are in charge of the development process. Over the past two decades, NGOs have successfully evolved participative tools and techniques for facilitating developmental processes and building social capital. This includes building the capacities of local communities through exposure, training and skill building, and facilitating the emergence of People’s Institutions (PIs), also known as community based organisations (CBOs). PIs serve the purpose of self-governance and collective decision-making with egalitarian values such as democracy, unity, equity, gender sensitivity, and ecofriendliness. These institutions also help bring out the collective strength of marginal and scattered producers in negotiating and/or partnering with external agencies, including markets, financial institutions, technology providers, and the government.

In the process, PIs become training grounds for developing community leaders and in empowering marginal producers. Hence, social capital development can be seen both as a means as well as an end of the development process.

Organization of the Handbook

This handbook is organised in four volumes.

i. **Volume I** deals with experiences of improving livelihoods through investments in the natural resource base. This includes both watershed development initiatives as well as specialized NRM interventions for areas where watershed development may not be possible or even relevant.

ii. **Volume II** provides experiences of augmenting livelihoods through market-led interventions, including interventions that address market imperfections and those that seek to tap or create market opportunities. Strategies for value-chain interventions are discussed as a special case of market-led interventions. These seek to augment livelihoods of the poor and marginalized through interventions at different nodes of the value chain by forming strategic alliances with different stakeholders/players in the chain.

iii. **Volume III** puts together the knowledge gleaned from innovative approaches to augment rural livelihoods through the use of ICT. ICT helps to augment livelihoods, especially of the educated youth by creating new opportunities in the service sector. Although ICT applications encompass all aspects of rural life, we have focused more on those that enable creation of human capital and livelihood augmentation.

iv. **Volume IV** dwells upon the difficult task of facilitating the creation of PIs and building the capacity of rural women and men, to implement livelihood projects. PIs help to oversee the maintenance of common assets after the completion of the project.

How to Use the Handbook

> *"I used to think I was **poor**. Then they told me I wasn't poor, I was **needy**. Then they said needy was an expression that is self defeating, I was actually **deprived**. Then again they said deprived created a bad image, I was actually **underprivileged**. Now they say underprivileged is inaccurate. I am actually **disadvantaged**. I still don't have a dime, but I sure have a rich vocabulary!"*
>
> – Jules Feitter

Development academics are known for their penchant for creating jargon where there is need for none, points out Pulitzer-Prize and Oscar-winning cartoonist and novelist Jules Feitter in his inimitable style. This may be one of the reasons that puts off the practitioner from reading academic literature, which otherwise may have useful content. The authors were painfully aware of this limitation when attempting to write this handbook. One self-correcting mechanism was to have a team of writers—one a practitioner, the other an academic. Efforts were also made to persuade (or cajole!) practitioners to take a look at the draft volumes and give their reactions. Despite our best efforts to make the volumes reader-friendly, we may have not succeeded completely, especially where we have drawn upon existing theoretical frameworks. To overcome this difficulty, we have provided a glossary of technical terms at the end of each of the four volumes.

Whereas the handbook is largely written to serve as reference material for the practitioner, it may serve other purposes as well. We believe there will be four categories of readers for this handbook.

a. The largest category comprises the practitioners, who may like to use it as a reference book.

b. The academics-oriented practitioners and/or researchers wanting to get a more complete understanding of one or more of the four themes presented in the handbook constitute the second group. Admittedly, this group will be much smaller.

c. A small minority may comprise individuals, who will not be satisfied with just one or two themes but will want to read the entire handbook in order to get a holistic understanding of the problems and opportunities of promoting livelihoods in rainfed areas.

d. We expect that training and support agencies will find this handbook useful from the training perspective. The handbook provides a large number of case studies, some of which have been already tested as training material.

Structure of the Handbook

For all categories of readers, it is necessary to understand how the series and the book are structured.

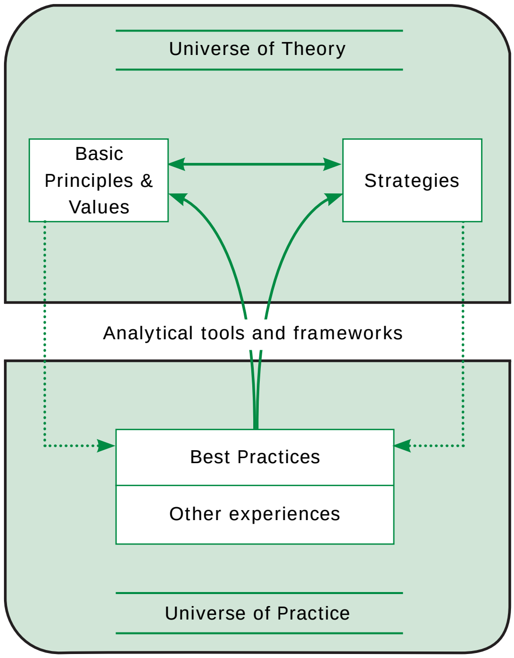
Broad structure

There are four volumes under a common framework. The first part of Volume 1 has a detailed introduction, which is common to all the volumes. Barring this, each volume stands alone.

Each volume comprises a) selected case studies of *best practices*, b) articulation of *basic principles and ethical values* and *c)* description of *strategies*. It also provides an understanding of why particular strategies work better in particular situations. The basic principles and strategies are derived from analyses of the case studies and other experiences and represent the transition from practice to theory (Figure 1). The feedback loop shows that the strategies presented may stimulate more action, leading to new best practices. Depending on one's orientation, the reader can start from practice and end up with theory, or vice versa. Analytical tools and frameworks used to understand strategies are included in the theory section. Human interest stories and checklists of various types are presented as Box items.

Additional information has been provided in the Annexures, keeping in mind the need of the practitioner. The annexures of each volume includes a *glossary of technical terms*, a *resource guide* and a guide to key *resource institutions*. The Resource Guide is in the form of an annotated bibliography of other guide books and references that a practitioner may find useful to pursue a particular strategy. Several of these are in the nature of 'how-to-do' books, covering related sectors and providing technical information, beyond the purview of this handbook. A guide to Key Resource Institutions, with contact details and short descriptions of their important projects/programmes, is also included.

Figure 1: Structure of Each Volume



Volume-specific structure

Each volume can be read as a stand-alone. It is, however, best read in conjunction with the other volumes for a more holistic understanding of the livelihood augmentation processes. The structure of the presentation varies somewhat from volume to volume, depending on the nature of content. A *navigation chart* presented at the beginning brings out the connections between different parts and chapters of the volume. The *index* at the end of each volume will help the reader to locate matter of his/her particular interest with relative ease.

Part-1

The Untapped Potential of Rainfed Areas

The Untapped Potential of Rainfed Areas

Introduction

Rainfed agriculture plays and will continue to play, an important role in global food production as 80% of agriculture is rainfed and contributes about 58% to the global food basket. (Wani, Rockstrom and Oweis, 2009)

The majority of the estimated 850 million poor people in the world live in the developing countries of Asia and Africa, mostly in the rainfed areas. As a result these areas have become co-terminus with poverty, malnutrition, water scarcity, severe land degradation and poor physical and social infrastructure; although this need not have been the case. A recently concluded comprehensive assessment on rainfed agriculture for food security carried out by leading scientists of the Consultative Group on International Agricultural Research (CGIAR) Institutions came to the conclusion that a vast untapped potential exists in rainfed agriculture. They found that currently the farmers' crop yields were two to five fold lower than the potential as evident from the clearly documented evidence. (Wani, Rockstrom and Owei This potential can be unlocked thorugh science-based development, investments in natural resource conservation and management, integration of genetic and natural resource management (NRM), innovative mechanisms to share the knowledge and science with farmers and other stakeholders, but above all by placing local communities and the people in the centre of all developmental processes (*ibid.*).

In India, where close to 400 million poor reside in rural areas (concentrated in dry lands/rainfed areas), a large number of innovative projects and ideas have been tried, to address the issue of productivity gap in rainfed areas. Documentation of these experiences is uneven, fragmented and rarely consolidated. Drawing upon such experiences, the present handbook points to new vistas and untapped opportunities in meeting the challenge of enhancing food security with limited water resources, and improving the carrying capacities of rainfed areas to match the rapidly increasing population in these regions and elsewhere.

While the experiences and best practices will be of direct relevance to practitioners in rainfed areas of western and southern India from where they have been drawn, the book offers 'distilled wisdom' in the form of basic principles, values and strategies that these experiences embody. It is this aspect of the handbook, we believe, that makes it valuable and applicable to a much wider audience, beyond the spatial and temporal boundaries of the interventions described. For the same reason, we expect that both practitioners as well as academics will find this compilation a useful reference and guide for unlocking the vast potential of rainfed areas for food security and livelihood augmentation (LA).

The handbook is presented in four parts in order to facilitate proper coverage and handling of key aspects of LA in rainfed areas. These introduction, which provides the context of rainfed areas, is common to all the volumes.

Emerging Crisis of Indian Agriculture

Like most other developing economies, India began as an agrarian State. Even today agriculture is a source of livelihood for about 60 per cent of its population and provides employment to about 56 per cent of the country's work force. However, the growth rate of agriculture steadily declined from 3.2 per cent in the 80s to around 2 per cent in the last 4-5 years. On the other hand, industrial growth has been buoyant at around 8 per cent. Such skewed growth rates are a matter of serious concern for planners and policy makers of the country at the highest level.

An analysis of spatial growth patterns in agriculture shows that the growth in the Green Revolution areas (Punjab, Haryana and western UP) has tapered off and in some places it is even showing signs of decline (*India Today*, June, 2007). The 'treadmill effect' caused by high and imbalanced external input farming, soil 'fatigue' and declining soil health, dependence on a narrow base of crop varieties leading to mono-culture, greater vulnerability to pests and depletion of groundwater resources are some of the better known reasons for stagnation and decline in yields in the Green Revolution areas. In addition, the cost of chemical intensive farming has been rising progressively without a corresponding increase in the price of produce, making farming less and less attractive as an economic activity. The growing rate of farmer suicides, which has crossed 20,000 per year, may be seen as one of the indicators of the emerging crisis of Indian agriculture (*ibid.*).

One way out of the crisis is to step up the investments in irrigation projects. However, public investment in irrigation has declined from 23 per cent during the First Plan period to about 5 per cent in the Tenth Plan (*ibid.*). According to the National Commission on Agriculture, even if the entire irrigation potential of the country is developed, more than 50 per cent of arable land will still remain rainfed. With productivity in the Green Revolution areas becoming stagnant and the likelihood of expanding irrigated areas in the short run being limited, it is unlikely that future growth will come from irrigated areas. Rationalizing the use of water resources and focusing on water resource efficiency, encouraging conjunctive use of chemical and organic fertilizers; promoting integrated pest management and using chemical pesticides as a last resort measure;

and promoting crop and varietal diversity are some of the ways of stabilizing production in irrigated areas. In the meantime, attention needs to be focused on rainfed regions, which constitute about 60 per cent of the total cultivated land in India.

Focus of the Handbook

Given the vast and ever-expanding scope of LA in rainfed areas, the authors were compelled to mark the boundaries, beyond which it did not venture either due to lack of expertise or practical exigencies. This has helped us to focus better.

Rainfed areas

The regions where crop production is exclusively dependent upon rainfall are called rainfed areas. Though this definition seems simple actual demarcation and estimation of rainfed areas are fraught with difficulties. The estimates have varied depending on the assumptions made and the methods adopted. According to one classification based on biophysical characteristics and dominant production systems, rainfed areas can be broadly divided into four groups as shown in Table 1.1. These agro-ecologies vary substantially in their production potential, cropping systems, as well as factors limiting production.

Table 1.1: Classification of rainfed areas

Attributes	Agro-ecology			
	Arid	Semi-arid dry	Semi-arid wet	Sub-humid dry
Percentage of geographical area	9.6	12.0	25.9	21.1
Rainfall (mm)	<500	501-700	701-1100	1101-1600
Soils	Aridsols, vertic-vertisols	Vertisols, vertic inceptisols, alfisols	Vertic inceptisols, alfisols, entisols	Vertisols, vertic soils, alfisols, mollisols, entisols
Length of growing period (days)	60-90	90-120	120-150	150-210
Production systems	Pearl millet, short-duration pulses, perennials and livestock farming	Pearl millet, groundnut, kharif and rabi sorghum, cotton-based systems	Soybean-based, maize-based and sorghum-based systems	Rainfed rice followed by pulses and oilseeds

Source: Singh et. al. (2000) in Wani, Rockstrom and Oweis (2009).

Official estimates place rainfed areas between 60 to 70 per cent. According to the Union Ministry of Agriculture, rainfed regions account for 68 per cent of the total net sown area in the country. An assessment by S M Jharwal, Principal Advisor to the Government of India, shows that 86 million ha out of a net sown area of 141 million ha (61 per cent), is rainfed. State-wise assessment shows that 13 states account for about 92 per cent of the total rainfed area. The main rainfed include states Maharashtra (14.49 million ha), Madhya Pradesh (9.31 million ha), Rajasthan (12.15 million ha), Karnataka (7.46 million ha), Uttar Pradesh (4.42 million ha), Andhra Pradesh (6.48 million ha), Gujarat (6.58 million ha) and West Bengal (2.54 million ha). (CSE, July 2007)

The extent of rainfed areas could be even larger if one takes a critical look at the sources of irrigation. Of the 54.56 million ha of the net irrigated area, 69.7 per cent is dependent on tanks, wells, and traditional water bodies. Barring the wells under command area, the rest, along with other sources, are also dependent on rain. This means that in reality rainfed areas could well be in the vicinity of around 80 per cent (CSE, July 2007).

According to the Central Ground Water Board, in 100 districts excessive ground water use has led to major economic and sustainability problems. These districts are termed 'critical' as far as ground water scenario is concerned. Eighty-five of these districts are in the rainfed regions. These areas happen to have the highest concentration of dug-wells in the country. Here falling water tables have had the most disastrous impact of drying up of wells, forcing farmers to revert to rainfed farming. The working group on rainfed farming constituted by the Planning Commission to prepare the 11th Five-Year Plan pointed out that the areas where ground water is stressed, should also be treated as rainfed areas and be covered under related programmes. This is because ground water is recharged by surface rainwater.

Scientists and research institutions have looked at rainfed regions somewhat differently. In the *Indian Journal of Agricultural Economics*, S L Bapna (1981) categorizes regions with less than 25 per cent of its gross cropped area under irrigation and having average annual rainfall in the range of 500-1,500 mm as rainfed areas. N S Jodha, an eminent scientist working on the problems of rainfed areas has endorsed this view. According to scientists with the Central Research Institute for Dryland Agriculture, those areas, which receive an annual rainfall of 750-800 mm, and have less than 30 per cent irrigated land, are rainfed (Bapna, 1981).

The experience of the authors and contributors is limited to arid and semi-arid regions, (also referred to as drylands) accounting for almost 60 per cent of the geographical area and more than 70 per cent of rainfed areas. Experiences and insights are drawn mainly from the six states of Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. So far as natural resource conservation, regeneration and utilization are concerned, the information provided would be relevant mainly to drylands. However, for all other aspects knowledge generated would be equally relevant for all other rainfed regions.

Need for a strategy handbook

Given the high biotic pressures, the extent of land degradation and the erratic rainfall patterns in rainfed regions, investment in natural resource conservation is a pre-condition for reviving farming systems and augmenting productivity. Substantial progress has been made through innovative approaches in the evolution of watershed development technology over the past two decades. The most dramatic results were achieved by Tarun Bharat Sangh in the Alwar region, who revived entire rivers (e.g. River Arvari) by adopting a river-basin approach to the treatment of catchment areas. Various watershed development programmes, supported by government and bi-lateral funding agencies, have achieved notable success. Since the watershed approach works best in undulating lands and in semi-arid regions, other approaches are being developed by agencies working in rainfed areas, including rolling and flat lands, and lands with specific problems like saline lands, desert lands affected by sand dunes, laterite lands and acidic lands.

The strategic knowledge accumulated through trial and error by these agencies is not readily available to practitioners. Although a large number of manuals have been written on the watershed development approach, a majority of these have focused narrowly on the technical aspects of various treatments. These manuals also lack focus on livelihood augmentation aspects, which is a key objective of investments in natural resource development. Hence, other equally important aspects like institutional development; sustainable use of natural resources; value addition and production for the markets; livelihood augmentation of the landless, marginalized, and women; development of common property resources; development of the service sector and use of ICT for enhancing local livelihoods; removal of drudgery especially from the chores of women; and water resource management with attention to drinking water issues do not find place in such manuals. There seems to be a near absence of literature that enables practitioners to develop strategies for specific conditions faced in their project locations. It is precisely this gap that the present manual seeks to fill. The handbook will help the practitioner make informed choices and decide what strategies can be attempted in specific situations. We believe that development leaders, including social entrepreneurs, programme directors and project leaders, will benefit the most from this handbook, although it will be of interest to all practitioners, academics and policy makers interested in the uplift of communities in rainfed areas.

Context of Rainfed Agriculture in India

In India, of the approximately 141 million hectares of cultivable land, about 86 million hectares is under rainfed cultivation (Bapna, 1981), which contributes about 45 per cent of the agricultural production. Significantly, about 86 per cent of pulses, 77 per cent of oil seeds and 50 per cent of cereals in the country are produced in these areas (WASSAN, September, 2007). Though rainfed areas have made a significant contribution to agriculture in the country, productivity levels have been abysmally low. The net impact of low farm productivity has been high levels of food and water insecurity, low employment opportunities in the village, leading to high distress migration, disruption of family life, low investment in children's education, high indebtedness and, in certain areas where cash crops are grown, high suicide levels among farmers.

Yield gap in rainfed areas

The adoption rates of agricultural technology are extremely poor because, a) the reach of the formal research and extension system in such areas is poor, and b) even where access to the extension system is not a problem, the package of practices recommended usually do not fit local conditions, which are rather different from those of the field station where these were developed.

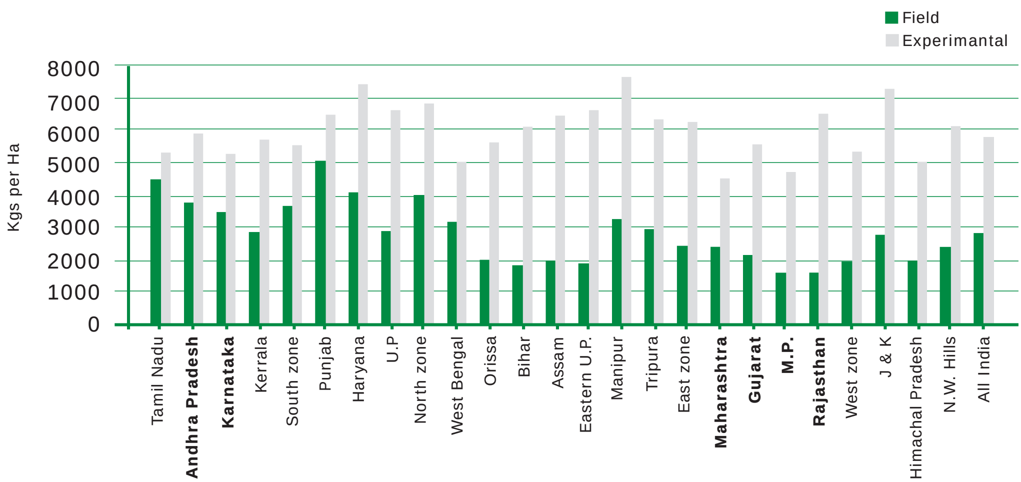
Discussing the case of crop varieties developed under the formal system (Indian Council for Agriculture Research [ICAR] institutions and State agricultural universities), Mondal (2007) asserts that the formal system suffers from several limitations:

- The extension process is supply driven, and not demand driven.
- Formal extension involves huge subsidies for certain varieties which the authorities feel have to be focused on. It dictates recommendations to the community; hence, the change to required varieties seldom occurs because it has not happened as a result of an informed decision making by the farmer.
- Due to uniform and generic recommendations, the monoculture of one prominent variety on a large area increases the chances of pest outbreak and diminishes the varietal diversity in a region. For instance, in Madhya Pradesh about 85 per cent of the 4.2 million ha. of soybean area is being sown with a single variety, JS-335, for the past 15-20 years (Mondal, 2007).

The implications of these limitations are found in the poor adoption rate of varieties. For instance, India has developed over 650 new rice varieties in the last 55 years, but hardly 10-15 per cent of them are in general cultivation on a sizeable area (Suhas Wani per. comm.). As a result, farmers continue to cultivate varieties that are more than 10-15 years old and which have, therefore, lost their genetic vigour.

Apart from depleted genetic vigour of varieties, lack of soil moisture and irrigation water are key factors limiting farm productivity. Land degradation on account of mindless deforestation, lack of vegetative cover and soil erosion from farmlands further exacerbate the problem of low productivity. An unusually large yield gap exists between the potential of a given variety (as measured on the scientists' experiment station) and the yield actually realized on the farmer's field. Figure 1.1 shows the yield gap for paddy in different states during the nineties. The figure shows that the yield gaps are particularly large in predominantly rainfed states.

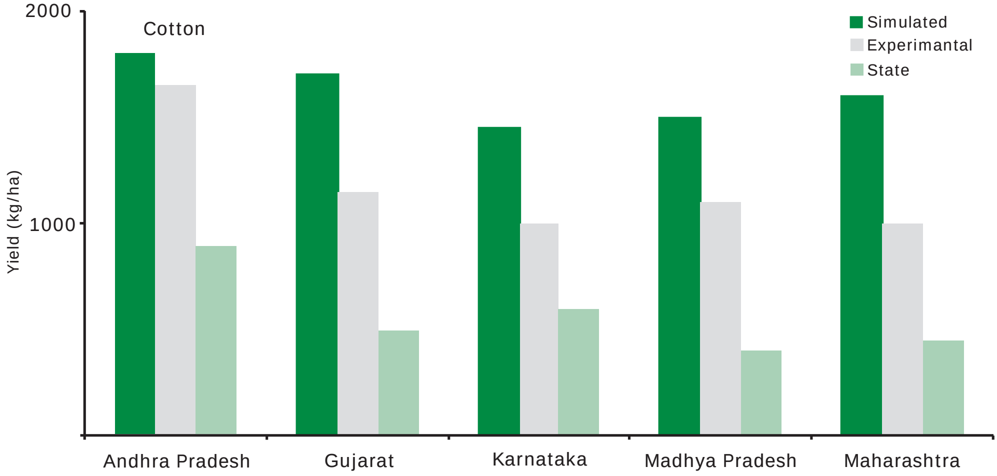
Figure 1.1: Yield Gap in Paddy in Different States (1991- 98)



Source: Mondal, (2007)

More recent yield gap assessments between simulated, experimental and state (actual) averages made by CGIAR system scientists for important rainfed crops such as cotton (figure 1.2), sorghum, pearl millet, groundnut, soybean, pigeon-pea and chickpea have yielded similar results. The yield gaps ranged from two to five times (Singh P. et. al. in Wani, Rockstrom and Oweis, 2009).

Figure 1.2: Yield Gap in Cotton in Different States



Source: Singh P. et. al. in Wani, Rockstrom and Oweis, 2009.

Some of the important reasons for the productivity gap in rain-fed regions can be summarized as:

- Erratic and uncertain rainfall,
- Large-scale soil degradation and groundwater depletion,
- Unscientific tillage practices, leading to soil erosion,
- Low cropping intensity,
- Low input use,
- Low seed replacement ratio,
- Low access to formal research and extension,
- Lack of location-specific technologies to match the high ecological diversity of rain-fed regions, and
- Lack of investment in infrastructure to harvest and conserve rainwater and control soil erosion.

The last two are most important from the viewpoint of designing interventions and are, therefore, discussed in some detail.

Need for location-specific technologies

While there exists a large potential which can bring about a quantum jump in productivity of rainfed regions, the challenges in exploring this potential are equally daunting. Experiences of developmental agencies during the past two decades have demonstrated beyond doubt that such a quantum jump is possible. However, unlike the Green Revolution areas, where environmental conditions were relatively homogenous, the highly diverse ecological conditions of rainfed regions demand a variety of approaches. What works well in the undulating lands of Bundelkhund is unlikely to work in the coastal saline belt of Saurashtra or in the arid regions of Marwar, or for that matter, in the laterite soils of Karnataka.

Rainfed farming systems are often multi-layered and complex, with micro-climatic conditions changing from field to field. Often agro-advisories need to be plot-specific in order to make a positive impact on productivity. The challenge lies in augmenting livelihoods of approximately 400 million rural poor residing in approximately 200 poorest districts of the country that constitute rainfed areas.

The task of carrying out location-specific trials and providing plot-specific advice to farmers appears to be beyond the capacity of the formal governmental extension system. The large majority of agricultural scientists have preferred to carry out research in the convenience of their field stations rather than on the farmer's field. As a result, the kind of benefits that were possible during the Green Revolution has not materialized in rainfed areas in spite of three decades of research and extension. Several NGOs like Gramin Vikas Trust (GVT), Action for Social Advancement (ASA), M.S. Swaminathan Research Foundation (MSSRF), Bharatiya Agro Industries Foundation (BAIF) and others have demonstrated the utility of participatory approaches to farm research and extension. Examples of 'farmer-led participatory research' documented for drylands in the western states of Gujarat, Maharashtra and Rajasthan (Pastakia, 2001) demonstrate the utility of such an approach. However, entrenched systems of research management in the state agricultural universities and ICAR institutions ensure that such approaches, at best, remain marginalized.

Need for increased investments in natural resource development

There is a considerable disparity between the investments in rainfed agriculture vis-à-vis irrigated agriculture. Typically, it takes more than Rs 1 lakh/ha to develop major irrigation systems, Rs 15,000/ha for tank renovation schemes and Rs 10,000/ha for developing groundwater schemes. Till recently, only Rs 6000/ha was provided to develop a micro-watershed. This has recently been increased to Rs 10,000/ha in the 11th Five Year Plan. The Working Group on Watershed Development, Rainfed Farming and Natural Resource Management for the Tenth Plan has estimated that 88.5 million ha will have to be treated by the Thirteenth Plan (2002-2022) at an investment of Rs 72,750 crores (1994 prices). At the current level of prices, the requirement of funds for developing these areas would be about Rs 1,36,042 crores *(Planning Commission, 2002).*

Creating a long-term vision

Given the nature of the problem outlined above, it is clear that the carrying capacities of rainfed areas will have to increase dramatically in the years to come. This means that the same unit of land will have to, perforce, support larger populations year after year. Failure to do so would lead to migration and enlargement of urban slums, and increase in food scarcity.

This calls for a vision over a long time-frame that will spell out the graduated steps by which rainfed areas will continue to improve productivity in ways that support the rapidly expanding population. The present compilation of knowledge is a modest attempt to move towards such a vision. In the next section, we describe briefly some of the approaches to LA that have been tried, tested and found effective in rainfed areas. These approaches, which are not mutually exclusive, can be used in conjunction with each other. They serve as the basis of the conceptual framework for the handbook.

Augmenting Livelihoods in Rainfed Areas: Various Approaches

The watershed development approach

The experience of watershed development has shown the way for augmenting the natural resource base in rainfed regions, particularly the undulating areas with semi-arid and arid climates. Innovative experiments of the 80s were used as inputs for scaling up watershed development in various states through governmental and bilateral funding. A wealth of knowledge is available with various developmental agencies in participatory processes and systems that have proved effective in implementing watershed projects.

Various ministries/departments of the Government of India and the state governments have implemented different schemes to improve the infrastructure for soil and water conservation: storage of surface water through check-dams, tanks, ponds, etc.; and storage of groundwater through recharge of wells, gabion structures, sub-surface dams, percolation tanks, etc. Table 1.2 shows the coverage and expenditure in some of the important schemes of past and present.

Table 1.2: Government Promoted Watershed Development Schemes: Coverage and Investment (2006-07)

No.	Department/Scheme	Year Initiated	Area Covered (Lakh ha)	Expenditure (Rs in crores)
A	**Ministry of Agriculture (Department of Agriculture and Co-operation)**			
1	National Watershed Development Project for Rainfed Areas (NWDPRA).	1990-91	93.09	3025.56
2	River Valley Project and Flood Prone Rivers (RVP & FPR).	1962 & 1981	64.86	2244.24
3	Watershed Development Programme for Shifting Cultivation Areas (WDPSCA).	1974-75	3.93	295.58
4	Watershed Development Fund (WDF) in collaboration with the National Bank for Rural and Agriculture Development (NABARD).	1999-2000	0.59	26.04
5	Reclamation of Alkali Soils (RAS).	1985-86	7.11	121.74
6	Externally Aided Projects (EAPs)		18.15	3967.35
	Sub-total		187.73	9680.49
B	**Ministry of Rural Development (Department of Land Resources)**			
1	Drought Prone Area Programme (DPAP)	1973-74	137.27	4842.50
2	Desert Development Programme (DDP)	1977-78	78.73	1949.88
3	Integrated Wasteland Development Programme (IWDP)	1988-89	99.56	2438.15
4	EAPs		5.00	292.67
	Sub-total		320.56	9523.20
C	**Ministry of Environment and Forests**			
2	National Afforestation and Eco-development Project (NAEP)	1989-90	0.70	47.53
	Grand Total		**508.99**	**19,251.22**

Source: GOI (2007) Report of Working Group on Natural Resource Management, Vol. 1.

Besides these, many state governments and non-government organizations (NGOs) have taken up programmes with external aid. Certain research organizations like the International Crop Research Institute for Semi-arid Tropics (ICRISAT) and ICAR have also taken up research projects for the development of rainfed areas.

Impact assessment studies and evaluation studies of watershed development programmes (WDPs) carried out by academic institutes and NGOs such as Development Support Centre (DSC) have shown that farmers and others have benefited through significant increase in the following parameters:

- Net sown area and gross cropped area,
- Cropping intensity,
- Crop productivity and biomass availability,
- Groundwater levels through recharge of groundwater aquifers,
- Number of livestock, with a marked preference for improved breeds,
- Agriculture-related employment, and
- Household income

According to a longitudinal study carried out by DSC in Gujarat, watershed development has led to long-term gains such as increased water, food, fodder and livelihood securities, which in turn have contributed to greater resilience against recurring droughts. The study, in its eighth year, is based on a sample of 16 villages from different ecological zones and compares the performance of watershed and non-watershed villages. Whereas the performance of watershed villages is superior to that of the non-watershed villages in a number of variables, the overall performance of agriculture is still highly dependent on rainfall pattern. Further, in case of recurrent droughts, watershed villages perform well for one year. After the third consecutive drought, the difference is nullified (Shah Anil, 2000, 2002, 2004; and Sen, 2005).

A meta-analysis of 311 watershed case studies in India revealed that watershed programmes have a positive impact in rainfed areas with a benefit-cost ratio of 2.14 and internal rate of return (IRR) of 22.04 per cent. The cropping intensity increased by 63 per cent, the irrigated areas increased by 34 per cent, the run-off reduced by 13 per cent and the employment increased by 181 person-days/ha/yr. (Joshi et. al. 2005). However, the study also reported that 65 per cent of the watersheds were performing below average because community participation was lacking, programmes were supply driven, equity and sustainability issues were elusive and a compartmental approach was adopted (*ibid*). The study led ICRISAT, in partnership with National Agricultural Research System (NARS), to develop and propagate a 'consortium approach' to watershed development.

There is a vast scope for improving these figures because only 35 per cent of the watersheds are performing above average and the remaining 65 per cent are below average. Some of the limitations found are:

- Inadequate capacity building and institution development at the watershed level,
- Inequitable distribution of benefits,
- Very low participation of women,

- Negligible work on common property resources,
- Little focus on water use efficiency and water demand management,
- Almost no use of ICT,
- Low effort to create linkages with credit institutions and the market,
- Lack of coordination between implementing agencies, and
- Lack of emphasis on livelihood augmentation.

Agencies have evolved different approaches to overcome some of these shortcomings. For instance, ICRISAT is propagating the integrated consortium approach to overcome the compartmental approach of the government departments and implementing agencies. Andhra Pradesh Rural Livelihood Project (APRLP) is promoting the livelihood approach to overcome the lack of emphasis on LA. Some of the older development agencies implementing watershed development projects have moved into the next phase, referred to as 'watershed plus' by some. Their focus is on augmenting livelihoods through new technology and marketing interventions, and building upon the social capital developed for implementing the project. Some of the LA approaches that go beyond watershed development are discussed below.

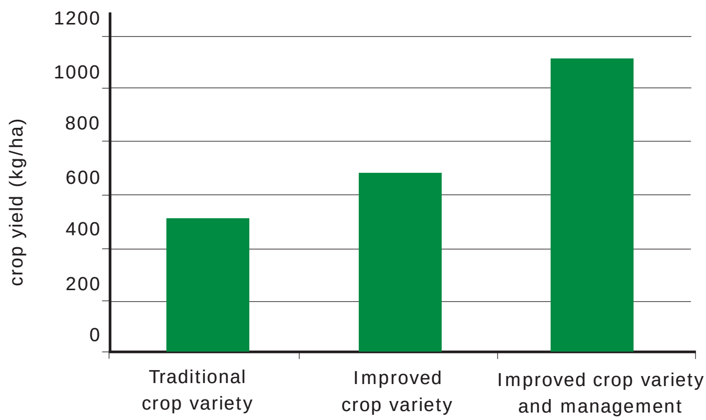
Participatory research and extension

A few natural resource initiatives are directed at improving agricultural productivity through participatory research. For instance, in the rainfed tribal belt of central India, agencies such as GVT and ASA have worked wonders with participatory varietal selection and promotion (PVSP). This approach has been used to bridge the gap from lab to land by offering farmers a basket of varieties to choose from, and selecting varieties after making trials in their own fields under their own management regime. The trials and scientific collection of data are facilitated by the developmental agency. Productivity gains from 20 to 40 per cent have been achieved by propagating farmer-preferred varieties.

Some of these varieties have diffused rapidly to cover as much as 70-80 per cent of the land under the crop. Besides the gains in yield, multiple benefits have been realized by the farmers, including early maturity and risk reduction, savings in input costs such as irrigation and pesticides, fodder security, and better taste and cooking attributes of varieties grown for home consumption.

The Jeypore tract in Orissa, considered the centre of origin of rice, is home to a rich diversity of landraces. Scientists from MSSRF worked with farmers and helped them in the process of selection and multiplication, storage and supply of local landraces, complemented by improved agronomic practices developed through participatory approach. They also trained rural women and men to carry out participatory plant breeding (PPB), demystifying the technology in the process. They helped build a people's institution to produce Kalajeera, a scented rice of the region, with financial support from National Agricultural Cooperative Marketing Federation (NAFED). The on-farm trials with local landraces and improved agronomic practices led to a 200 per cent increase in productivity (Arunachalam et. al., 2006). There is clear evidence from other experiments as well that the largest productivity gains in semi-arid regions can come from combining new varieties with improved crop management and natural resource management (NRM) (Figure 1.3). These results help to bring out the logic of integrated genetic and natural resource management (IGNRM) approach propagated by ICRISAT, which seeks to integrate crop improvement research and extension with NRM.

Figure 1.3: Contribution of Different Technology Components on Sorghum Yield, Observed in On-farm Trials in Zimbabwe



Source: Heinrich and Rusike, 2003.

Market-led approaches to LA

The market-led approach entails developing backward linkages for the supply of quality inputs to farmers at a reasonable price as well as forward linkages for better marketing of produce and better price realization. A few developmental agencies have tread the difficult path of developing the entire value chain, which throws up opportunities for poor women and men to get gainfully self-employed at different nodes of the value chain. It also enables people's institutions (PIs) to retain control over the marketing of farm produce and absorb market risks on behalf of the primary producers. Examples include:

- The Kesla model of household broiler farming, which is run and managed by poultry cooperatives, promoted by Professional Assistance for Development Action (PRADAN). These cooperatives, which have integrated backwards with their own feed units and hatcheries are highly competitive, and have withstood recurrent shocks in the market caused by the bird-flu scare.

- Value chain for organic cotton, promoted by AGROCEL. The organic cotton and its value added products are produced by farmers in Kutch and marketed through fair-price channels and up-market retail chains like, Marks and Spencer's in the UK.

- PRADAN's intervention in the tasar silk value chain saw the production of disease free layings through demystification of technology, establishment of reeling units by poor women, and control of the value chain right up to the production of sarees, stoles, and other garments sold in urban and export markets by a professional marketing company, spawned by the producers' company MASUTA.

ICT for livelihood augmentation

Recent developments in ICT have opened up new possibilities of LA in rainfed regions by:

i. Improving access to knowledge and information that can protect crops, and improve productivity of assets like land, water bodies, forests, dairy animals and poultry. Plot-specific advisories can be provided through the Internet and hand-held devices to farmers by experts, sitting hundreds of miles away. Examples of such services include M-krishi developed by Tata Consultancy Services, e-Sagu developed by Media Lab Asia, and IFFCO Kisan Sanchar Ltd. (IKSL) a national organization of cooperatives developed by IFFCO.

ii. Improving access to credit (inclusive banking) through the use of hand-held devices and biometric identification, which eliminate the need for an illiterate person to spend time and money in visiting the bank in order to carry out a simple transaction. Such a system has been developed by Ek-Gaon, which has received international recognition for the same. State Bank of India, among other banks, is in the process of reorganizing itself completely in order to facilitate inclusive banking in rural areas.

iii. Improving the farmer's access to market information so as to improve price discovery and realization. The Multi-commodity Exchange (MCX) has done pioneering work in this area. ITC's e-choupal model has also been widely adopted in Madhya Pradesh and other States.

iv. Various other applications that can help to monitor large-scale development projects, improve transparency and accuracy of accounts, for example, new software packages developed to monitor the National Rural Employment Guarantee Scheme of the GoI, and software to monitor the National Literacy and Health Missions.

v. Creation of new job opportunities for rural youth in the service sector through computer literacy. New opportunities exist in the provision of knowledge-based services such as tele-medicine, tele-education, e-governance, desk-top printing, railway ticketing, rural BPOs and a host of other such services.

So widespread are the applications that ICT can be seen to cut across themes to strengthen various NRM and market-led interventions and other schemes offered to farmers.

People-centred approach

By the 90s, realization had dawned upon most development agencies that the benefits of rural interventions do not last long unless people are involved in the decision-making and in every step of the intervention. Building the capacities of local communities, through exposure visits to successful projects, training and handholding has become an integral part of all participatory projects and all the approaches described above. The creation of PIs of various types has facilitated not only the implementation of projects by people themselves but have also enabled equitable distribution of resources and sustainable use of natural resources. Mechanisms by which people contribute to the project in cash and kind have helped to build their stakes in the project and to ensure that the infrastructure created to conserve and harvest valuable natural resources are protected and maintained. PIs vary from the informal (like self-help groups and common interest groups) to the formal (like cooperatives, producers' companies and mutual benefit trusts), depending on the aims and membership profile of the organization.

The choice of institution should be made carefully after considering the legal and administrative implications of the same. This is because building sustainable institutions with democratic values of equity, gender sensitivity and sustainability call for long-term investments in capacity building. These institutions may work in tandem with local entrepreneurs and service providers as well, depending on the underlying strategy of the particular intervention.

Noticing a reversal of trends in the 10th Five Year Plan, Development Support Centre catalysed a National Meeting of NGOs, academics and developmental planners that resulted in the “Bopal Declaration” of 2005. The declaration sought to reassert the importance of people-centred, decentralized inclusive and sustainable development by puttiing down a set of eight declarations that should serve as the non-negotiable principles for all natural resource based programmes. The efforts initiated by late Anilbhai Shah, of DSC have not been in vain. Ultimately the civil society initiative had the desired impact on policy makers at the highest level. The Bopal Declarations found mention in the Planning Commission’s Approach Paper for Rainfed Areas and were also adopted in the new watershed guidelines of April 2008 (see Annexure 1 for the full text of Bopal Declarations).

The experiences and approaches described above are highly relevant at a time when Indian agriculture and rainfed farming, in particular, are once again at the crossroads. The handbook showcases many such examples and experiences, which practitioners can draw on while designing and implementing their own programmes.

While the experiences and best practices will be of direct relevance to practitioners in rain-fed areas of western and southern India, from where these are drawn, the book moves from the realms of practice to theory by attempting to distill the basic principles, values and strategies that these experiences embody. It is this aspect of the handbook, we believe, that makes it valuable and applicable to a much wider audience beyond the spatial and temporal boundaries of the interventions described. For the same reason, we expect that both practitioners as well as academics will find this compilation a useful reference and guide for unlocking the vast potential of rain-fed areas for food security and LA.

Part-2

NRM Based Strategies

1 Introduction

In rainfed regions, local communities depend a great deal on the available natural resource base for their food and livelihood security. When this base gets depleted to such an extent that it is unable to support the population, people are forced to migrate in search of employment. Hence, investing in natural resource conservation becomes the first and foremost priority for livelihood augmentation in rainfed areas. As seen earlier, productivity in rainfed areas has remained way below the actual potential, largely due to neglect and/or over exploitation of natural resources.

The conservation of valuable resources like soil, water and biomass can serve as the basis of food security not only during normal monsoon years but also during years of drought. During stress periods, local communities can fall back on stored groundwater to provide life-saving irrigation to food crops. Community grasslands and forests provide fodder and non-timber forest produce (NTFP); even wilderness vegetation can provide stress foods and fodder that will sustain the population during difficult years. Food and fodder banks, maintained by the community *in situ*, can also help tide over scarcity months/years. The experiences of developmental agencies during the past two decades show that a systematic and integrated approach to natural resource management (NRM) such as watershed development can augment resources to such an extent that there is dramatic increase in productivity of crops and animals. During good years, such lands can produce marketable surplus, which can greatly improve the food security of the nation as a whole while providing a boost to the local economy.

In this volume, our attempt is to bring together the somewhat fragmented knowledge on the subject in the form of basic principles and values as well as strategies/approaches found effective in different ecological conditions. The focus all along is not on NRM *per se*; rather, it is the end result of supporting more livelihoods without compromising on the sustainability of resource use.

Watershed Development: An Integrated NRM Strategy

The success of micro-watershed development in the villages of Ralegon Siddhi, Adgaon and Dharewadi in Maharashtra has led to a large number of initiatives and programmes in other areas. Among the celebrated cases of micro-watershed development, the name of Sukhomajri stands out. Sukhomajri is a small hamlet of about 80 families, located in the foothills of the Shivaliks in Haryana. Under the leadership of P R Mishra, the Central Soil and Water Conservation Research and Training Institute, (CSWCRTI), Chandigarh, made an intervention that brought about dramatic changes both in the ecology of the watershed as well as the economic situation of Sukhomajri and adjoining villages. The intervention comprised of the creation of a series of earthen dams on the drainage line, protection of degraded forest lands through 'social fencing' by the villagers themselves, and reclamation of wastelands through the cultivation of valuable tree species and *bhabbar* grass (*Eulialopsis binata*), used locally for making ropes and also as fodder. The all-round improvement in natural resources led to the strengthening and opening up of a variety of livelihood activities. Within a decade, the benefits accruing from the project brought a sea change in the ecological and socio-economic situation in the village (see Box 1.1).

Box 1.1: Benefits Accrued from Watershed Development in Sukhomajri

The benefits accrued from the project over the span of a decade, starting from the mid 70s, may be gauged from the following:

- Run-off sedimentation from the highly eroded Shivaliks reduced dramatically from 80 t/ha to less than 1 t/ha.
- Production of grass more than doubled from 3.82 t/ha to 7.72 t/ha.
- Increased availability of fodder led to a transformation in the composition of livestock in favour of buffaloes, which increased from 79 in 1975 to 291 in 1986. This led to increased milk production from 334 litres per day to 579 litres per day.
- Tree density increased from 13 per ha to 1,292/ha in 1992. About 500 *khair* trees mature in the forest every year. These trees produce *katha*, an extract used in medicine, pan and natural dyes, which are highly valued in the market and fetch a price of Rs 500/kg. If the villagers were to set up a small village enterprise, they would produce and market *katha* directly and earn Rs 36 million annually.
- Availability of irrigation water doubled the productivity of wheat and maize.
- *Bhabbar* grass sold to paper mills earned the villagers Rs 2 lakhs per annum.
- Prosperity became a by-word in Sukhomajri. The 80 households replaced their thatch and mud dwellings with brick and cement houses, and more than half of them own television sets.
- Sukhomajri was one of the few villages to be taxed on income from natural regeneration. Since 1989, when the Income Tax Act brought about an amendment, the Community Based Organization (CBO) in charge of the economic activities has been paying 15 per cent income tax and a sales tax of 8 per cent on sale of *bhabbar*.

Source: ENVIS, June 2008

Since these early experiences, a number of large-scale projects and programmes have been implemented, generating a wealth of information and knowledge. (See Chapters 3 and 4.)

Specialized Strategies for Problem Lands

Lack of available financial and human resources, harsh ecological and social conditions, specific natural resource problems and other limitations may often prevent developmental agencies from pursuing an integrated NRM strategy like watershed development. Under the circumstances, development agencies pursue specific strategies to address specific problems:

- Specialized NRM strategies are called for to address livelihood problems, arising from problem soils such as saline and alkaline soils, laterite soils, etc.
- In arid regions, like the Thar Desert, the critical problem is to first address the issue of shortage of drinking water. Here, livestock-based livelihood strategies though evolved over the centuries are facing a crisis on account of degraded pasturelands and forests, breakdown of traditional institutions for managing community resources, and resultant scarcity of drinking water and fodder. Urgent steps are needed to revive and strengthen these livelihoods.

The limited experience gained in addressing these specific problems is discussed in Chapter 5.

Strategies for Distress Hotspots

Integrated strategies are needed for 'distress hotspots', which have witnessed a high rate of farmer suicides in recent years. The adoption of non-sustainable farming, emphasizing water inefficient cash crops, high use of chemicals, mono-culture and high indebtedness are some of the reasons for distress in areas such as Vidharbha in Maharashtra, Anantpur in Andhra Pradesh, and Bundelkhand in UP. Some of the innovative solutions being tried in these areas also have the potential for solving the issue of agricultural sustainability in the Green Revolution areas. These ideas and approaches are summarized in Chapter 6.

The Critical Role of Livestock in Rainfed Areas

Livestock forms an integral part of farming systems in rainfed areas. Not only does it help in maintaining the nutritional cycle of soils, it also provides food and nutritional security to the human population during years of drought and scarcity. Different livestock species are adapted to different ecological conditions. Arid zones are particularly known for having developed drought-resistant breeds over the centuries. However, recent changes in the ecological environment, leading to widespread scarcity of fodder, is threatening this traditional livelihood activity and making people more vulnerable. We have, therefore, tried to collect experiences of strengthening and reviving livestock-based livelihood strategies, which are presented in Chapter 7.

Need to Recognize People's Knowledge and Creativity

Local communities have their own knowledge systems and a resultant body of local technical knowledge (LTK). They also have unique traditional institutions that have evolved to manage particular natural resources in a sustainable way. Unfortunately, this traditional knowledge is discounted by the modern educational system. In the process, many of these traditional institutions and technical practices are either getting extinct or are under tremendous pressure.

A different approach is needed to recognize, validate and diffuse grassroots innovations of farmers, artisans and local communities. A few NGOs are trying to revive traditional institutions and practices that are still relevant today. There is also tremendous scope for harnessing the creativity of farmers by making them partners in the technology development process. Linking grassroots innovators and entrepreneurs and making available micro-venture capital can help promote rural entrepreneurship at the grass roots. Chapter 8 looks into grassroots innovations and knowledge.

Importance of People's Institutions

The initial success, especially in watershed development during the 80s, triggered substantial investment in natural resource conservation in the past two decades. As on 2006, the government and other donor agencies had together invested about Rs 192.5 billion in watershed development programmes (Wani et al., 2008). Many of the watershed projects, however, got implemented mechanically, without the realization that livelihoods would not get augmented automatically.

PIs play a significant role in facilitating inclusive, gender-sensitive development and in ensuring that the resources are being used in a sustainable manner. Agencies can pursue a policy of positive discrimination to ensure that the poorest of the poor are not denied access to the newly developed resources. Building people's institutions and placing people at the centre of the development process are critical to ensure success in all NRM initiatives. Chapter 9 deals briefly with the strategies for building people's Iinstitutions. For a full treatment of the subject, readers are referred to Volume IV of the handbook.

2 General Principles and Ethical Values

Practitioners interested in NRM based livelihood promotion need to consider the following basic principles and values, which hold the key not only to successful programme implementation but also ensure sustainability of natural resources and the livelihoods based on them. These are based on an analysis of the case studies/ experiences shared in this volume as well as the available literature on the subject.

1. The interconnectedness of natural resources in any ecological unit, be it a farming system or a micro-watershed, provides an uncommon opportunity to harness synergy when all components are treated simultaneously. It is not surprising, therefore, that integrated NRM approaches like micro-watershed development (MWD), as compared to piecemeal interventions, give better results.

2. Natural resources provide ecological services, which go much beyond the *use* and f*uture* value (economic values today and in future) of a resource. These services include purification of air through processes like carbon sequestration, decomposition of wastes, and provision of water and food. Apart from serving as a life-support system, a well-developed ecology connects us to nature and we derive an *intrinsic* value that improves the very quality of existence.

3. Natural resources do not follow man-made boundaries; the treatment, therefore, must perforce follow the ecological boundaries and processes. But the ownership and control of these natural resources follow certain social and economic equations in a given village. Hence, the implications of any natural resource intervention on the existing social relations and must be taken into account while designing the intervention.

4. Whereas women use natural resources as much as men and contribute equally, if not more, to agriculture and animal husbandry, they are rarely able to exercise control over these resources. Women's preferences in the use to which resources are put and in the choice of species, etc., are known to be distinctly different from those of men. Yet men are rarely willing to accommodate these. Externally supported NRM interventions provide a

unique opportunity to address the gender balance by empowering women and involving them in the decision-making.

5. Local knowledge systems have valuable knowledge about local natural resources and these systems have also evolved technological practices over time. This technical knowledge should be taken as the starting point in the search for sustainable and innovative solutions for augmenting natural resources.

6. There are important choices to be made in the utilization of newly developed resources. If wisely utilized, it will lead to sustainable and equitable development. However, if the resources are not carefully used, the development could become skewed and only a few powerful individuals would corner the resources.

7. Drinking water is a fundamental right of all citizens. In the absence of access to the necessary quantity of potable water within the village, women and men have to travel long distances to meet this basic requirement. As a result they are deprived of the opportunity of being engaged in productive activities. Hence, care should be taken to ensure that natural resource-based interventions, particularly in particular watershed development, first meet this basic need for all sections of the society before diverting water for irrigation and other uses.

8. Livestock forms an integral part of rainfed farming systems. Animal husbandry represents a traditional livelihood strategy, particularly of the poor, to survive during droughts and scarcity years. Strengthening livestock-based livelihoods is critical for improving the resilience of farming communities in arid and semi-arid regions.

9. All NRM interventions need to place people in charge of the development process for sustainable outcomes. Building people's institutions is critical for the conservation and sustainable use of natural resources, and for the maintenance of common property assets, on which the poor, mostly rely for their livelihood.

10. Investments in natural resource development alone do not guarantee augmentation of livelihoods, specially for the poor and marginalized. To improve the access of the poor to the newly created resources developmental agencies may need to make special efforts to facilitate investments in infrastructure.

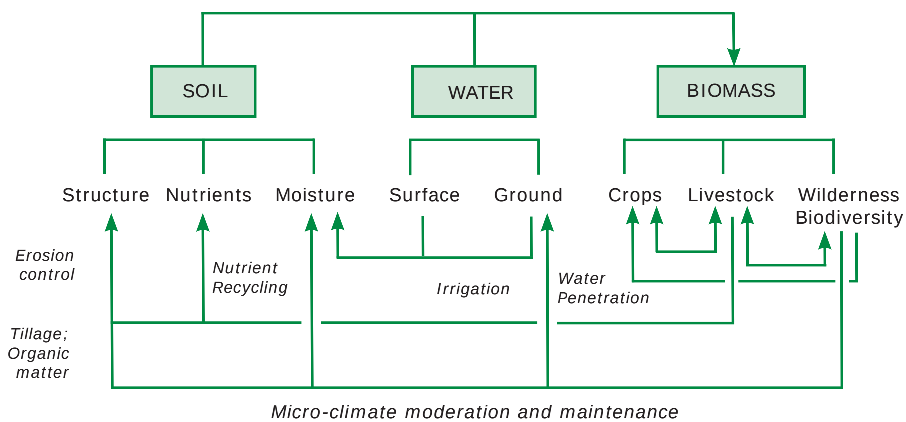
Adopting the above principles and ethical values can spell the difference between success and failure. Hence, we need to understand these in more detail.

1. Interconnectedness of natural resources

The interconnectedness of natural resources in any ecological unit, be it a farming system or a micro-watershed, provides an uncommon opportunity to harness synergy when all components are treated simultaneously. It is not surprising, therefore, that integrated approaches to NRM such as micro-watershed development (MWD), as compared to the piecemeal interventions, give best results.

Figure 2.1 shows how the three main components of a micro-watershed, namely, soil, water and biomass are intimately related and contribute to each other if natural processes and cycles are allowed to proceed without interruption. The extraction of biomass for human and animal consumption should be within the carrying capacity of the ecological system. This is well recognized by both - modern science as well as traditional knowledge systems, to be a cardinal principle for maintaining the sustainability of farming systems.

Figure 2.1: Interconnectedness of Natural Resources



Soil represents the key medium for biomass production. It is said, "Seven inches of soil separates man from starvation!" This is because most food-grain crops have a root span that is limited to this depth. For perennial crops, plantation crops and other plants with a well-developed tap root system, the lower layers of the soil are also important for productivity. Unlike industrial production, soil is a 'living medium' and is inhabited by both beneficial as well as harmful microorganisms, insects and other small creatures. For soil to be productive, it should be in good health with an optimal balance of beneficial organisms. An extractive production cycle like chemical intensive farming can result in rich harvest in the short run but leave the soil impoverished. Maintaining soil health is both a science and an art.

Many development agencies working on sustainable agriculture have started monitoring soil health to ensure sustainable outcome. Table 2.1 provides a list of the key indicators of soil health along with the suggested monitoring frequency. For a more detailed understanding of soil health, the reader may refer to standard textbooks on the subject of soil science and plant nutrition (See Annexure 4).

Table 2.1: Key Indicators of Soil Health

Soil Indicator	Suggested Monitoring Frequency
Physical Indicators	
Soil moisture	Every week
Bulk density and penetration resistance	Every week
Hydraulic conductivity	Yearly
Structure	1–2 years
Infiltration	1–2 years
Available water-holding capacity	3–5 years
Texture	3–5 years
Chemical Indicators	
pH	Seasonal
Total nitrogen	1–2 years
Available nutrients	1–2 years
Cation Exchange Capacity (CEC)	1–2 years
Biological Indicators	
Earthworm activity	Every season
Biomass carbon	1–2 years
Soil organic carbon	1–2 years
Crop Indicators	
Yield	Every season
Root growth	Every season
Nutrient status	1–2 years

Source: Ratan Lal, 1994

Traditional Indian agriculture evolved on the premises of conservation and sustainable use of natural resources. No one knew this better than the late K M Munshi, the first Minister of Agriculture in Independent India. Munshi articulated this explicitly in *The Gospel of the Dirty Hand* (1952), in which he expounded the relevance of water, nutrient and habitat cycles, which must be maintained in delicate balance in order for the system to be sustainable. When these cycles are thrown out of balance due to excessive abstraction of resources, the downward spiral begins, leading to lower and lower capabilities of the system to support local populations.

Micro-watershed development and organic farming techniques were evolved through a process of experimentation with the objective of arresting this downward spiral and gradually building up the three cycles again in ways that generate synergy in the entire agro-ecological system. Some of the proven ways of reviving these cycles are shown in Box 2.1.

Box 2.1: Measures to Revive Agro-ecologies

- Recycling of biomass to the soils in order to maintain the nutrient status.
- Creating structures to check the run-off in order to store water on the surface as well as in the soil and sub-soil strata.
- Recharging of groundwater and wells.
- Integrating animal husbandry in the farming system in order to improve both nutrient cycling and livelihoods.
- Controlling the erosion of valuable top-soil through various physical and vegetative means.
- Developing vegetative cover in the upper reaches in order to reduce the run-off and increase water penetration.
- Adopting measures that help to retain soil moisture and conserve moisture *in situ*.
- Adopting measures to improve the genetic potential and the productivity of biomass—both cultivated crops and animal stock, used for supplementary income.
- Adopting measures to raise the genetic potential of fodder sources—both seasonal and perennial.
- Adopting measures to conserve the wilderness bio-diversity, which plays a significant role in agricultural productivity, through ecological services.
- Ensuring collective restraint on the abstraction of natural resources beyond the replenishment level.

2. Ecological services of natural resources

Natural resources provide ecological services that go much beyond the use and futures value (economic values today and in future) of a resource. These services include purification of air through processes like carbon sequestration, decomposition of wastes, and provision of water and food. Apart from serving as a life-support system, a well-developed ecology connects us to nature and we derive an intrinsic value that improves the very quality of existence.

Very often, we believe that watershed development has a built-in ecological perspective because it deals with soil and water conservation. However, excessive focus on production and productivity takes away the positive gains from conservation efforts. If we were to focus on rebuilding agro-ecologies through such programmes, these very programmes would have to be redesigned. Resource literacy to bring home the need to address sustainability of natural resource use would need to precede implementation of such modified watershed programmes.

Bringing ecological consideration within the purview of watershed development would imply among other things:

- Understanding and restoring relationships among various life forms.
- Appreciating the importance of ecological services provided by nature like, recycling, waste assimilation, thermal equilibrium, contribution to micro-climates, etc., and taking measures to protect nature in ways that it continues to provide such services to local communities.
- Stream bank management .
- Promoting soil formation processes.
- Providing corridors for various life forms and developing 'difficult areas' as bio-reserves.
- Creating and nurturing habitats for microbial and invertebrate life forms.
- Planting species with varying depths of root systems.
- Promoting cultural mechanisms that protect and preserve agro-bio-diversity such as land races of different crops.
- Ensuring the maintenance of base flows in streams.
- Acknowledging the role of live fences and wilderness in serving as hosts to beneficial predators, insects, microbes, etc.

The above is only an illustrative list. Ecological concerns are, as of now, not well engrained in watershed development projects. Under the circumstances, the gains from soil and water conservation can only be short-lived. Ecological economists have acknowledged the need to value nature differently from conventional ways that reduce various components of nature into resources to be exploited by human beings for their benefit. The importance of valuing ecological services provided by nature needs to be enshrined in all projects related to the use of the natural resource base. Farmers can, often, relate to these values more easily than to project implementers coming from urban backgrounds.

3. Interconnectedness of natural resources with social equations

Natural resources do not follow man-made boundaries; the treatments must, therefore, perforce follow ecological boundaries and processes. But the ownership and control of these natural resources follow certain social and economic equations in a given village. Hence, the implications of any natural resource intervention on the existing social relations must be taken into account while designing the intervention.

The above principle makes it imperative for any agency to study the property rights regime in a given watershed (Table 2.2). This regime may be intermediated through a complex system of sharecropping in private lands and usufruct rights in common and government lands. In the absence of clearly defined property rights, many an intervention has gone astray for one or both of the following reasons:

- Lack of motivation and participation because the benefits from investments made by stakeholders were not clear and guaranteed
- Emergence of conflicts between contending groups or individuals

Table 2.2: Interface between NRM and Social Relations

NRM Component	Property Rights / Access Rights		
	Private	Common	Government
Soil			
Water			
Biomass			

Another implication of this principle is that if the intervention generates benefits in a skewed manner, it could alienate certain groups and stakeholders, leading to breakdown of governance of local institutions. On the other hand, external developmental agencies can see interventions as an opportunity to pursue a policy of positive discrimination through which marginal communities and women get empowered during the process of development, leading to more equitable social equations. In semi-feudal areas, where social equations are highly skewed, such a *policy of positive discrimination* becomes all the more important, but it must be pursued with due diligence. Care should be taken to ensure that the dominant class does not feel so threatened as to stall the entire process. Local institutions should be enabled to build conflict resolution mechanisms into their operating systems. Developmental agencies too should be prepared to face and handle situations in which conflicts are inevitable. Some of these issues are discussed in more detail in Volume IV, which deals entirely with the strategies for building social capital.

4. Need to recognize gender differences in natural resource use

Whereas women use natural resources as much as men and contribute equally if not more to agriculture and animal husbandry, they are rarely able to exercise control over these resources. Women's preferences in the use to which resources are put and in the choice of species, etc., are known to be distinctly different from those of men. Yet the men rarely willingly accommodate these. Externally supported NRM interventions provide a unique opportunity to address the gender balance by empowering women and involving them in the decision-making.

Women contribute to more than 50 per cent of the labour in agriculture and play a major role in animal husbandry. In women-headed households and in regions with high migration, it is the women who take care of agricultural operations. In addition, they have the responsibility of providing for the drinking and domestic water needs of the family as well as the fuel and fodder needs. In the Indian context, women generally do not have ownership of land, which deprives them from control over the land and makes them ineligible for many governmental benefits.

The needs and priorities of women in the use of natural resources are often at variance with those of men. These differences arise out of the role divisions prevalent in a given community. The local institutions can create a platform for men and women to address these differences and resolve them (see for instance the case of Dhamrasala village in Box 2.2).

When given an opportunity and with the right kind of capacity building inputs, women have proved better managers of natural resources like drinking water, community fodder and community forestry. However, for women to be accepted at the village level, it is often necessary to empower them through the formation of small groups that engage in savings and credit, and later, in the management of small projects/technologies.

Box 2.2: Negotiating Gender Differences in Water Use: Dhamrasala village

In Dhamrasala village of Surendranagar District, a percolation tank was renovated in 1995. The tank met the women's need for domestic water and put an end to their hardship. However, farmers started lift stored water directly from it to irrigate their crops. The women could do nothing to stop them.

A ban against direct lifting of water for irrigation was proposed but was disputed in the village meetings for several years. Finally, in 1999, the women of Dhamrasala managed to reach a compromise with the farmers. The depth of the tank was 5 feet: the farmers were allowed to lift only three feet of water, leaving two 2 feet in the tank for women to meet the domestic need until the following monsoon. Today, even when the standing crops wither due to lack of moisture, the pumps are idle. Obviously, the farmers continue to abide by the community decision.

Source: Hemani, Rushabh and Manju Ravi. 2004.

The successful implementation of these projects and the simultaneous sensitization of men are often instrumental in bringing about a change in the gender equations. It then leads to greater participation of women in NRM projects.

5. Need to acknowledge and harness local technical knowledge and innovations

Local knowledge systems have helped to accumulate valuable knowledge about local natural resources and evolved technological practices over time. This technical knowledge should be taken as the starting point in the search for sustainable and innovative solutions for augmenting natural resources.

Rainfed regions are characterized by high ecological diversity. Local communities have evolved, over time, specific technical practices, especially in the conservation and use of water and biomass, which are often highly area specific. For instance, traditional water harvesting practices like *khadins, johads, tankas* and *beris* of Rajasthan, *bandharas* of Maharashtra and *bandhis* of Madhya Pradesh and UP are well known. The unique water harvesting practices of Rajasthan (many of which have fallen into disuse) have been well documented (Agarwal and Narain, 1997). A major initiative to revive traditional water harvesting systems in the Marwar region of Rajasthan is currently underway. The project was conceived and implemented by Jal Bhagirathi Foundation (JBF). The project has brought about a dramatic improvement in drinking water security in 150 villages out of 400 villages in the Marwar region. It hopes to cover all the villages in the next few years. This intervention draws inspiration and support from Tarun Bharat Sangh's work in the Alwar region of Rajasthan. This agency had earlier demonstrated how traditional water harvesting structures like *johads* could be revived through the creation of new social capital for decentralized water governance.

Scientists like S C Manhot and P K Singh from the Udaipur Agricultural University have tried to add value to the traditional designs of structures by incorporating modern technology and scientific inputs where necessary, to make these more efficient and economical (Mahnot and Singh, 1998). An understanding of the locally available expertise and knowledge should be the starting point for initiating a dialogue between the formal and the informal science to arrive at new and innovative solutions that help to augment local natural resources.

Utthan Trust, an NGO working on issues of coastal livelihoods in Gujarat, has tried to institutionalize this concept by setting up a People's Learning Centre (PLC) in the coastal areas of Bhavnagar. The PLC has been instrumental in testing new ideas to augment coastal livelihoods. While working with fisher-folk, it developed techniques of fattening juvenile lobsters before these are sent to the market. In this way, the price realized per kg of lobster increased from Rs 200 to Rs 800, representing a four-fold increase. Seventy per cent of the lobsters caught were juvenile. Hence, the technique has the potential to significantly improve the income of the fisher-folk. The lobsters are fattened either in pits dug out on the rocky coast or in bamboo cages in the creeks. A preliminary assessment of the pit method shows that the investment per pit can be recovered in one season itself.[1]

The Honey Bee Network and its scaled-up version, National Innovation Foundation, have been documenting farmers' innovations for the past two decades. Several ideas and innovations have been patented. Some farmers have even been able to commercialize these innovations with the help of these institutions. This approach to livelihood augmentation is unique and deserves greater attention on the part of developmental agencies working in rainfed areas. This is discussed in detail in Chapter 8.

6. Collective wisdom for sustainable use of augmented resources

There are important choices to be made in the utilization of newly developed resources. If wisely utilized, it will lead to sustainable and equitable development. However, if the resources are not carefully used the development could become skewed and only a few powerful individuals would corner the resources.

The general tendency for most farmers with the necessary means is to start cultivating cash crops in place of traditional food security crops. Whereas cash crops can help to diversify the economy of the village, care should be taken to ensure that these are not water inefficient. New technology should be introduced to make efficient use of the augmented resources, focusing on water resource productivity as much as on land productivity. The slogan ‘more crop per drop’ has been adopted by many a successful agency at this stage of watershed development. Where drought resilience is an overarching goal, allocation of some land to perennial horticulture and silvi-pastoral systems may be considered. Fodder and food banks can be established in anticipation of lean years.

Collective restraint on the use of valuable common natural resources is an important aspect of sustainable use. In Rajasthan, there were traditional institutions that preserved the *oran* lands from indiscriminate grazing. Each year, on a prescribed day, the elders used to meet to decide in which direction grazing will be banned for the year. This direction was determined by a unique method of randomization. A goat was brought and later released amid the beating of drums and cymbals. The direction in which the scared animal ran would be the direction for the collective restraint of grazing.[2] Such institutional norms are no longer practiced and most common pasturelands have been encroached upon, making it difficult to revive them as common property resources.

In recent times, one has witnessed the serious problem of the mining of groundwater, especially in arid and semi-arid lands. The case of Mehsana District in Gujarat is notorious in this regard. In the arid region of Jodhpur, Rajasthan, when deep bore-wells struck water, farmers chose to cultivate chilli as a cash crop, regardless of the fact that the region suffered from chronic shortage of drinking water. There is an urgent need for regulation to prevent this process of over-exploitation of a valuable resource like groundwater. Most state governments are unwilling to introduce legislation because the practical aspects of implementing such a law are daunting. Perhaps collective self-restraint may be the only solution to the problem. An initiative taken by farmers in the drought-prone regions of Andhra Pradesh on these very lines demonstrates the potential of this idea (Box 2.3).

Box 2.3: Collective Restraint on the Use of Groundwater: Andhra Farmers Show How!

The Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) is a unique project aimed at bringing about behavioural change in the use of groundwater, leading to voluntary self-regulation. In seven drought-prone districts of Andhra Pradesh, over 50,000 farmers residing in about 650 habitations spread over several hundred kilometres have voluntarily taken a number of steps to reduce groundwater pumping, for tiding over the problem of groundwater depletion. An NGO, Bharatiya Integrated Rural Development Society (BIRDS) and FAO of the United Nations are jointly implementing the project with the financial support from the Government of The Netherlands.

Launched in July 2003, the APFAMGS project formed a partnership with farmers for managing groundwater from the demand side as opposed to the conventional wisdom of managing the supply side. The project equips farmers with the necessary data, skills and knowledge to manage groundwater resources available to them in a sustainable manner, mainly through managing and monitoring their own demand. It works on the assumption that access to scientific data and knowledge enables farmers to make appropriate choices and decisions regarding the use of groundwater resources and agricultural practices.

By 2007, over 28,000 men and women farmers in the project area had been trained to monitor groundwater levels and water discharge from the local aquifers and rainfall, to compute water balances, and to analyze changes in water resource availability. The farmers were organized in groups, known as Groundwater Management Committees (GMCs). These groups then would share this knowledge with others in their communities to enable them to make informed decisions on how to maximize available water resources in their area. GMCs work out appropriate cropping systems, given the estimate of the total groundwater resources available. When crop-water balance estimates in September 2006 showed deficits in most areas, the farmers decided to ban any further drilling of wells. They also stopped cultivating crops requiring intensive irrigation like paddy and sugarcane. They took it upon themselves to improve the irrigation efficiency of less water-insensitive crops. The result was savings of water by more than 30 per cent. The project represents a new approach to groundwater governance—moving from a culture of top-down service provision to empowering people to understand, manage and develop their own resources.

Source: FAO, 2007; APFAMGS, June 2008

7. Giving priority to drinking water security

Drinking water is fundamental right of all citizens. In the absence of access to the necessary quantity of potable water within the village, women and men have to travel long distances to meet this basic requirement. As a result they are deprived of the opportunity of being engaged in productive activities. Hence, care should be taken to ensure that natural resource-based interventions, particularly watershed development, first meets this basic need for all sections of the society before diverting water for irrigation and other uses.

The National Water Policy, has accorded the highest priority to use of water for drinking purposes, followed by irrigation, power generation, industries and navigation for the first time in 2003. The concern for drinking water was highlighted in the guidelines for watershed development It was stated as an additional objective besides that of harvesting rainwater for agriculture. In 2004, DSC carried out a study (Hemani and Manju Ravi, 2004) to assess the status of drinking water security in watershed villages. Of the 48 villages studied only 18 had water supply for domestic purposes and that too only during the four monsoon months. In another 36 villages, it was available only for 8 months. It also found that women had a negligible influence in the watershed programme in all the sample villages. The study, therefore, advocated the convergence of the Swajaldhara Programme (decentralized drinking water programme) of the state with the watershed development schemes. It further advocated empowerment of women's groups for planning, implementing and managing the water supply scheme as part of the watershed project.

The latest guidelines for watershed development (GoI, 2008) has included drinking water as one of the areas that needs to be developed. The document specifically lists the development of drinking water sources, repair, restoration and upgrad of existing common property assets and structures (for example village tanks) among the 'entry-point activities' in a watershed development project.

8. Critical role of livestock in rainfed farming systems

Livestock forms an integral part of rainfed (particularly dry-land) farming systems. Animal husbandry represents a traditional livelihood strategy, particularly of the poor, to survive during droughts and scarcity years. Strengthening livestock-based livelihoods is critical for improving the resilience of farming communities in arid and semi-arid regions.

In arid and semi-arid regions, livestock forms an integral part of the farming system. It forms a critical link in the nutrient cycle. It converts biomass into valuable organic manure that is recycled into the soil. In the process, livestock also produces nutritional products that support human beings during scarcity, thus serving as a safety net. The small ruminants act as a fixed deposit for poor households in emergencies because their sale provides instant income as well as insurance during drought. The livestock-based livelihood strategies are, therefore, well developed in dry-lands. In the semi-arid regions, especially in Gujarat, the dairy cooperatives promoted by National Dairy Development Board (NDDB), around the celebrated 'Amul pattern of cooperatives', have contributed significantly to the livelihood of local communities.

However, in arid regions, this traditionally evolved livelihood is under severe stress on account of a number of limiting factors, for example, degraded pasture and forest lands, poor quality and quantity of fodder, shortage of drinking water for animals, degeneration of traditional breeds, breakdown of traditional institutions that managed common property resources like pastures, water storage structures and bulls as common property assets. In these lands the challenge is to revive and strengthen this traditional livelihood strategy.

9. Indispensable role of PIs

All NRM interventions need to place people in charge of the development process to ensure sustainable outcomes. Building people's institutions is critical for the conservation and sustainable use of natural resources and for the maintenance of common property assets, on which the poor mostly rely for their livelihoods.

The PIs are seen not only as a means to implement projects but also as a process of empowerment and self-governance, leading to sustainable management of natural resources. It is widely acknowledged that unless people are involved in the planning and implementation of the developmental projects, they are unlikely to take any interest in maintaining the structures and productive assets of the projects in the future. Institutions offer a unique opportunity not only to build the capacity of the local community but also to instill modern values of democracy, equity, gender sensitivity and inclusive growth. Respect for nature, which is a traditional value, needs to be reinforced. The PIs have demonstrated superior results in virtually every aspect of NRM, whether it is the management of small resources like check-dams or the development of plans for treating an entire river basin.

10. Investments to improve access of the poor to the conserved resources

Investments in natural resource development alone do not guarantee augmentation of livelihoods, specially for the poor and marginalized. To improve the access of the poor to the newly created resources developmental agencies may need to make special efforts to facilitate investments in infrastructure.

In the case of watershed development, for instance the large farmers would benefit the most as they would have the necessary assets to extract water harvested in check-dams or to take advantage of groundwater recharge in wells, which already belong to them. To improve the access of the poor, developmental agencies may need to facilitate investments in infrastructure such as group wells or collective lift irrigation schemes etc. This in turn may call for investments in the necessary social capital to manage common property resources or community assets.

End-notes

1. Personal communication with PLC and Utthan staff during a field visit to the coastal areas of Bhavnagar and Amreli in Saurashtra, March 2008.

2. As recounted by Prof N S Jhoda, during a small-group meeting of researchers at IIM A in the mid 90s.

3 Watershed Development: An Integrated NRM Strategy

Introduction

Micro-watershed Development (MWD) has been found to be the most appropriate strategy for integrated natural resource management and can be applied equally to the arid, semi-arid and sub-humid regions. The differences, if any, would be in the choice of treatment and in the design of water harvesting structures.

Defining MWD

Very simply, a micro-watershed can be defined as:

> *A unit of area that includes all land and water areas that contributes runoff to a common point or single outlet.*
>
> *(IntelCooperation and SDC, 2003)*

Rain, falling on the opposite sides of a 'drainage divide', falls into two different watersheds. Hence, the boundary of a watershed is provided by the ridgeline. A typical watershed can be divided into three parts for the purpose of planning: a) upper, b) middle and c) lower. The objectives of watershed projects, are to arrest the flow of the water so that it percolates into the soil rather than running off quickly to the lower reaches. The treatment comprises creation of a variety of physical structures and/or vegetative barriers that would check the flow of the water, prevent soil-erosion and help to store water on the surface, in soil or in sub-surface aquifers. The redistribution of water and moisture makes it possible to rejuvenate different categories of land, including forest lands, pasture lands and private farmlands as well as wastelands. This is the first step in restoring water and nutrient cycles, leading to improved biomass production. Recycling of biomass and restricting extraction within the carrying capacity of the micro-watershed will ensure the upward spiral of soil health, animal health and human health.

The logic of MWD

Michael Evenari, an Israeli scientist had carried out a number of experiments in the early 70s to find out how people of the ancient Israeli civilization had built towns right in the middle of the Negev desert where the average annual rainfall was a mere 105 mm. He was among the first to bring out the logic of MWD. His experiments showed that the larger was the size of the catchment area, lesser was the volume of run-off that could be collected from it (See Table 3.1). This is because, in large catchments, water has to flow over greater distances before it gets collected, and during that period, much of the water gets lost in puddles and small depressions, and through evaporation or infiltration into the soil.

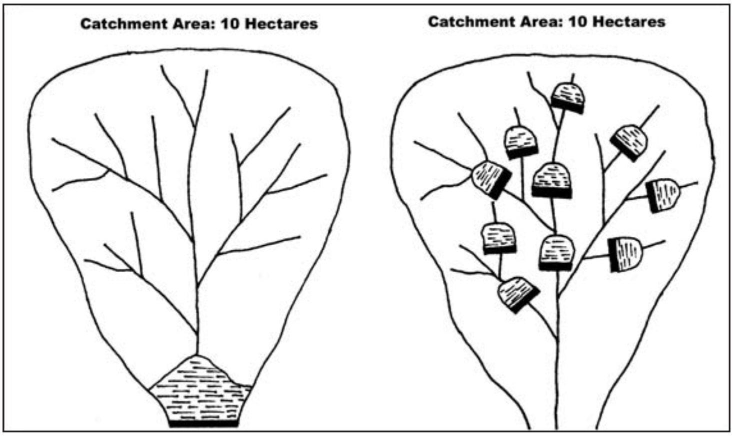
Table 3.1: Effect of Size on the Quantity of Water Harvested

No.	Size of Catchment (ha)	Quantity of Water Harvested (cu m / ha)	Percentage of Annual Rainfall Collected
1	Micro-catchment (up to 0.1 ha)	160	15.21%
2	20	100	9.52%
3	300	50	3.33%

Source: Agarwal, Narain and Khurana, 2001

This effect is more pronounced in drought-prone areas. In these areas, it is estimated that 10 tiny dams with a catchment of one ha each will collect more water than one large dam with a catchment of 10 ha. (Agarwal, Narain and Khurana, 2001) (See Figure 3.1)

Figure 3.1: Comparative Efficiency of Small and Large Dams



Source: Agarwal, Narain and Khurana, 2001

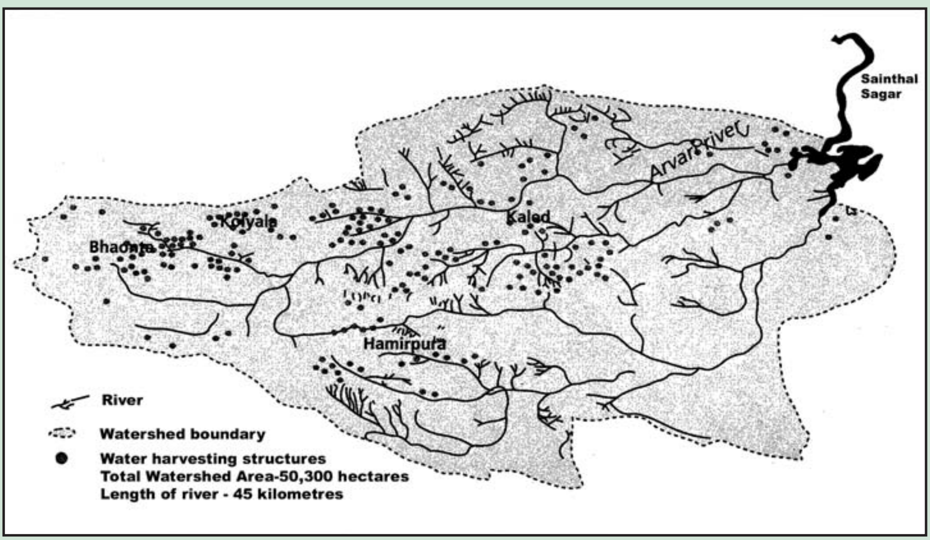
A typical watershed treatment procedure would begin at the ridge and go all the way to the valley. This is often held as the cardinal principle of watershed treatment. However, though in general, it is true that the sequential process of treatment from ridge to valley can generate the maximum gains in terms of conservation, there are exceptions to this rule. In coastal areas with salinity ingress, for instance, it has been found beneficial

Box 3.1: Breathing New Life into River Arvari

Arvari is a small river in the Alwar District of Rajasthan. The river was no more than a monsoon drain for decades and the region reeled under drought year after year. With the help and support of Tarun Bharat Sangh, common men and women, whose lives were vitally affected by the river, took the matter in their hands and decided to see that Arvari would flow again.

The process of rejuvenation of the river began in 1987 when a small water harvesting structure, *johad*, was constructed in Bavla village. A *johad* is a traditional earthen dam built to harvest every drop of rainwater falling on the ground. This simple water conservation measure paid rich dividends. Once people saw the benefits of a *johad*, especially during the toughest drought conditions, they came forward to build these structures in their villages. The activity gathered momentum, and soon more than 350 *johads* were built in the catchment area of Arvari River. *Johad* is not only a physical structure, it has a social dimension—it is considered a symbol of peace, love, and unity of a village society.

With *johads* coming up everywhere, the farmers' lot improved as agricultural production increased. Women did not have to work as hard to collect drinking water and could utilize the time saved to do other productive work. As the groundwater got recharged, the water level in the wells went up. Finally, the rate of migration went down as the land in the village once again became cultivable. Water started to flow in Arvari again on a perennial basis and changed many lives for the better.



Source: Agarwal, Narain and Khurana, 2001 to stop the ingress first and then work backwards, treating the land from the lower reaches to the upper catchments. Also, sometimes it may be prudent to change the order of treatment for tactical reasons and for the anticipated delay in the availability of clearance from the various government departments (like Revenue or Forests). The understanding should be that unless the entire treatment from ridge to valley is completed, the full benefits of the project cannot be realized.

Importance of treating contiguous areas

The concept of micro-watershed treatment can also be extended to river basins with remarkable results. In a watershed area all precipitation flows to a single stream. However, there are hierarchies of streams that flow into each other as tributaries. Likewise, there are hierarchies in watersheds. Starting from a micro-watershed (100-1000 ha), the hierarchy includes various levels until it encompasses the entire river basin, which could be anything from 30 to 300 lakh ha in size (Table 3.2).

Table 3.2: Hierarchy of Watersheds

Category	Size (ha)
Basin	30,00,000–300,00,000
Catchment	10,00,000–30,00,000
Sub-catchment	2,00,000–10,00,000
Watershed	50,000–2,00,000
Sub-watershed	10,000–50,000
Mini-watershed	1000–10,000
Micro-watershed	100–1000

Source: InterCooperation and SDC, 2003

What happens in a small watershed also affects the larger watersheds. The treatment of contiguous sets of micro-watersheds or the treatment of an entire river basin can generate a bigger impact on natural resource development as compared to the development of micro-watersheds that are scattered and disconnected. The dramatic revival of river Arvari, in Alwar region of Rajasthan, (Box 3.2) through the systematic treatment of the entire catchment area, bears testimony to this principle.[1] Similar results have subsequently been achieved by AKRSP-I in the Meghal River-basin in Junagadh, Gujarat (See Best Practices, this volume).

Box 3.2: Arvari Sansad: A Parliament without Politicians!

Arvari Threatened Again

Thanks to the community action initiated by Tarun Bharat Sangh, the Arvari river became perennial by 1996 and fish began to breed in it. Seeing the growing fish population, the government decided to give fishing contract to a large contractor. The villagers saw this as a thin end of the wedge: fish today, water tomorrow. They wondered, 'Who owns the river?' It was they who had rejuvenated the river with their hard work and they feet that they should have the right to use it.

People Take Back their River

To discuss all these matters, a *Jan Sunwai* (public hearing) was organized on December 19, 1998. Experts from different fields, environmentalists, activists, government officers, scores of representatives of NGOs and villagers attended it. The meeting decided to establish a River Parliament (Arvari Sansad) to protect the rights of the people, who had brought the river back to life. The Parliament would make its own rules and regulations about the use of water in the river, keeping in view people's needs and priorities. On their part, people would abide by the rules and regulations. The River Parliament's decisions would be executed by the gram sabha and supervised by the Arvari Sanchalan Samiti. Its writ would run through the entire river basin.

Formally constituted on January 26, 1999, the Sansad held its first meeting in Hamirpur on the same day. It had representatives from 72 villages, selected by their respective gram sabhas. Every 500 ha piece of land or 500 people have one representative in the Parliament regardless of land use. It meets four times a year and, if required, could convene an emergency meeting. The Parliament makes rules and regulations about using well water and Arvari water directly for irrigation as well as for protection and conservation of all natural resources.

The people who fought for Arvari had an opportunity to show their mettle again when they did not allow a liquor company to set up a brewery in the region.

Source: Abridged from http://www.tarunbharatsangh.org/programs/water/arvariparliament.htm

Social Capital for MWD

Early experience in implementing watershed development projects in Karnataka by Dry Land Development Board (DLDB) showed that even when water-harvesting structures were created successfully, there was no guarantee that the people would look after them and maintain them in good condition. In fact, more often than not, these structures were neglected and they fell into disuse when repair was needed. Often project processes ended up alienating people rather than eliciting their active participation. Learning from these experiences, subsequent efforts by KAWARD, the new avtaar of DLDB, took care to reverse this trend. The creative potential and traditional knowledge of the people were leveraged both during planning and implementing watershed projects. This led to greater participation, greater transparency and efficiency, and continued involvement of the people even after the project period was over.

The case of Tarun Bharat Sangh also shows how the creation of PIs is critical not only for protecting the newly developed structures and resources but also for serving as effective governance mechanisms for the sustainable use of the resource and inclusive development of the community (Box 3.2). Many development agencies such as Myrada and BAIF have found that promoting User Groups to look after common property assets like check-dams and group wells are an effective means to ensure sustainable management of such resources. The user groups and the affinity groups (which carry out self-help activities including savings and inter-loaning) form the building blocks for larger watershed-level institutions.

PIs have now become indispensable in NRM projects because they represent both the means as well as the ends of development. Watershed development committees can grow into village development committees and take up the implementation of new projects with the guidance of facilitating agencies. Promoting PIs calls for capacity building of the people over an extended period of time. A more detailed discussion is provided in Chapter 9.

Participatory Methods of Planning and Monitoring

Once the developmental agencies decided that people should be in the centre of the development process, the way was paved for the evolution of participatory methods of planning and monitoring. The decade of the 80s saw a plethora of participatory methods being tested and put to use. The term Participatory Rural Appraisal (PRA) was coined to describe the various approaches and methods that enabled local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act. Robert Chambers from the Institute of Development Studies, University of Sussex, UK, played a major role in the development and proliferation of participatory methods among NGOs in India. Agencies like the AKRSP-I, DSC, PRAXIS, Myrada, among others, were at the forefront of the PRA movement. Some of the more popular methods, as described by Chambers (1992), are summarized below:

- **Participatory mapping and modelling:** People use the ground, floor or paper to make social, demographic, health, natural resource or farm maps or construct three-dimensional models of their land.
- **Seasonal diagramming:** Farmers prepare diagrams that bring out the seasonal patterns (by major season or by month) to show days and distribution of rain, amount of rain, crops, agricultural labour, diet, types of sicknesses, prices, fodder security, etc.
- **Participatory analysis of aerial/satellite photographs:** These are used to identify soil type, land conditions, land tenure, crop estimates, forest cover, stock of water resources, etc.
- **Transect walks:** Systematically walking with informants through an area, observing, questioning listening, discussing, identifying different zones, local technologies, seeking problems, solutions and opportunities, mapping and diagramming resources and findings.
- **Time lines:** Documenting chronologies of events, listing major remembered events in a village with approximate dates.
- **Ethno biographies:** Local histories of a crop, an animal, a tree, a pest, a weed, etc.
- **Wealth ranking:** Identifying clusters of households according to well being or wealth, including those considered to be the poorest or the worst off.
- **Scoring and ranking:** Matrices and seeds are used to compare/rank different parameters through scoring, for example, different trees, soils or methods of soil and water conservation or varieties of a crop.
- **Key local indicators:** Using local indicators like poor people's criteria of well-being, local indicators of soil health, productivity, etc.

In addition, a handbook on Participatory Monitoring and Learning Tools (Jayanthi et al., 2007) provides information on the tools not listed above:

- **Resource dependency (forests):** To understand the nature and extent of dependency of different socio-economic groups in the village on the available forests in the area.

- **Mobility mapping:** Shows the patterns of mobility of different groups within a community, for example, caste groups, women, elders, youth, etc. Mobility is used as an indicator of a person's contact with and knowledge of the outside world, and his/her authority in the community.

- **Livelihood assessment:** To understand the livelihood of an individual, group or community. The analysis involves listing of all livelihood options pursued as well as the constraints and strategies to overcome these. It also includes seasonal variations in livelihood options, activities and survival strategies.

- **Vision building:** Describes, through a diagram, the vision building and planning of the people based on their understanding of the local situation. This can also be used to develop indicators for monitoring progress towards this vision.

- **Group self-assessment chart:** To monitor the progress and performance of the group as a whole against a pre-determined set of indicators. The tabular presentation is helpful to make comparisons across CBOs within a village or across number of villages.

- **Impact mapping:** It involves developing a flow diagram that depicts the impact of an activity, intervention or an event, capturing both planned and unplanned, positive and negative impacts.

In addition to the above, *social audit* and *peer review* are also used as tools by NGOs and local communities to assess the performance and impact of projects and programmes. Several books are available that provide details of PRA methods and techniques (see resource guide, Annexure 6).

Framework for Developing Micro-watershed Treatment Plan

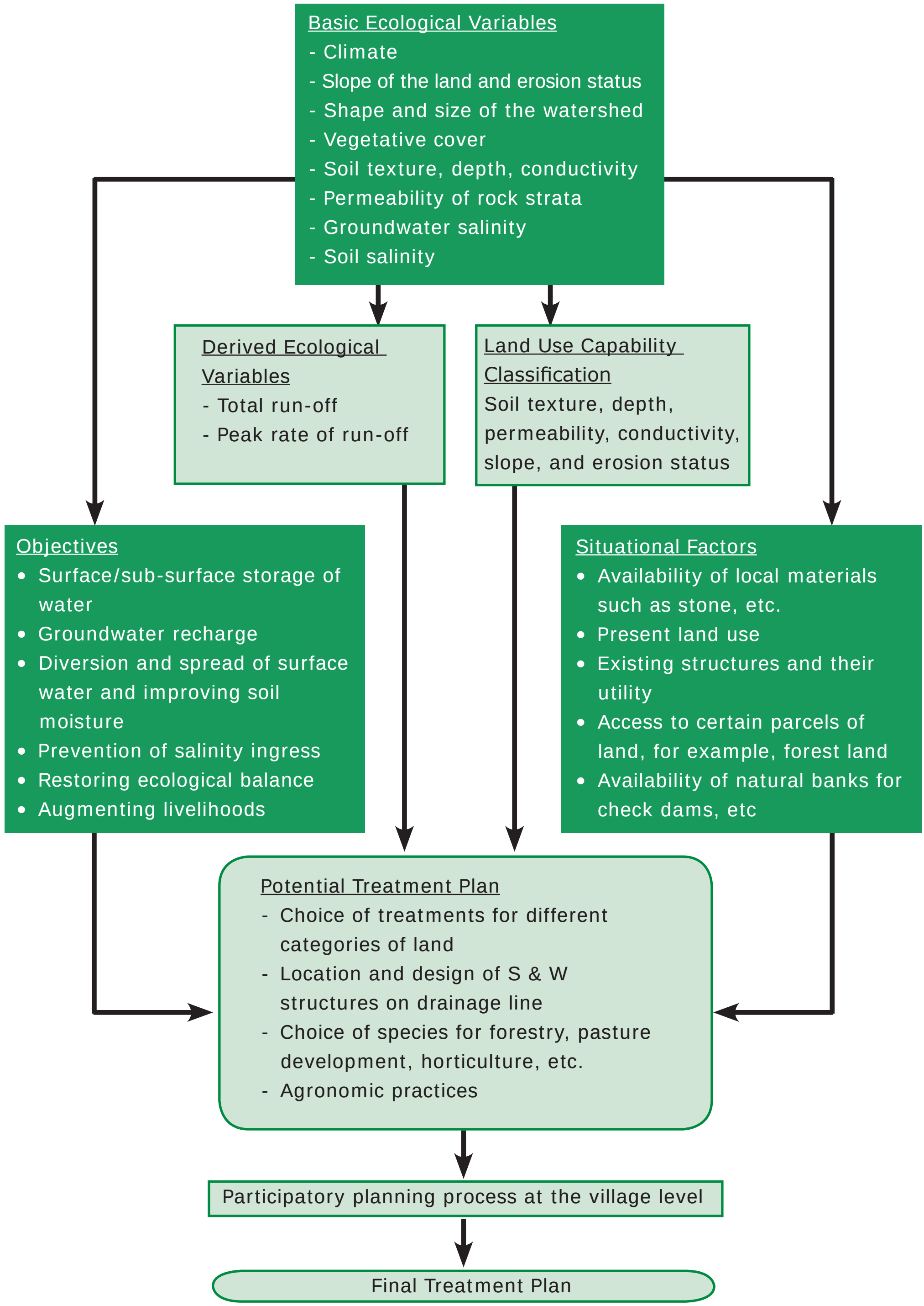
The treatment plan in a given micro-watershed is derived from the interplay among *ecological variables, situational factors* and *objectives* of the treatment (Figure 3.2).

This plan would later have to be vetted with the local community and modified to meet the specific social and economic requirements of different stakeholder groups, before it can be finalized. For the moment, we are looking only at the technical considerations, in order to find out what is technically desirable and possible.

A *treatment plan* comprises the entire set of treatments needed in a given watershed. This includes both soil and water harvesting structures as well as vegetative and agronomic treatments. The plan specifies the number; type and location of structures needed on drainage lines as well as the treatment needed on farmlands, wastelands and common property lands. The dimensions and design of structures are also specified. A standard textbook approach to developing a treatment plan is to adopt a 'ridge-to-valley' approach. This means starting treatment from the ridge and gradually moving down from the upper reaches to the middle and finally to the lower reaches of the watershed. Whereas this is considered ideal, even the best of agencies have often found themselves compromising on this principle, on certain occasions, in the interest of expediency. The underlying principle used by them is: "The best should not be allowed to become an enemy of the second best!"

Arriving at an optimal treatment plan requires a good deal of work by the technical team. The technical team will need to assess two important variables, namely, total run-off and peak rate of run-off, in order to design appropriate structures and specify appropriate treatment. The *total run-off* refers to the quantum of rainwater that flows over the surface of the land after precipitation occurs. When rain falls, some water enters the soil and flows as sub-surface run-off. In permeable soil strata, the proportion of sub-surface to surface run-off will be higher than in the non-permeable strata. Most engineers consider only the surface run-off in their calculations for designing water harvesting and storage structures. Therefore, the total run-off here refers to the total surface run-off. As we move from arid to semi-arid to sub-humid regions, the total run-off increases from low to high due to increased levels of precipitation. The *peak rate of run-off* is the rate at which the water flows over the surface of the land. In general, as we move from undulating to flat lands, the peak rate of run-off slows down from high to low.

Figure 3.2: Framework for Developing Treatment Plan



Ecological variables

These variables are derived from the more basic ecological variables like climate, slope, vegetation, soil texture, shape and size of the watershed, presence or absence of depressions, nature of sub-surface rock strata, etc. Among these, climate is the most important variable and, therefore, needs to be examined in some detail. This is because the total amount of precipitation depends on it. Although climatic zones are determined on the basis of a number of variables like rainfall, temperature and relative humidity, and different institutions have developed different typologies, we have adopted a very simple classification that divides rainfed areas in India into four broad climatic zones as shown in Table 3.3.

Table 3.3: Classification of Climate Based on Rainfall

Climate	Approximate Rainfall (mm)
Arid	<500
Semi-arid dry	501-700
Semi-arid wet	701-1100
Sub-humid dry	1101-1600

Source: Singh et. al. (2000) in Wani, Rockstrom and Oweis (2009).

Ecological variables also govern land use capability classification, which is frequently used to plan interventions for improving their productivity. Using land according to its capability to produce common cultivated crops, pastures and other vegetation is a basic principle of soil and water conservation, and land development. Land Capability Classification (see Annexure 2), along with other soil- and water-related information and potential, forms the base for land use planning. Usually land is classified into eight broad classes, the most and least productive being classes I and VIII, respectively (Kakade, 2005). The impact of ecological variables on the treatment plan is discussed in greater detail in Annexure 3.

Besides ecological variables, the objectives of treatment and the situational variables also contribute to the contents of the treatment plan, as discussed below.

Objectives

It is important to keep in mind the purpose of the treatment, which can vary from harvesting and storing surface water to groundwater recharge, salinity ingress prevention and diversion of water flow. Although strategies may vary, depending on the local situation, the ultimate objective should be to restore the ecological balance while improving production in a sustained manner so as to augment local livelihoods and the well being of the people.

Situational Factors

Situational factors also play a part in contributing to the treatment plan. The existing water harvesting structures as well as the prevalent land use pattern must be taken into account. Access to different categories of lands will often determine what lands can be treated and in what order. Availability of local material for construction, the presence of natural banks in the case of check dams, the extent and nature of soil erosion, etc., may determine the design of a water harvesting structure. Caste, class, gender and other social variables can affect the extent of participation of the marginalized groups and how they are involved in the planning and implementation process. Similarly, the importance of including common property plots for development would depend on the existing resource-use pattern of the poor.

Developing a Treatment Plan

Treatment can be related to land, water or biomass. There are five broad groups of treatment, namely,

- Soil and water treatment,
- Agronomic practices in agricultural land,
- Afforestation,
- Pasture land development, and
- Dry land horticulture.

Whereas the purpose of soil and water structures is to check the erosion of soil and conserve water as well as soil moisture, the remaining treatments serve to conserve soil and water and, at the same time, make the land productive. Given the ownership pattern of land and water resources in India, not all categories of treatment are possible in all types of land. A broad indication of what is possible in different types of land is provided in the Table 3.4.

Table 3.4: Matrix Showing Potential Components of Treatment Plan

Ownership	Type of Resource	Soil and Water Treatment	Agronomic Practices	Afforest-ation	Pasture Land Development	Dry Land Horticulture
Private	Wasteland	√	-	√	√	√
	Cultivable land	√	√	√ (farm forestry)	√	√
Community/ Government	Waste land	√	-	√	√	√
	Pasture land	√	√	√ (fodder trees)	√	√
	Drainage line	√	-	-	-	-

i) Soil and water treatment

The most important and basic form of treatment is conservation of soil and water through the creation of physical structures. Different sets of treatments are available for wastelands, cultivable lands (including pasture lands) and for the drainage line. The choice of a particular treatment will be guided by a number of ecological factors, the most important among them being the climate and the slope of the land. In Table 3.5 (see overleaf), an attempt has been made to show the most suitable choices for different combinations of climate and slope. (See Annexure 5 for definitions of different treatments).

ii) Agronomic practices

Certain agronomic practices help to conserve soil and moisture whereas faulty practices can actually lead to soil erosion and loss of valuable soil moisture. These practices are knowledge intensive and do not need much investment. Farmers whose land has been treated within the watershed programme should be sensitized about these practices so that they may derive full benefits of the treatment. Table 3.6 provides an illustrative list of such practices and the climate in which these are best suited.

Table 3.6: Agronomic Practices

Type of Treatment	Arid	Semi-arid	Sub-humid	Special conditions
Inter cropping	√	√	√	
Sequential multiple cropping		√	√	
Crop rotation	√	√	√	
Multistoried cropping		√	√	
Mulching and crop residue management	√	√		More effective in rabi and summer seasons
Strip cropping		√	√	
Contour farming	√	√	√	

Sources: Compiled from Kakade, 2005; InterCooperation and SDC, 2003; Tideman, 2000

Table 3.5: Soil and Water Treatment

Treatment (Climate and slope)	Arid >45 %	Arid 30-45	Arid 10-30	Arid 5-10	Arid 0-5	Semi-arid >45 %	Semi-arid 30-45	Semi-arid 10-30	Semi-arid 5-10	Semi-arid 0-5	Sub-Humid >45 %	Sub-Humid 30-45	Sub-Humid 10-30	Sub-Humid 5-10	Sub-Humid 0-5	Special Conditions
Wastelands																
Contiguous contour trenches											—	—	—			Steep, uniform slopes; Soil cover > 30 cm
Staggered contour trenches		—	—	—			—	—	—							Gentle but variable slope, availability of stones; Soil cover > 30 cm
Gradonies	—	—	—	—		—	—	—	—							
Live hedges											—					Heavy rainfall, and higher slopes (.50%), where trenches cannot be made
Brushwood check dam				—												
Gully plug						—	—	—	—	—	—	—	—	—	—	Locate in upper catchment rills and gullies just formed; length of gully upstream should be < 100 m
Infiltration pit						—	—	—			—	—	—			Made in upper/middle reaches where top soil is permeable so that surface water infiltrates and increases sub-surface soil moisture in cultivated areas.
Contour bunds				—	—				—	—						Scanty and erratic rainfall, permeable soils; usually in < 6% slope.
Micro-catchment farming/planting				—	—				—	—						Can be used in flat lands as well as undulating lands but with less slope
Farm lands																
Land levelling									—	—				—	—	On slopes < 25 degrees, sites not too stony; area affected by soil erosion, small land holdings and dense population; generally in irrigated land
Bench terracing								—								Usually on steep slopes (15 to 30%)

Continued...

Climate and slope / Treatment	Arid					Semi-arid					Sub-Humid					Special Conditions
	>45 %	30-45	10-30	5-10	0-5	>45 %	30-45	10-30	5-10	0-5	>45 %	30-45	10-30	5-10	0-5	
Stone wall terracing																Where stones are easily available
Graded bunds																In clayey soils and where contour bunds may lead to waterlogging
Farm ponds																
Micro-catchment farming/planting																Can be used in flat lands as well as undulating lands but with less slope
Farm/contour bunds and field outlets																
Well recharging																
Drainage Line																
Dry boulder gabion																Sites in upper catchment and narrow gullies
Impermeable gabion with core wall																Used where high potential for storage of surface run-off but masonry dams uneconomical
Check dam or overflow weir																Favourable on small streams, or nullahs, with continuous flow, particularly in rabi
Gunny bag check dam																
Sub-surface dyke (underground bandhara)																Suitable where flow of groundwater varies from high following monsoon to negligible during summer

Continued...

Climate and slope / Treatment	Arid					Semi-arid					Sub-Humid					Special Conditions
	>45 %	30-45	10-30	5-10	0-5	>45 %	30-45	10-30	5-10	0-5	>45 %	30-45	10-30	5-10	0-5	
Earthen dam/ nullah bunding																Used for surface storage in non-porous soils For recharging sub-soil water in permeable soils
Percolation tank																
Water spreading																
Anicut																
Spring development																
Naadis/Talabs																
Khadins																Large, natural, high run-off potential; catchment in proximity of a plain valley; land with deep soils; cultivated land
Kuins/Beris																
Johads																

Source: Compiled on the basis of information provided in Kakade, 2005; InterCooperation and SDC, 2003; Tideman, 2000

iii) Afforestation

Afforestation includes the protection of natural forests and the creation of community and private forests on wastelands. On private lands, this could take the form of a farm forestry or the cultivation of tree crops like dry land horticultural crops and bio-fuel crops.

The benefits of afforestation are varied and include both economic goods as well as the ecological services. The ecological services include control of erosion, better infiltration of rainwater into soil, building soil and restoring wastelands, improving micro-climate and restoring local agro-ecology, providing sanctuary to natural predators of crop pests, providing protection from the wind and stabilizing sand dunes. Economic benefits include provision of fodder, fuel, fruit, minor forest products and timber. Some of the ecological services such as water conservation through groundwater recharge also translate into economic benefits over time.

It is most common to find wastelands, particularly in the upper reaches of the watershed being treated with afforestation, in combination with soil and water conservation measures such as gully plugs and contiguous contour trenches or variations thereof. In the case of wastelands belonging to the Revenue Department, local communities can take up these land on lease for development, provided they are willing to set up a collective or a cooperative to manage the land as a common property asset. In the case of forest lands, forest protection groups under Joint Forest Management schemes of the various state departments can be empowered to protect and develop degraded forests on a long-term agreement with the department. However, getting permission for soil and water treatments like check dams within the forest land is often difficult because the department works according to its own plans and has its own funds for carrying out developmental works within forest lands. Attaining convergence between the Forest Departments' (FDs') work and watershed projects has been taken up as a policy issue by organizations like Seva Mandir in Udaipur.

The choice of species in all afforestation programmes is of paramount importance if the people are to sustain interest over time. It has been seen that there are significant differences between the choices of the local communities versus that of the Forest Department. Even within the local communities, men and women exhibit different choices, based on their own criteria. The expectations of the people should be matched with the agro-ecological situation, which will allow only a particular set of species to establish and grow to maturity. Trees are sensitive to the type of soil strata, availability of water, drainage conditions and climate etc. In Table 1 of Annexure 4, a list of popular tree species is provided, indicating the conditions in which they are most likely to perform well. Table 2 of the Annexure provides a similar list for of horticultural tree species.

In arid regions, the poorest sections of the society rely on the use of the available bio-diversity in common and open access lands to supplement their livelihoods. In this context, technologies developed by scientists at Central Arid Zone Research Institute (CAZRI), Jodhpur, are worth considering. A few examples are given below:

- Grafting of wild *bordi (Zizyphus mauritiana)* plants with improved varieties,
- Gum collection from *kumat (Acacia senegal)*, using the new technique to improve the rate of secretion of gum
- Grafting of *Prosopis alba* and other thornless species on *Prosopis Juliflora*, to make the latter thornless, etc.

Many of the technologies developed for scrublands and grasslands may be economically viable, but have not been diffused on a scale worth mentioning because of severe conflicts over access to these lands. With the breakdown of traditional institutions to manage the common lands, many of these suffer from problems of encroachment. Conflicts related to common lands can also trigger larger conflicts, which are embedded in caste-based differences. The only way to restore these lands to their original levels of productivity is through social fencing and rotational grazing. Once a system of governance is in place, new technologies such as the ones developed at CAZRI could be implemented.

More recently, with the availability of new technology for the manufacture of bio-diesel from non-edible seeds, the cultivation of oil-seed trees such as *Jatropha Curcas* in semi-arid and sub-humid regions is becoming popular. However, in order to make bio-fuel plantations viable, there is a need to establish a reliable supply of genetically improved seed stock. In Andhra Pradesh, a private company named Naturol Bioenergy Ltd., was incorporated in October 2007 to manufacture bio-diesel. This venture has opened up scope for the large-scale use of many non-edible oils in India like *neem, karanj* and *jatropha*. As a part of its backward integration strategy, Naturol has formed a subsidiary, Naturol Biosciences Ltd., to focus on research in improved strains of energy crops sourced locally. It has entered into MOUs for the buy-back of jatropha seeds from farmers in Andhra Pradesh, to cover up to 3 lakh ha. (Naturol Bioenergy Ltd., 2007). In Andhra Pradesh, farmers also cultivate tree crops to supply to paper mills. Hence, the choice of species should also be directed, among other things, by the availability of new technology and changing market conditions. The interaction with markets is discussed in greater depth in Volume II of this handbook, which focuses on the market-led and entrepreneurial interventions for livelihood augmentation.

iv) Pasture land development

Most Indian villages had common pasture lands called *gaucher*, traditionally managed by local village institutions. Over time, these village institutions have broken down. The village panchayats are technically in charge of these lands whereas the ownership rests with the Revenue Department. In practice, most of these lands are in a degraded condition or are encroached by powerful elite of the village and, hence, inaccessible to the common villager.

Treatment of pasture lands becomes all the more important in arid and semi-arid areas, where animal husbandry forms either the main or subsidiary source of livelihood. During drought years, when crops fail, it is again animal husbandry that sustains the population. The treatment and the upgradation of pasture land is an integral and important component of watershed development. Yet, few organizations have actually been able to achieve success in this component of the programme. This is because of the inherent problems of encroachment and related conflicts, which need to be tackled before a village-level institution can be established to manage the village common. A good deal of investment in developing human capacity is needed to accomplish this goal, which most agencies are often not equipped to make because of their own limitations or due to lack of adequate funds for the software component of the programme. The work done by VRTI in Kutch (Box-3.3) Myrada in Karnataka and Seva Mandir in Rajasthan in this regard are notable exceptions. Investment in common property assets like community forests and pasture lands hold the key to the equitable development of micro-watershed projects since the poor and the landless rely on these resources for meeting their basic requirements of fuel, fodder and minor timber, apart from wild fruits and medicine.

Table 3 of Annexure 4 provides a list of species of grass and a list of species of tree with fodder value, along with the climatic conditions in which they are most suited.

Equity-based Model of Watershed Development

A number of developmental agencies have criticized the conventional 'area–based' model of watershed development. The main limitations of this approach according to Deccan Development Society (DDS) are as follows (Satish, 1997):

i) Inequitable development

The benefits tend to accrue mainly to the richer farmers, who traditionally own the lion's share of the fertile land, especially in the lower reaches. The ridge land, owned mostly by the poor, for all practical purposes become the catchment areas for percolating water to the lower reaches. In effect, the land belonging to the poor is used as 'blotting pads' to absorb water for the better-off farmers.

ii) Low and unsustainable employment generation

Although increased agricultural productivity leads to increased employment, agricultural labour is entirely dependent on the rich farmers for employment. The day the latter decide to mechanize their operations or grow crops that need less labour, the employment scene will change completely.

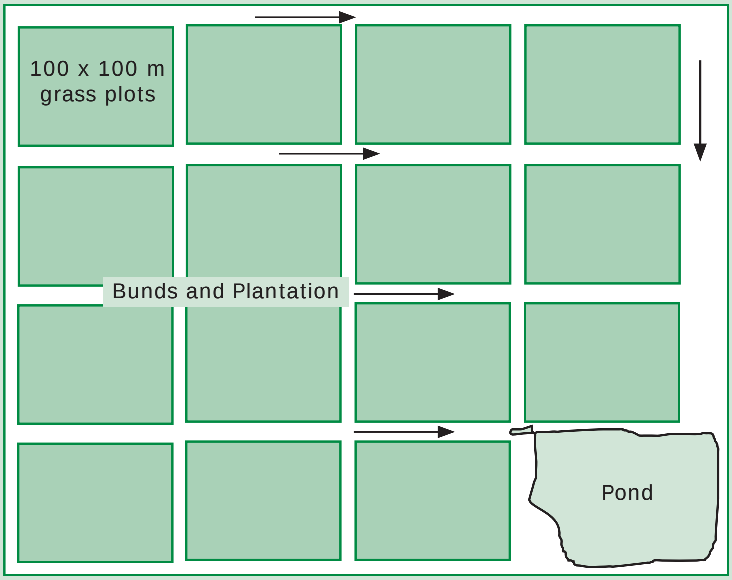
Box 3.3: Pasture Development Method in Kutch

Kutch has a very large livestock population. The degradation of pasture land, uncontrolled grazing and land grabbing by large industries have resulted in scarcity of fodder. Poor families resort to migration and distress selling of cattle and other assets for their subsistence. To stem the tide, VRTI has been promoting pasture land as common property resource. The technique adopted as described below proved highly effective.

A common land of 30 acres is identified in the village. After levelling the land, it is divided into plots of 100 x 100 m. Trenches of 10 x 5 m are excavated to form bunds on the boundaries of the plot. The slope is maintained in such a fashion that each plot drains excess water into subsequent plots and ultimately in a channel, which leads to a small, excavated pond. High quality varieties of grass like *Dhaman* and *Jinjuvo* are planted in the plots. Trees are planted on the bunds. A cattle prevention trench is excavated on the periphery of the land. Water collected in the pond is used by the cattle for drinking. Grazing is allowed only in summer. Fodder available throughout the year is stocked for summer.

The creation of such community pastures is highly process intensive. Since much of the common pasture lands has been encroached upon, the first step for the village would be to get together to free the required amount of land. When the demand is generated, a user group is formed, which acts under the guidance of the village development committee. Bylaws, rules and responsibility for operation and maintenance of the land are evolved through a process of consultation and consensus. Initially, SHG groups collect seeds (of desired grass) from other villages. These seeds are purchased by VRTI at a predetermined price. Cow-dung cake and seeds are prepared and used in the plot for planting the grass seed.

Using this method, about 120 acres of land benefiting 250 families were developed in four villages of Abdasa and Lakhpat Talukas by the end of 2007. About 6,000 kg of jowar fodder was produced annually and stocked in one of the villages.



This fodder is made available in summer when it becomes scarce. New and improved grass adds to the nutritional value of the fodder, which ultimately leads to increased yield of cattle. Also, such projects have had an impact on reducing further encroachment and loss of land to industries.

Source: Based on information provided by Ajubhai Suvan and Ghanshyambhai Patel from VRTI at a workshop organized by DSC on October 16–17, 2007, in Ahmedabad.

iii) Ecological risks

Once the water table rises, most farmers tend to cultivate cash crops like cotton, potato and sugarcane. The attendant problems of chemical agriculture and vanishing bio-diversity will be harmful for the agro-ecology of the region.

In a bid to bring about social equity through NRM interventions, Deccan Development Society (DDS) and AFARM among others have tried to initiate exclusive watershed development programmes for the *dalits* (SC/ST communities)

A *dalit* watershed project employs the same principle of soil and water conservation as any other mainstream watershed but the project focuses consciously on the lands belonging to the *dalits*. These lands are either on the upper reaches of a catchment or on the periphery of the village. Such lands are reclaimed and made cultivable and are used for raising food crops so as to ensure food security for dalit families. Therefore, control over agricultural processes and food production is relocated in the hands of the dalits and other poor women.

Whereas the concept of watershed exclusively for the *dalits* is attractive inasmuch as it promotes equity through natural resource development, this model can only be implemented in places where the poor have land in continuous patches either in the ridge or the periphery, as suggested by DDS. On the social side, working exclusively for the dalits is never an easy proposition because the local nexus will try its best to derail such development, especially if it means a major change in the social and political equations. This is not to suggest that such projects cannot be implemented or that these are not desirable.

Other agencies have tried to take the middle path by adopting a *policy of positive discrimination* during the implementation of watershed projects. This discrimination could take various forms, including:

- Developing common property lands on which the poor depend the most,
- Implementing the entire work through labour rather than through machines,
- Adopting differential rates for local contribution,
- Forming SHGs of the poor, landless and women, and
- Allocating funds for the promotion of non-farm enterprise.

Conclusion

In this chapter, we have tried to understand the various technical and social dimensions of watershed development. The chapter also gives us an idea about the potential of watershed interventions in rainfed areas. However, with the implementation of watershed development programmes, practitioners and policy makers have realized that much more needs to be done in order to translate the natural capital into tangible livelihoods for local communities, especially for the poor. The next chapter, therefore, is devoted to this aspect of watershed development. This aspect is also less understood, and perhaps, that is why in spite of huge investments in such projects, the impact on the livelihoods is often not very clear.

End-notes

1. Because of his pioneering efforts in working closely with local communities to revive entire river basins in Alwar, Rajasthan, Sri Rajendra Singh, founder of Tarun Bharat Sangh, has received international recognition, including the Magsaysay Award in 2001.

4 Watershed Development: From NRM to Livelihood Augmentation

In the previous chapter, we discussed how to develop treatment plans at the micro-watershed/village level. However, investments in NRM alone do not automatically translate into livelihood augmentation. Additional investments are needed to make these resources accessible to the people, especially the poor. Linkages with formal institutions need to be created to improve access to credit and technology. Linkages with markets and capacity building of local service providers may also be needed to fully realize the benefits of natural resource development. In this chapter, we will try to understand the range of other inputs necessary in order to move from NRM to livelihood augmentation (Figure 4.1). Each of these is discussed separately below.

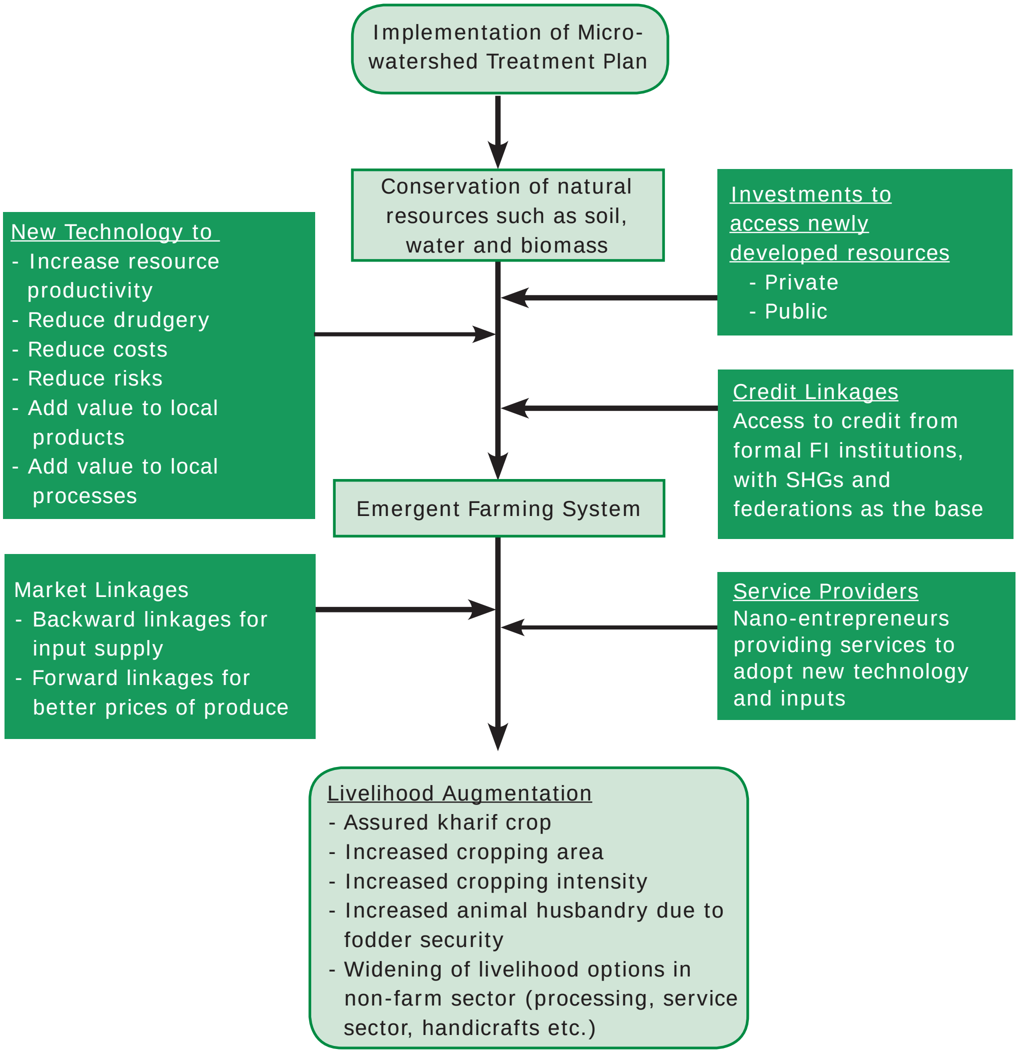
Investments to Access Developed Resources

NRM interventions lead to conservation and storage of the natural resource base. However, substantial additional investments (at private, group or community levels) are needed to access the augmented resources. Interventions that fail to recognize this simple fact cannot make a significant impact on the livelihoods of the people. Hence, this should be planned for in order to realize the full benefits of the treatment. According to one study (Chopde, Pastakia and Bhardwaj, 2002), such investments could be as high as 50 per cent of the original investments in creating the resources. A more recent study in Madhya Pradesh found that such private investments could be equal or even twice the original public investment. (ASA, 2009)

This principle is particularly true in the case of water resources. The development of surface resources may require investment in lift irrigation equipment for water to reach the fields of a sufficient number of farmers. Often, this calls for formation of lift Irrigation societies. The repair of old wells and the creation of new ones may be needed to access the newly augmented groundwater supply. Such investments can be made by individual farmers or by groups of marginal farmers. Sadguru Foundation has organized a large number of lift irrigation cooperatives of tribal farmers in Dahod to access water harvested in checkdams (see case study in Part 3, this volume).

Very often, the poor are unable to access new resources because they lack the ability to make these last-mile investments. In such cases, promoting groups to invest in common assets has proved to be effective. BAIF, for instance, has successfully promoted 404 group wells in the tribal belt of south Gujarat and in Uttar Pradesh, bringing access to groundwater for irrigation to 1,781 families (Box 4.1). In Prakasam District of Andhra Pradesh, about 50 small and marginal farmers from backward castes got together to form 13 water users' groups, in order to access groundwater. One group was formed around each bore-well drilled for them under the APWELL project. The groups had to raise their share of capital investment as well as the cost of electrification, which came to Rs 30,600/- per bore-well. In order to create the common infrastructure and deal with common problems with the electricity department and other external agencies, the groups organized themselves under an umbrella organization called Bore-well Users' Association. (Dr. Sridhar Kolluru, per. comm.)

Figure 4.1: NRM to Livelihood Augmentation



Creating Access to Credit

Access to credit through bank linkages, SHGs, etc., may have to be planned in advance if the marginalized and women are not to be left out from the development process. The study of successful interventions has shown that SHGs (particularly women's groups) contribute significantly in making investments in agricultural assets/infrastructure, wherever the formation of SHGs have preceded watershed interventions. Increased productivity in agriculture and other biological resources, in turn, has strengthened the SHGs. Such SHGs are able to save at a faster rate and establish bank linkages in order to take up micro-enterprise activities and/or make investments in productive assets that strengthen their agriculture and animal husbandry. The aggregation of SHGs over time has made it possible to increase the range of activities that SHGs can take up. Many federations have introduced micro-insurance schemes, including weather insurance, which helps to mitigate the risk involved in rainfed farming.

Box 4.1:
Access to Groundwater through Group Wells: The BAIF Experience

BAIF Development Research Foundation came up with the concept of group wells for equitable water use and efficient management of groundwater resource. The approach has been successfully implemented in the watershed projects in five states, mainly in Uttar Pradesh and Gujarat. During the mid 90s, BAIF and its associate societies observed that marginal farmers were unable to take advantage of the increased groundwater levels resulting from watershed development simply because they could not afford to invest an amount in the range of Rs 30,000- Rs 50,000 needed for a well. Hence, the idea of a group well, in which the project would contribute about half the cost, was mooted. The remaining cost would be borne by the group of farmers, who would gain access to the water from the well. By 2008, a total of 404 groups had been formed, benefiting 1,781 families.

The Functioning of Water Users' Group

- About 5-10 farmers form a water-users' group. The farmer who donates his land for the well usually becomes the group leader. The group decides the terms and conditions for sharing the costs and the benefits of the well, and formalizes it in an agreement. The office bearers of the *Gram Vikas Samiti* (Village Development Committee) and the group members sign the agreement.
- The group shares monetary costs and contributes labour, as stipulated.
- All members share water equally. In times of severe water shortage, the group cultivates a common crop, sharing its costs and benefits. If conflicts arise, the group is expected to resolve them.

- To ensure that tail-end farmers do not suffer, the farmer at the periphery of the command area of the well gets water first whereas the farmer with land closest to the well gets it last. The crop period is also staggered so as to ensure efficient rotation of water.
- To ensure sustainability of the water source, the groups have adopted well-recharging techniques apart from implementing extensive soil and water conservation measures.

Impact

The group wells have helped address the issue of equity in watershed and other NRM programmes. The involvement of small and marginal landholders and equitable distribution of water to them have ensured assured access to groundwater for the poor families. With lands now producing yields in two seasons, the net annual income has increased by Rs 15,000 to 20,000. The increase in crop production has also solved the problem of food security for these farmers. Women are active members in the group. Each group has about 2-3 women members, and several groups have women office bearers. Hence, group wells are contributing to the sustainable and equitable use of groundwater.

Source: Abridged from Neelam, Kakade and Jape, 2008.

New Technology to Enable Livelihood Augmentation

Farmers need to access / adopt new technology so that the new resources could be used in a cost-efficient way to improve income and the quality of life. The importance of new technology, in widening the choice of livelihood options can not be overemphasised This is, therefore, discussed in more detail below.

The technologies related to NRM have already been discussed in the previous sections. However, in order to harness the full benefits of watershed treatment, local communities need to go beyond NRM, because the ultimate purpose is to augment livelihoods and alleviate poverty. Hence, technologies that help to, a) improve resource productivity, b) reduce costs, c) eliminate drudgery especially for women, d) mitigate production risks, e) offer opportunities for livelihood in a rapidly emerging rural service sector, and f) add value to local produce are equally important. Many of these technologies may need to be introduced soon after investments in natural resources. Scaling up of farmer's innovations and involving local experts in participatory technology development is also an effective way of addressing the technology needs of local communities (see chapter

8) In addition, technologies and institutions that mitigate risks go a long way in helping rural producers in making two ends meet. We take a look at each one of these below.

Technology to enhance resource productivity

Micro-irrigation

Among the technologies that can significantly enhance water and land productivity are micro-irrigation technologies. These can broadly be categorized into two types: a) low cost micro-irrigation, and b) commercialized state-of-the-art systems. The first includes low-cost systems like Pepsee easy drip technology, bucket and drum kits, micro-sprinklers, micro-tube drip systems, etc. These have been designed by organizations like the International Development Enterprises (IDE), along with innovative farmers. The second more sophisticated, capital-intensive system is the conventional drip and sprinkler system (Varma, Verma and Namara, 2008). The technical, economic and social attributes that distinguish the two types are summarized in Table 4.1.

Table 4.1: Low-cost Versus Commercial Micro-irrigation Systems

Criteria	Micro-irrigation Systems	
	Low-cost Systems	**Conventional Systems**
Affordability	Require little initial capital	Require high initial capital
Local manufacturing capacity	Based on local skills and materials	Require relatively sophisticated facilities
Payback period	Usually covers investment cost in one or two seasons	Requires several years (say 8-10)
Compatibility to the farming system	Available in a range of small packages and expandable	Generally adopted by large farms but small versions of high-tech systems are also being marketed
Pressure requirement	Require low pressure	Require high pressure
Ease of technical understanding by users	Simple and easily understood	Sophisticated and need technical expertise
Operational convenience	Low	High
Compatibility with local micro-entrepreneurship	Compatible - require limited skill and capital to design, service and maintain	Less compatible - require special skill

Source: Varma, Verma and Namara, 2008

Numerous studies have established the gains from micro-irrigation. Low-cost drip systems increase income of the poor farmers by enabling more efficient use of water resources, improving yield, improving quality and reducing labour. These systems allow farmers to plant early so that the crop is already established at the onset of the monsoon and rainwater is used efficiently. One of the key benefits is that it helps to extend the use of water during water scarcity period, and mitigates the risk of losing a crop. Under micro-irrigation, the farmer can cultivate multiple crops and increase the cropping intensity on the same field. They also have the choice of extending the irrigated or cultivated area on their land. All this contributes significantly to food security (including nutritional benefits when vegetables are produced for household consumption) and increase in the income levels.

Although several NGOs and government organizations are engaged in actively promoting these technologies, adoption has been slow and restricted to pockets. According to the research carried out by International Water Management Institute (IWMI), "Drip irrigation is often prompted for reasons that do not match with the farmers' main concerns. While the government promotes drips as long-term investments for water saving and sustainable agriculture, the farmers look for more immediate and assured benefits such as lower costs and increased incomes" (IWMI, Sept. 2006). On the other hand, low cost micro-irrigation is largely promoted among poor farmers. Small and marginal farmers can generally recover their initial investment capital within one to three years. Subsidies and avenues for credit can further increase the acceptance of this technology, as shown by the schemes promoted by IDE, AKRSP-I and the Gujarat Government. AKRSP-I has been promoting the technology by training local entrepreneurs as 'assemblers' and extension officers as marketers of the technology. Researchers at IWMI believe that although these innovative low-cost systems have a shorter lifespan, once the returns start flowing in, farmers may decide to shift to the more durable varieties (ibid.).

Crop Improvement

The popularization of low-cost technologies like micro-irrigation, vermi-composting and the use of natural pesticides has contributed significantly to the sustainability of farming systems. However, state of the art technology to improve the productivity of genetic material of bio-resources is equally important. In this regard, M/S/ Swaminathan Research Foundation, Chennai, has taken the lead by developing genetically modified paddy plants, which are tolerant to salinity and drought conditions. Once field-tested, this technology could help change the livelihood and food security of the people in the coastal and drought-prone regions in a significant if not dramatic way. (Annual Report MSSRF, 2004–5)

The practices like Participatory Varietal Selection and Promotion (PVSP) and

Participative Plant Breeding (PPB) adopted by agencies like GVT and ASA in the tribal belts of Madhya Pradesh, Gujarat, Jharkhand, etc., have contributed tremendously in the improvement of the productivity of seed material by ensuring best fit of improved varieties to local conditions. The PVSP allows farmers to choose varieties from a basket of choices and to test them in their own field conditions, and compare the results with local checks. Fourteen producer companies in different districts of MP are now producing farmer-preferred varieties. The practice of PVSP has led to an increase in the productivity of important dry-land crops. The increase has been in the range of from 20 to 80 per cent. (See case study of ASA in Part 3 of this volume).

Intensive multi-story farming

In the tribal areas, BAIF and its associate institutions have introduced intensive and multi-story farming in small parcels of land under a model named Sustainable Multispecies Agriculture Resource-use Trial (SMART) (Box 4.2). The orchard or *wadi* model, which is similar but is anchored around horticulture, has been taken up by NABARD for scaling in the tribal areas in several states of the country (Case study, Part 3).

Box 4.2: SMART Way to Improve Agricultural Productivity

The main objective of the European Union (EU) project *Transfer of Technology for Sustainable Development*, implemented by BAIF in the states of UP and Gujarat between 1996 and 2004 was to alleviate poverty. One of the project interventions was aimed at improving agricultural production in order to improve food security and income levels of the marginal farmers. The Sustainable Multi-species Agriculture Resource-use Trial (SMART) model, introduced during the course of the project in certain areas of Bharuch and Surat Districts of Gujarat, has shown tremendous potential to augment the livelihoods of marginal farmers through intensive farming.

A typical beneficiary of the project is a farmer owning less than 2.0 ha of low-fertility land in the semi-arid tropics who depends totally or predominantly on rain-fed subsistence farming and cannot afford to meet production costs. Although intensive crop production has never been a goal of such small farmers, who are always resource-constrained, this is precisely what BAIF introduced through the SMART model, which was well accepted by the farmers in the project area.

The SMART model aimed at maximizing production of food, fuel, fodder, timber and income of farmers owning farming units between 0.1 ha and 0.2 ha. The designated plot in each farm was divided into 3-6 subplots and each subplot was allotted a different crop. The crops grown included pulses, vegetables, cash crops such as tamarind, ginger and coriander, and medicinal crops like *tulsi* and *nagoda*. In addition, other crops, like moringa, curry leaf, Gliricidia, Jetropha and papaya were planted on farm bunds and borders. The focus was on high value produce hence, cereals were not encouraged. But the model was flexible enough to allow some farmers to include fodder grass. The land was irrigated with the help of a pump located on the plot and the entire family looked after the land. The farmers used vermi-compost and farm yard manure (FYM) instead of chemical fertilizers. The on-farm biodiversity ensured minimum pest problems and the practice of organic farming gave good quality products, which could be sold directly to the consumer.

Starting from 20 in 2003, the number of farmers adopting the SMART model grew to almost 300 in about 30 months. The annual average net profit from a 0.1 ha plot was more than Rs 8,000 as compared to less than Rs 2,000 prior to adopting SMART.

The participants had to make an investment of about Rs 15,000, towards the development of the water source. This investment would be covered within two years. The design of the model is such that harvesting is staggered throughout the year. Marketing of the produce is done directly by the farmers to households locally or in the nearby weekly fairs.

The model is replicable in areas where there are no serious problems with the soil, groundwater is available at a reasonable depth (say, 35 m) and atmospheric conditions are conducive to crop growth through out the year. The model has the essential features for sustainability in species diversity and flexibility in crop selection. Almost all SMART farmers have more than 20 species on their plots at any point in time. However, being a more intensive system as compared to say the *wadi* model developed by BAIF earlier, the plots require intensive management. Further, replication by a large number of farmers within a relatively smaller geographical area may lead to problems of marketing, which would then have to be addressed through special marketing interventions.

Source: Vihol, et al., 2004

Food security through SRI

A promising new technology for paddy cultivation called System of Rice Intensificaiton (SRI) is being actively promoted by several NGOs like BAIF and PRADAN in the tribal areas. Many aspects of SRI like the use of organic matter, traditional rice varieties and non-flooding of fields appeal to small farmers operating under resource-limited conditions. Paddy cultivated in SRI plots has many positive attributes like profuse tillering and dense rooting, and the resultant yields are comparable to the conventional chemical system, but at significantly lower costs and higher water resource use efficiency.

The technology, however, has not diffused very rapidly. Daniel (2005) identified some of the constraints in diffusion of this technology:

a) Unlike irrigated paddy, rainfed paddy requires greater flexibility in the seedling age at planting, which is not available in the SRI method. The SRI requirement of 10-12-day-old seedlings (as compared to 25-35 days for conventional paddy) means less flexibility with regard to the age of the seedlings. The practice of sharing labour during the peak time of transplanting is quite common in the tribal areas. However, the SRI method does not allow such sharing of labour because two days is too little to cover all the families. The situation is aggravated by the need to transplant single seedlings, which is laborious and time consuming.

b) The SRI requires maintaining the field under saturated conditions immediately after transplanting followed by wetting and drying cycles. Following such a strict water management regime was difficult in rainfed conditions. The problem is further aggravated in the fields that have not been levelled properly—resulting in seedlings wilting in the elevated spots.

c) The organic matter available for use as manure is limited. Even households that have two heads of cattle cannot produce more than 5 tonnes of manure whereas the SRI requires the application of at least 10 tonnes per ha. Wherever the soil has low organic matter content, the soil tends to dry rapidly after being wet. Under rainfed conditions, if the next rains are not received in time, there is likelihood of the crop experiencing a drought stress.

The above constraints are not totally insurmountable. However, the transition to SRI will require further adaptation to local conditions.

Technology to reduce cost of production

Optimal use of inputs

In chemical agriculture, farmers often do not use the correct dose of inputs like fertilizers and pesticides. Preferring to err on the right side, the farmers end up using higher doses than what is recommended by research institutions. The farmers also tend to use the same seed material, year after year. As the genetic potential of the seed goes down, the farmers are inclined to step up the seed rate. The traditional method of broadcasting seed is also more wasteful as compared to sowing seeds with seed drills. With the limited reach of the formal extension system in many rainfed areas, access to scientific methods and knowledge is a constraint that affects the cost of the production.

The Development Support Centre (DSC) took up the demonstration of improved practices of wheat cultivation with 69 farmers of 16 villages in the rainfed areas in 2008. For the first time, soil testing was carried out and recommended doses of fertilizers were applied. The highlights of the improved crop practice adopted by the farmers that led to significant cost reduction and improved productivity are given below:

- Reduced seed rate from 200 kg to 120 kg,
- Reduced inputs of DAP and Urea from 200 kg to 100 kg per ha,
- Replacement of old, home-produced seeds with certified new seed material,
- Shift from broadcasting method to seed drill method of sowing, and
- Irrigation of crop at six critical stages only.

Non-chemical and organic farming

Adopting non-chemical and/or organic farming is a way to cut down costs. A large number of farmers in Andhra Pradesh (AP) and other areas, who at one time used chemicals indiscriminately to control pests in cash crops, realized this. In AP, over 3000 villages have adopted non-chemical farming under the guidance of the Society for Elimination of Rural Poverty (SERP), established by the state government. The experience of these villages shows that the cost of pesticides can be cut down without adversely affecting productivity. The pesticides can be replaced by adopting non-chemical pest control methods. (*Down to Earth*, January, 2009)

The orchard growers in Himachal Pradesh, who adopted organic farming to cultivate apples, apricots, plums, etc., reported an 80 per cent savings in the cost of production (*ibid*).

Farmers practicing organic farming have reported an initial loss in productivity, which was covered within 2-3 years. After this, the productivity improved and ultimately outstriped even that of the chemical farming. The cotton farmers in Kutch, aligned with AGROCEL, a private company with social motives, in order to convert to organic farming. They were provided seed capital by the Shell Foundation, an international NGO involved in promoting organic and fair trade value chains. Later, the farms were certified to be organic and they became an integral part of a unique organic cotton value chain (See Volume II for the case study).

Technology/Institutions to mitigate production risks

The greatest source of production risk in rainfed areas is the uncertainty of rainfall. Whereas rainfall is required in measured dozes in critical periods of crop growth, very often it arrives at the wrong time and with the wrong intensity. Water harvesting methods practised in watershed treatment can help to provide critical support during kharif season if rains have failed during the growth stage.

Crops also face the risk of disease and pest attack. Here too, prophylactic measures like seed treatment to prevent bacterial and viral diseases are helpful. Agronomic practices like timing the crop to avoid the cycle of the pests are also helpful in mitigating this risk. Maintaining pest-predator relations, field sanitation, etc., are other technological measures that farmers can take to prevent or minimize pest attacks.

However, technology alone may not succeed in eliminating the production risks completely. With the growing problem of climate change, the monsoons are becoming increasingly more erratic. Innovative weather insurance projects that are being tested in various rainfed areas of India, may ultimately prove to be a viable solution. Whereas the growth rate of the Indian economy is related to the quality of the monsoon, the value of global financial markets are not. Hence, the global financial markets are well suited to insure this risk (Cole, Tobacman, and Topalova, 2007).

Weather/Rainfall insurance

"Rainfall insurance is a financial contract, which pays policyholders a payout if accumulated rainfall during a period falls outside pre-specified bands. The contract specifies a weather station at which rainfall is measured along with start and finish dates and the payout in case of shortfall and, sometimes, excess rain" (Down to Earth, January, 2009).

Weather insurance products use weather parameters as proxies for losses in crop production. Rather than measuring the actual losses, the insurers look at deviations in weather variables from pre-determined triggers, to determine the payouts. The correspondence between the weather parameters and the crop production losses is manifest through a specific formula called the weather index. The products are designed for different crops in different localities based on the specific relationships between the weather events and the yield. The influence of weather on crop growth varies at different stages, namely, sowing, germination, flowering and harvesting. Hence, the premiums can be defined for each of these stages. This helps to disaggregate the risk and the farmer is free to pick up the risks, that he/she is more averse to for insurance.

The weather insurance has a number of advantages over the crop insurance, thus making it more acceptable to the farmer. Some of these are listed below:

- It is simple and farmers can understand and administer it easily.
- There is no need for verifying the actual losses at the field level. Claims can be settled quickly on the basis of variations in weather parameters from their reference values. Hence, early payment of claims is possible in weather insurance; not often the case with crop insurance.
- Index-based products reduce to a great extent the moral hazard and adverse selection.
- A variety of insurance products are available covering various crop growth stages from sowing to harvesting, which meet the complete requirements of the farmers.
- Unlike other insurance lines, the insured need not submit a claim form for assessment. Payment of claims is automatic and is initiated by the Agriculture Insurance Company of India Ltd. (AIC)1 based on the performance of the index. Under this policy, no claim is provided on the basis of field inspection or any subjective loss-assessment methods. Payments are released to farmers within 45 days of the completion of the policy period.

AIC has been in the forefront for promoting weather insurance as an alternative tool (to the more cumbersome ‘crop insurance’) in mitigating farm production risks. During kharif 2009, AIC insured over 1.3 million farmers under its weather insurance programme, covering about 30 crops and clearly taking a lead with a market share of 85 per cent.

AIC has been working with NGOs and MFIs in designing customized weather insurance products for many crops and target groups. Among them is Sajjata Sangh,[2] a network of NGOs working in Gujarat on watershed development. The partnership is now into its third year with 10 member institution having taken up the scheme in 17 different locations for three crops. In 2009, a total of 1,377 policies were sold through active campaigning by the NGOs. Some of the operational difficulties encountered and how the network members are tackling these are discussed below:

a) The programme is targeted at small and marginal farmers, and women farmers. However, most of the target farmers find the premium unaffordable even after it has been subsidized by support agencies. The premium rates ranged from 11 per cent to 16 per cent. Besides, the premium has to be paid at the time when farmers need to purchase agricultural inputs, creating a liquidity crunch. DSC provided 40 per cent subsidy in the premium amount whereas AKRSP-I provided up to 70 per cent subsidy in the tribal areas, and up to 75 per cent for socially backward classes. Many NGOs, however, are unable to provide such subsidies.

b) The success of the programme depends on the quality of the rainfall data and the intensity of network of the meteorological centres. In many cases, the nearest Indian Meteorological Department (IMD) station is about 100 km from the fields; however this data would not reveal the true picture. This challenge was overcome by the AIC agreeing to consider the data of rain-gauge stations of agencies other than the government departments in the project area.

c) The programme calls for active promotion and campaigning among farmers. This cost is presently being borne by partner agencies. The study by Cole, Tobacman and Topalova (2007) shows that education, income level and risk aversion were correlated with the decision to purchase weather insurance. The use of negative language[3] had a significant effect on household decisions, increasing the take-up by 12 per cent.

Technology that removes drudgery for women

Women are involved in many agricultural and post-harvest activities. In tribal areas the men migrate most of the year to cities in search of labour; it is the women who take care of the farms. Many of the small technologies that women can use hold great promise for improvement from the viewpoint of removing drudgery. AKRSP-I has undertaken a unique initiative by introducing drudgery reducing, small equipment, like maize decorticators and groundnut shellers in tribal areas of south Gujarat. These technologies have diffused rapidly. Besides increasing efficiency, and reduce drudgery, they also protect women from health hazards associated with the earlier post-harvest methods - like using nails to decorticate maize or teeth to break groundnut shells. (Box 4.3)

Box 4.3: Tribal Women Embrace Drudgery-reducing Technology in South Gujarat

The Government programmes have hardly paid attention to post-harvest technologies used by small landholders. They need technologies that are simple, low-cost and appropriate for small volumes. Such technology would mainly benefit women, who perform more than 80 per cent of the post-harvest work. The Aga Khan Rural Support Programme-India (AKRSP-I) took a modest initiative in this direction when it introduced simple tools for maize shelling and decorticating groundnuts. Here are two stories of how drudgery and health hazards were reduced for women in Dediapada Taluka.

Shelling Maize

Soniben Vasava of Panuda village spent over 3-4 hours every night for almost 12 days per season manually shelling maize. She suffered from shoulder pain, broke her nails and had sores on her palms. When she heard about the low cost maize sheller, she invited the extension volunteer (EV) for a demonstration and immediately purchased the equipment. The maize sheller cost Rs 20. Soniben found it easy to use. "It is like playing a game with maize now," she says.

The Impact

The use of the sheller has led to improved efficiency. Whereas earlier 2 kg of maize would be shelled in an hour, now 10 kg are shelled in that time. The percentage of seeds broken in the process came down from 10-12 per cent to 1-2 per cent. There is no shoulder pain, no broken nails or sore palms. An exclusively woman's job earlier, now about half the men from the families have begun using the sheller.

Decorticating Groundnuts

After it became possible to irrigate crops in Jambar village, many farmers readily accepted to shift to groundnut cultivation as a livelihood-enhancement strategy. Little did women like Manjulaben Shantilal realize, that they would have to put in 500 additional labour hours to decorticate the kernels. More groundnuts meant frequent nail injury.

When Manjulaben heard about the groundnut shellers, or decorticators, at her SHG meeting, she called the EV for a demonstration. The equipment seemed useful to her.

Her husband thought that Rs 500 was too high a price for a decorticator. With the help of the EV, she convinced her husband that the equipment was economically beneficial and had other uses. “Earlier, we always bought seeds from the market but this year we used our own seeds. This saved us Rs 1,400.” The decorticator had more than paid for itself.

The Impact

A family, whose average production of groundnuts is three quintals, can save 15 person-days of labour (Rs 450). Wastage is reduced drastically—from 12-15 percent to 4-5 percent. Broken nails became a thing of the past. In addition, the decorticator is useful for grading, thereby enabling seed preparation. Moreover, it can decorticate castor too. Earlier only women decorticated the kernels. At present, 75 percent of the men too have joined them.

Why was the technology so readily accepted? The main reasons are:

- The tools are simple, low cost, and easy to operate. They are also easy and inexpensive to maintain.
- The tools are lightweight, making it easy to carry. This meant that they could be borrowed; everyone need not buy it.
- The dissemination of information was effective, supported by regular guidance and follow-up by EVs.

Source: Chabadia and Mehta, 2008

Technologies for rural service sector

The search for new technology that can address local needs should be relentless and sustained. A good way to access new technology is to develop public-private partnerships with business organizations, which have a social agenda (Yunus, 2007, Prahalad 2006). In Rajasthan, Jal Bhagirathi Foundation (JBF) of the Marwar region has signed an agreement with Environze Pvt Ltd of New Delhi, to access reverse-osmosis (RO) technology, under the Rajasthan Community Business Alliance on Water Programme. The company has taken up the responsibility of setting up and running the RO plant and supplying water at a fixed price of 0.15 paise to the Jal Sabha (water user’s association). The Jal Mandals (women’s SHGs) have taken up water distribution as a livelihood alternative in the service sector.

Other promising technologies include solar condensers (solverters) developed by TERI, New Delhi, as an alternative to the expensive solar cells (TERI, 2007) and a new zero discharge toilet designed by IIT Kanpur, which minimizes the use of water by re-using the water for flushing (*Down to Earth*, January 2008). The Tata Group of companies has also come up with Swach, a low-cost water purifier that uses nano-technology and local materials such as rice husk ash to make water potable. Priced below Rs 1,000, its unique selling proposition is that it does not need electricity, a vital challenge in rural areas (*Times of India*, December 7, 2009). These technologies have the potential to create new livelihoods by providing new services to rural communities. Development agencies and CBOs need to quickly capitalize on there ideas and technologies, especially in the regions where natural resource-based options are insufficient to meet the growing needs of the local population. Part 3 provides a best practice showing how BAIF has promoted vermi-compost making as a micro-enterprise among women's SHGs. Vermi-composting serves the dual purpose of providing new livelihoods to women while simultaneously rejuvenating local soils, thereby reducing risks in rainfed farming.

Technologies that add value to local products and processes

ICT applications

With the growth of ICT in India, private companies have started developing applications that can bridge the digital divide and reach out to markets that were earlier considered unviable or inaccessible. ICT technologies that empower the poor and the marginalized by giving them access to critical information to increase productivity, save crops or realize better prices are now available. Consider the following applications:

- The mobile phone, Fisher Friend, provides information to fishermen out at sea that helps them locate shoals of fish, thereby ensuring that they do not return empty-handed after each outing (Box 4.4).
- The farm-specific agri-advisory service, E-Sagu, is provided to farmers in Andhra Pradesh by an expert group of scientists on the basis of digital photographs sent to them by volunteers, using ICT channels. The cost benefit of the service to farmers is 1:4 (see Volume III for the case study).

Agro-processing

Technologies for processing agricultural produce have huge untapped potential for creating livelihoods while improving price realization for the farmers. In Surendranagar, AKRSP-I has facilitated the establishment of a plant to manufacture cheese from goat's milk. The milk is contributed by the members of a federation of producers, who are from the backward caste communities. In this way, the plant has helped to raise the economic status of the poor directly (Box 4.5). For other examples of harnessing processing technology such as Rudi Bazar, Janarth adat, AGROCEL etc. see Volume II.

Box 4.4: Fisher Friend in search of Fishermen

With innovative ICT applications like Fisher Friend for rural computing, QUALCOMM is taking communications access to the next level. Astute Systems Technology, Indore, developed the technology for QUALCOMM in 2006, under its BREW programme, which awards small grants for such creative work. QUALCOMM collaborated with the M.S. Swaminathan Research Foundation, Chennai, for carrying out the initial experiments with the fishing community. Tata Indicom provides connectivity through the CDMA network. The phone uses CDMA technology to integrate voice and data applications for subscribers.

The Fisher Friend Service provides information on weather and sea conditions, emergency information, etc., to fishermen. The range of Fisher Friend is about 15 km out in the open ocean. Using this mobile phone, fishermen can gain access to information on wave height, weather, potential fishing zones, news flashes, government schemes and latest market prices.

In June 2007, six cell phones were given to fishermen in Viranpatnam to try out this new service. On December, 26, 2007 the third anniversary of the tsunami, 40 more phones were distributed to the fisherfolk of Puducherry, Chidambaram, Nagapattinam, Manamelkudi, Thangachimadam, Vembar and Nagercoil. The simplicity of the approach makes it effective and acceptable to the fishermen.

Source: The Hindu, December 27, 2007
and MSSRF brochure on Fisher Friend

Creating Service Providers

Many developmental agencies have found it useful to build the capacities of local youth to provide critical services like input delivery and technical services in the case of new technology. Examples include the 'assemblers' of the micro-irrigation promoted by AKRSP-I in Gujarat; the 'grainage entrepreneurs' in sericulture promoted by PRADAN in Jharkhand and the 'lift irrigation operators' of the Lift Irrigation Cooperatives, promoted by Sadguru Foundation. These youth become 'nano-entrepreneurs'[4] and help their community members to take up new livelihood activities through the services they provide. These nano-entrepreneurs often work in tandem with the community-based enterprises of their area. Sometimes, they are absorbed as employees of the CBO, as in the case of poultry cooperatives promoted by PRADAN.

Creating Market Linkages

With improved water resources, the prospects of cultivating cash crops or cultivating part of the crop for markets, becomes real. With the introduction of new varieties and crops under intensive farming, the need to procure quality inputs such as seeds, fertilizers, pesticides, etc., at a reasonable price becomes critical. Here, the emergence of community-based entrepreneurship can help to meet the need through the aggregation of demand. The same community-based institution can also help the farmer secure better prices for his/ her produce through aggregation and market intelligence. At this stage, the community launches into entrepreneurship. This aspect is discussed in detail in Volume II.

Box 4.5: Maldhari Women from Mouli Are Saying "Cheese!"

The Maldharis are a pastoral, nomadic community, who tend goats and sheep and earn a living by selling milk and wool. As forests and pasturelands thin out people prefer to buy processed, packaged cow milk, the Maldharis find it difficult to maintain their way of life and make ends meet. About 20 years back, the community began to settle in Mouli, Morwa and other places in Surendranagar District of Gujarat. But their lot did not improve much—women had to go from door to door, pleading with people to buy goat's milk. Although goat's milk has higher protein and lower fat content, consumers prefer cow's milk. The Maldhari women tried to sell goat milk products, buttermilk and *khoya*, but selling milk products proved just as difficult.

It was only when the AKRSP-I stepped in (2005-2006) that their vocation got a new lease of life. The AKRSP-I set up a cheese making plant, which bought all the goat milk the Maldharis produced, processed it into cheese and found institutional buyers for the product.

A cheese plant would need regular supply of an assured quantity of milk. To facilitate it, Maldhari men and women from nine selected villages formed the Goat Dairy Producers' Association. Women from these villages were federated into the Panchal Mahila Cheese Utpadak Sewa Sangh under AKRSP-I's guidance. The AKRSP-I provided a number ancillary services: animal husbandry and livestock management. Goats are de-wormed and vaccinated. In addition, it also supplies quality feed concentrate as fodder. There is a plan to train two Maldharis from each of the nine villages as para-vets. A medicine bank, a herbal animal treatment centre and a goat-breeding centre are also on the horizon. Goat milk is sold to the cheese plant at Rs 10 per litre, four rupees more than what it would fetch if sold directly to customers. Milk is sold to the cheese plant at a higher price and gives an assured income to its members.

The cheese plant has the capacity to process 3,000 litres of milk per day; but the Maldhari community, at present, is able to deliver only 800 litres per day. Shankarbhai, who supplies milk to the dairy, says that he and others would like to increase the size of their flock but they do not have the space to keep them. Ever ready to look for solutions, the AKRSP-I worked to re-design their huts: there was space for animals on the ground floor and residential quarters were shifted to the first floor on stilts.

In late 2007, a top chef from the Taj Mahal Hotel in Mumbai approved their cheddar cheese. A well-known bakery shop in Mumbai has liked the feta produced by the Maldharis. Whereas cheddar cheese is sold at Rs 110 per kg, feta sells at Rs 300 per kg. No wonder the Maldhari women from Mouli are saying, "Cheese!"

Source: Civil Society, January 2008

Conclusion

At each of the stages discussed above (as per Figure 4.1), a need for creating village-level institutions was felt, although the type of institution would vary depending on the nature of the activity undertaken. Whereas resource groups are formed to create and manage water-harvesting structures, the implementation of the overall watershed development plan is done through village-level watershed committees. New technology to improve resource-use productivity can be routed through the same committee or through some other institutions like farmers clubs. Access to credit is made possible through small SHGs of (preferably) women. These groups may aggregate at a later stage, making it possible to add products such as micro-insurance to their portfolios. Market linkages can best be created through producer companies or cooperatives. The creation of social capital is, therefore, an indispensable part of livelihood augmentation programmes. This aspect of livelihood augmentation is discussed further in Chapter 9 of this volume and in greater detail in Volume IV of the handbook.

End-notes

1. AIC was formed by the Government of India in 2002. It has taken over the implementation of the National Agricultural Insurance Scheme (NAIS) that was earlier being implemented by the General Insurance Corporation of India.

2. Sajjata Sangh was initiated by DSC in 2001 and continues to be anchored by it. Currently, it has 31 member institutions.

3. In this case it refers to propoganda that plays upon the fears of the potential clients in order to induce them to buy an insurance policy.

4. The term was used by Soumen Biswas, CEO PRADAN, during an informal discussion with him in April 2008. It refers to such entrepreneurs, who cannot be called micro-entrepreneurs because the scale of their enterprise is so small. Nevertheless, they perform all the functions of an entrepreneur and take risks, which given their level of income and asset holding can be considered to be significant.

5 NRM Strategies for Problem Lands

Specialized NRM strategies are needed for lands with special problems, for instance, salt-affected lands, laterite soils, acidic lands, waterlogged lands, desert lands, rocky lands and lands affected by mining. Whereas a lot of the research findings carried out by formal institutions on problem soils are available, practical experiences of restoring these lands in a cost-effective manner through community participation are few and far between. We have, therefore, restricted ourselves to sharing information only on salt-affected and laterite lands. With the pressure on productive lands increasing, problem lands can be seen as opportunities for livelihood augmentation in the near future. The potential of these lands can be gauged by the extent of such land lying unutilized or under-utilized, and the availability of new/emerging technology to put these to productive use.

Strategies for Reclaiming Salt-affected Lands

The most challenging among problem lands are the salt-affected lands. These can be classified into two broad groups, a) lands with induced salinity and b) lands with inherent salinity. Salinity can occur in coastal areas as well as in the hinterlands. The matrix in Figure 5.1 shows the possible situations.

Figure 5.1: Typology of Salt-affected Lands

		Location	
		Hinterland	Coastal land
Salinity	Inherent	Few pockets with saline groundwater	Marine origin of land
	Induced	Excessive irrigation, poor drainage	Salinity ingress

Hinterland Salinity

The biggest reason for hinterland salinity is excessive irrigation and poor drainage. This is commonly found in large irrigation projects that are typically completed without paying attention to the important task of providing proper drainage. The situation results in bringing salts from sub-surface layers to the surface through evaporation and capillary action. This has ruined vast tracts of fertile land. The Central Soil Salinity Research Institute, Karnal, has developed a number of technologies to reclaim such lands.

In general, the salts accumulated in the soil can be leached out with the help of sweet water, after installing a proper drainage system. It follows that sandy soils are more easily reclaimed as compared to silt and clayey soils because sandy soils are easier to drain. Alkaline patches, if any, can be treated with gypsum, available as a waste product of the fertilizer industry. Biological methods are also in use whereby degraded lands can be recovered by first planting salt-tolerant trees and bushes.

A few pockets like Luni in Rajasthan have problems of inherent salinity, owing to saline groundwater. The Thar Desert, where surface water is scarce, also has to contend with the issue of saline groundwater.

Coastal Salinity

The lands with inherent salinity in coastal areas are the most difficult to reclaim because of the marine origin of the soils. Coastal mudflats in arid zones like those in Gujarat are even more difficult because drainage is poor, and sweet water is not easily available to leach out salts from the upper layers of the soil. Moreover, due to capillary action, salts are continuously brought to the surface through evaporation. To protect their cultivable lands, farmers have to maintain a constant vigil and check this process through tillage, mulching and other means.

Some of the water harvesting methods found effective in coastal areas are:

- Surface storage in ponds lined with bitumen and/or HDP sheets.,
- Sub-surface dams to check salinity ingress through streams/creeks,
- Recharging of wells, and
- Inter-connected tanks with waste-weirs.

Tackling salinity ingress

In the coastal areas, the problem of salinity ingress is assuming alarming proportion in many states, leading to loss of cultivable land and livelihoods (Box 5.1). This problem has been triggered by, among other things, excess withdrawal of groundwater for irrigation rendering larger and larger tracts of coastal groundwater saline. Utthan Trust has demonstrated the successful use of sub-surface dams/dykes to check salinity ingress through streams or creeks in the coastal district of Amreli, Gujarat. In Pipavav village on the Jholapuri River, such dams help to revive wells that had turned saline due to salinity ingress (Box 5.2). The treatment of the catchment areas of small rivers was found not only to improve available surface water for agriculture and horticulture but also to reduce groundwater salinity in the region. The Vivekanand Research and Training Institution (VRTI), an NGO working in the coastal saline regions of Kutch, has been successful by using a method similar to the one used by Utthan Trust.

Box 5.1: Salinity Ingress

According to the Central Pollution Control Board, the landward movement of 'sea water-fresh water' interface has resulted in salinity intrusion in several areas, for example, the Minjur area of Tamil Nadu, the Mangrol-Chorwad area in the Porbandar belt along the Saurashtra coast and the area east of the Neyveli lignite mines in Pondicherry. Although International Groundwater Resources Assessment Centre (IGRAC) has provided the basic information on the regions prone to sea water intrusion, it is difficult to provide precise data about the extent and nature of, and trends in, the coastal salinity in India. This is because no such data are collected systematically by any agency. In order to assess the trends and causes of salinity ingress, therefore, case studies of several coastal pockets were used. The study is clearly show an increase in salinity ingress in certain coastal regions. The causes vary from region to region as described below:

Krishna Delta

The local area has low impermeable marshy land. According to the Planning Commission, the main problem of this area is saline water ingress due to tidal effect. The loss of fresh water and flooding during monsoon are added problems. In the coastal regions, the shallow aquifer contains good quality water. Further inland, the upper three aquifers contain good water although it is observed that the freshwater-saline water interface moved inward and upward after the survey was done in 1976. This was attributed to the reduced flow of water in the Krishna River and extensive aquaculture.

Vasai-Palghar Coastal Zone

The zone with low salinity is being contaminated with salts from the clay present in the tidal flats whereas the zone with high salinity is contaminated by the seepage of brine from the salt pans. The suggestion to line the salt pans with geo-synthetic material to contain the seepage, was not found economically viable.

Kolkata and Haldia

This tract has excess salinity largely emanating from the excess withdrawal of groundwater. Groundwater depletion over the past 30 years in Kolkata and Haldia are estimated to be 7m to 9m.

Khambhat, Gujarat

In addition to enormous wind speed, the soil in Khambhat is affected by the high evapo-transpiration and low rainfall, which make this region a semi-arid region. As a result, over the years it has accumulated salt in its soil. There is high salt content in the upper, clayey, impermeable soil layer. Therefore, the long residence time of water in the upper layer not only causes waterlogging but also increases water salinity. The groundwater recharge in the upper region is so low that it is unable to counteract the salinity ingress.

Coastal Saurashtra

The salinity mechanism on the Saurashtra coast has five main components:

- *Inherent salinity*: Gaj beds composed of tertiary clay and limestone have been deposited in the marine environment. Therefore, this formation is assumed to have inherent saline water.
- *Lateral seawater intrusion*: The over-extraction of groundwater causes reduction in the hydraulic head, lowering the water table. When the reduced head becomes lower than the sea water level, it causes inland movement of sea water.
- *Tidal ingress*: This is primarily due to the upcoming mechanism described earlier. In the lower confined aquifers, salinity intrusion also takes place through creek-land alluvium or porous front.
- *Irrigation with saline water*: The application of saline water to field causes salt accumulation, making the soil saline.
- *Salt laden winds*: The Saurashtra coastal track experiences salt laden winds of high velocity from March to May. Deposits of fine-grained sand and salt carried by the wind from the Rann area ultimately cause surface and groundwater salinization. Sea water spray is also carried by the wind up to 15 to 20 km inland.

In the final analysis, coastal salinity ingress is a consequence of the unsustainable development process. It is a symptom of the underlying dynamics of coastal development. Therefore, it needs to be addressed not only through symptomatic but also systematic measures. Instead of addressing salinity independently after it has grown, there is a need to promote a process that regulates the salinity and manages it well.

Source: Hirway, et al., 2008

Addressing the drinking water problem in coastal areas

Many coastal areas suffer from the problem of lack of potable water, especially since the groundwater is saline and unfit for human consumption. Efforts are on to harness new technologies to tackle drinking water problem in these regions. WASMO, an NGO established by the Gujarat government, has commissioned 114 reverse osmosis (RO) plants to be run as common property assets by the water committees of various villages facing acute drinking water problems due to the presence of salt, fluorides and nitrates in the groundwater. An RO plant, with a capacity of producing clean potable water of 4,000 liters/hour, can provide water to end-users at a cost of 10-12 paise per litre. The Gujarat Government has promised to bear 90 per cent of the investment cost (Rs 2.5 to 6.0 lakhs, depending on the capacity) and the remaining will come in the form of people's contribution (Pathan, 2008).

The problem with the RO technology is that it produces effluents in the form of high concentration of saline water that needs to be disposed of safely. A practical solution to this problem is to use solar energy to evaporate the water and collect the salt. WASMO in Kutch is in the process of trying out a new technology for converting highly saline water into potable water through the age-old principle of evaporation and condensation. The technology of 'water pyramids' was developed by Martijn Nitzsche and is being supplied by Aqua Aero Water System (AAWS), a social business company from The Netherlands The high capital cost of the water pyramid has prompted some people to experiment with very small sized water cones that work on the same principle (Box 5.3).

Yet another interesting technology to bring relief to the villages with coastal saline groundwater is the use of 'dew harvesters', developed by Prof Girija Sharan of the Indian Institute of Management, Ahmedabad (Sharan, 2006). The technology has been tested in the coastal areas of Kutch, where the availability of drinking water is a critical issue. It has the potential for replication in those coastal regions where the levels of dew precipitated are high enough for harvesting.

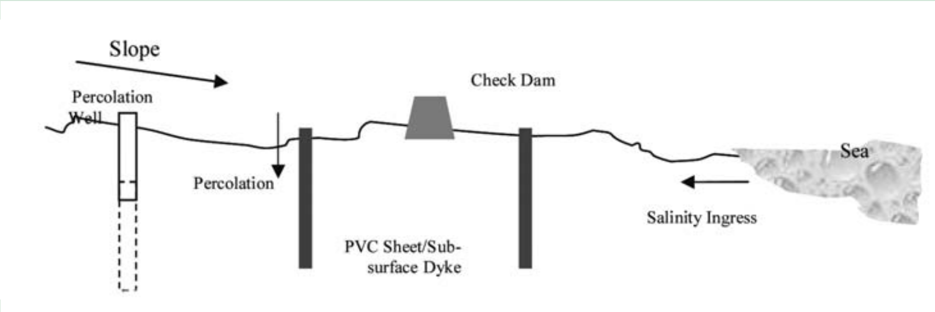
A dew harvest system typically comprises, a) a condenser made of thin metal sheet or plastic film insulated on the underside, b) water collection and conveyance accessories, and c) storage. Properties that have large metal (GI) rooftops offer good opportunity for dew harvesting. However, with most other rooftops, it is necessary to install plastic condensers. Among the plastic materials tried, the one found affordable was polyethylene film. A typical family relying on rooftop harvesting will have a nominal yield of about 20 litres of potable water per day. The total collection over a season of eight months would be approximately 5,000 litres. Other larger systems using triangular ridge-shaped condensers can be built on wastelands, and they can serve the community by bottling dew and selling it locally at an affordable price. Among the other possible uses being explored is the harvesting of dew on barren hill slopes with the outlet of the condensers channelled to the base of trees.

Box 5.2: Sub-surface Dykes to Prevent Salinity Ingress in Coastal Areas: Pipavav village

Jholapuri is one of the two important rivers of Rajula block in Amreli District, Gujarat. The river drains into the Gulf of Cambay. About 25 villages are located on the banks of the river in its catchment area. Jholapuri was a perennial river till 1990. With the introduction of modern machines for lift irrigation and the extraction of groundwater, the land-use pattern changed. The people started cultivating water inefficient cash crops. As a result, most of the time there is no water in the river over the past 15 years. In addition, most of the wells near the river in the coastal village of Pipavav have turned saline due to salinity ingress.

In consultation with Utthan Trust, the villagers decided to make two sub-surface dykes in the path of the river with a check dam in between. Each sub-surface dyke was 20-25 feet broad and about 15 feet deep. The process of construction involved digging a vertical pit and laying an HDPP sheet in it. The soil was then put back in the pit and the lining folded back on the top. As a result of the treatment, salinity ingress was brought under control. At the other end, rainwater was harvested and stored in the dry riverbed. This resulted in about 11 wells on the riverbanks, which had earlier turned saline, getting recharged and filled with sweet water. These wells now irrigate 75 ha of land.

Figure: Cross-section of the Jholapuri River and its Treatment Points

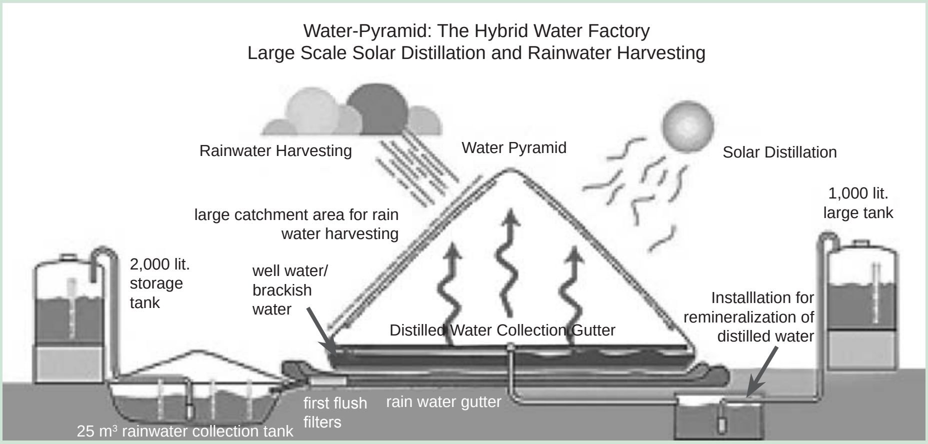


Source: Personal communication with Kaushik Raval of Utthan Trust, and Devabhai Makwana and Laxmanbhai Panchabhai Bharwad of Pipavav village during a field visit in March 2008

Box 5.3: Water Pyramids and Cones

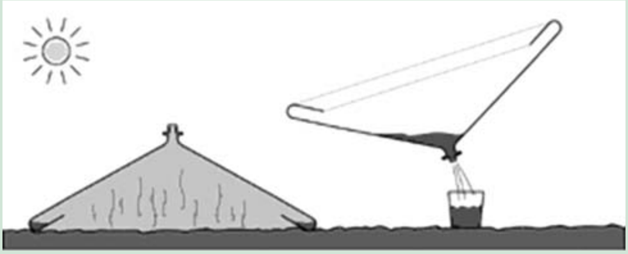
Water pyramid

The Water Pyramid, is an innovation developed by Martijn Nitzsche from Aqua-Aero WaterSystems BV of the Netherlands. It is patented and recognized by the World Bank and has received the Development Marketplace Award-2006 for small-scale water innovations. It is a uniquely designed inflated foil structure, which uses energy from the sun to evaporate brackish or polluted source water and condense it to high-quality drinking water. The concept is based on the solar still principle optimised for large areas. The pyramid is inflated using a simple pump backed by a 24 volts chargeable battery.



The raw water is filled on the floor of the pyramid and evaporates due to the solar energy. The water condenses along the inside foil of the pyramid and is collected in a tank through a gutter for distilled water which can be used further to market different products for industrial and medicinal uses or used locally in combination with other sources of water for drinking and domestic purposes. The salt which remains can be used for the domestic need in the village or can be traded. The production rate is expected to be 1000 litres of distilled water per day on sunny days. The Water Pyramid has a base of 600 to 650 sq m and height of 9 m. Consequently it offers a substantial surface area for rainwater harvesting during monsoon. This water too can be collected in a tank through gutters on the outside of the pyramid and can be used for drinking purposes.

Shirva Village in Mandvi block of Kutch District is among the first villages in India to test this technology. The ground water at Shirva has a TDS level of 2300-2700 ppm and in the absence of any other option the population of more than 2500 is dependent on the government for supply of drinking water. The Gram Panchayat has already installed a Reverse Osmosis plant, which desalinates the water of the village well. The brine which is produced as the by-product of the RO system is being used as the water source for the water pyramid system. At Shirva two tanks of 5,000 litres capacity have been constructed for collection of the distilled water, while the rain water will be collected in a pond with the 4000 sq m.



The setting up of this water pyramid was made possible by the partnership between WASMO, Aqua-Aero WaterSystems BV and the Government of the Netherlands in cooperation with the VRTI (a local NGO partner implementing WASMO's drinking water project in the village), the Gram Panchayat and Pani Samiti of Shirva village.

Water cones

While the water pyramid has obvious benefits the high initial capital is a major limiting factor. The search for simpler and cheaper applications of the solar still has led to the development of small, portable water cones. A typical water cone yields between 1.0 to 1.7 liters of condensed water per day. These yields were reported for WATERCONE(r) with a base diameter of 60-80 cms tested in Casablanca, Morocco where the average evaporation level was 8.8 liters per sq m.

The water cone is made from transparent, thermo-formable polycarbonate (same as water dispensers) outfitted with a screw cap spout at the tip and an inward circular collecting trough at the base. Salty / brackish water is poured into the pan on which the water cone is floated. The black pan absorbs the sunlight and heats up the water to support evaporation. The condensed droplets trickle down the inner wall into a circular trough at the inner base of the cone. By unscrewing the cap at the tip of the cone and turning the cone upside down, one can empty the potable water gathered in the trough directly into a drinking device. WATERCONE(r) is a long lasting UV-resistant poly carbonate product and can be used daily for up to five years. The material is non-toxic, non-flammable and 100 per cent recyclable.

Source: Aqua-Aero WaterSystems BV, company website at (www.aaws.nl/details.htm); WASMO organization website (www.wasmo.org/CMS.aspx?content_id=80); WATERCONE company website (www.watercone.com/product.html) accessed August 2010

Strategies for augmenting coastal livelihoods

In the coastal areas, some communities rely exclusively on marine resources for their livelihoods. Marine aquaculture of a wide range of species like sea-grass, mollusks, shrimp, lobster and crab remain under-utilized and have great potential for development.

The development of the coastal aquaculture efforts in India have so far concentrated mainly on shrimp, especially on the landward side due to their economic importance, the ready availability of technology and ready market for the produce. Pilot, or experimental trials have been attempted for other species of commercial importance. Indian research institutes have already standardized breeding technologies for many of the potential species in our waters. However, commercialization of such efforts has not has taken place due to various reasons. The potential candidates for marine aquaculture on the Indian coast are listed in table 5.1 (Vishnu Bhatt and Vinod P N, 2008):

Table 5.1: Potential Aquatic Species for Sea Farming in India

No.	Name of Species	Scientific Name
1	Asian sea bass	*Lates calcarifer*
2	Grouper	*Epinephelus spp*
3	Milkfish	*Chanos chanos*
4	Mullet	*Mugil cephalus*
5	Silver pomfret	*Pampus argenteus*
6	Cobia	*Rachycentron spp.*
7	Tunas	*Thunnus sp, Euthunnus sp.*
8	Mud crab	*Scylla serrata*
9	Rock lobster	*Panulirus spp*
10	Edible oyster	*Crassostrea spp.*
11	Pearl oyster	*Pinctada fucata, P. margaritifera*
12	Mussels	*Perna viridis, P. indica*
13	Clams	*Anadara granosa, Paphia malabarica*
14	Sea cucumber	*Holothuria scabra*
15	Seaweeds	*Gracilaria, Gelidiella, Kappaphycus, etc.*

It is estimated that out of the total quantity of shrimps exported from India cultured shrimps constitute 63 per cent. Therefore, in order to diversify the export basket, the Marine Products Export Development Authority (MPEDA) has set out an action-oriented plan, which envisages increasing the share of the non-traditional cultured varieties to about 50 per cent of the total production from aquaculture.

MPEDA has, therefore, constituted a separate society, namely Rajiv Gandhi Centre for Aquaculture (RGCA). RGCA has embarked upon various missions to standardize and popularize the aquaculture of potential species that have commercial significance in Indian waters (Vishnu Bhatt and Vinod P N, 2008). The following are some of the activities recently taken up by this organization:

a. Breeding of Asian sea bass (*Lates calcarifer*),
b. Cage culture of Asian sea bass,
c. Fattening of rock lobsters,
d. Breeding and culture of mud crabs (*Scylla serrata*),
e. Production of *Artemia spp*,
f. Breeding and culture of groupers, and
g. Culture of Tilapia fish

A unique experiment initiated by People's Learning Center for Livelihood Security and Disaster Mitigation (PLC) on the Saurashtra Coast, led to the successful development of lobster fattening technology. The activity is presently seen as a supplementary activity to seashore fishing. However, it also has the potential of providing year round self-employment and thereby arresting stress migration of coastal communities in the region (see Box 5.4).

Box 5.4: Lobster Fattening in Coastal Saurashtra

People's Learning Center for Livelihood Security and Disaster Mitigation for Coastal Communities (PLC- Coastal) was promoted by Utthan Trust in June 2006, in Bhavnagar-Amreli coastal area with the broad objective of developing, promoting and protecting the livelihoods of coastal communities. PLC provides a platform for coastal communities to come together and exchange ideas and innovations, interact with the formal researchers and come out with new solutions to their livelihood related problems. Between 2007 and 2008, PLC carried out trials on lobster fattening as a supplementary livelihood activity for coastal communities of the area, with remarkable success. This was made possible with the financial support of Coastal Salinity Prevention Cell, SRTT. The project now into its second phase is involved in scaling-up the trials and fine-tuning the technology.

The spiny or rock lobsters (Panulirus spp.) are marine crustaceans (shellfishes) commonly found in rocky shores and grow up to a body length of 60 cm. Eight species of spiny lobsters, six shallow water species and two deep-sea species and the sand lobster

contribute to lobster fishery of India. Juvenile lobsters weighing between 50 to 100 gms represent a significant portion of the daily catch of fishermen on the Saurashtra coast. In the market, lobsters fetch a good price, but to be marketable, they must have attained a body weight of at least 150 gms. As a result, the potentially valuable catch is either thrown back into the sea or sold at the price of trash fish. Enterprising fishermen in many parts of the world are developing methods to raise the juvenile lobsters on the seacoast, to their marketable size. In India, PLC worked with self-help groups of the Vaghri community on the Bhavnagar-Amreli, coast to develop techniques to fatten lobsters.

Building upon local technical knowledge and working with self-help groups of fisher-folk, PLC facilitated the scientific experimentation and trials of lobster fattening in two villages viz. Akhtariya of Mahua and Chanch Bawadiya of Rajula block. The trials led to the establishment and successful demonstration of two different methods of fattening rock lobster (Panulirus homarus) also known as spiny lobster:

Pit culture method practiced on rocky shores

The Sagar Khedut Matsya Mandal, Akthariya, which has 15 members, experimented with the pit culture method. The method involves excavation of pits in soft rock in the inter-tidal zone, where these are flushed regularly by tidal water. Pits of small size (virdas) (8’ x 6’ x 3’) and larger sized tanks (20’ x 30’ x 5’) were made to find out the best option. These pits get filled with tidal water in which the lobsters are raised. They are protected from predators with the help of nets. Fresh seawater is pumped into the pits/ tanks in case these are located at a higher level. Artificial feed is provided and care is taken to maintain the dissolved oxygen and salinity levels within the prescribed ranges.

Cage culture method carried out in coastal creeks

The Dariyai Putra Matysa Mandal, Chanch, which has 33 members, developed the cage culture method. At Chanch Bawadiya there are many creeks. The people used to carry fish and lobster in bags made of net and keep them for a while before marketing. Rambhai the facilitator from PLC, asked Bachubhai Verabhai, one of the SHG members, to put some juveniles in a net bag and tie it in a creek.

After three months, the lobsters grew from 50 gms to 70 gms. And after another two months they became 150 gms in weight, making them marketable. However, predators had damaged the legs of the lobsters affecting their market value. The experiment paved the way for developing the cage method and standardizing the culture procedures. The cages were made of bamboo sticks and nylon nets were tied in two or three layers around the bamboo structure.

Economics of lobster culture

Reports of lobster fattening in other parts of the world have concluded that the margin can range from 50 to 100%. The lobster-fattening project in Bhavnagar, has shown over two seasons that this is an economically attractive proposition. The lobster-fattening season starts in September and ends in February during which period it is possible to take two crops. At Akhtariya the total investment in creating 28 pits and three tanks (with approximate life of 10 yrs) along with other costs of equipment etc. was about Rs. 1.05 lakhs. The recurring cost per cycle was about Rs. 6,500/-. With an income of about Rs. 80,000/- per cycle, the very first cycle covered a major part of the investment. With the second cycle, the project had broken even. One of the reasons for the highly favourable economics was that the lobsters were fed trash fish, which was otherwise being wasted.

The price realized for marketable lobsters has increased four fold by liking the producers to larger traders supplying lobsters to processing houses in Veraval. The price realized by the SHGs went up from about Rs. 200/-kg to 800/kg. This four-fold increase was made possible by better access to market information and aggregation of the produce for marketing.

Source: PLC's brochure on lobster fattening

On the basis of a survey commissioned by MPEDA in the 90s, it was concluded that about 2,000 sq km of sea surface be ideally available to take up offshore farming. A production potential of 8 million tonnes of high quality marine fish will then be harvestable through cage culture practices. The export of marine products has steadily grown over the years - from a mere Rs.3.92 crore in 1961-62 to Rs. 8607.94 crore in 2008-09.

It is expected that export will increase from the current level of 0.61 million MT to at least 2 million MT by 2015. The value of export will increase to US $ 4 billion by 2012 and U$ 6 billion by 2015. The employment generation of the Industry will grow from the current level of 3.0 million to 6.0 million by 2015.

The coastal lands and the livelihoods of the local communities are under severe threat from the government's policies of industrialization, which provide special concessions under Special Economic Zones (SEZs) to large industrial houses. There is a need for coastal communities to lobby for SEZs designed exclusively for farmers and fishermen, in which value-added products can be produced and exported by community-based enterprises. (This point is discussed in greater detail in Volume II, which deals with entrepreneurship).

Strategies for Reclaiming Laterite Soils[1]

Laterite and lateritic soils are formations peculiar to India and some other tropical countries that have intermittent moist climate, like Sri Lanka, Mayanmar and parts of Africa. In most laterite regions, the annual rainfall exceeds 1,750 mm and the soils are susceptible to heavy erosion. However, laterite wastelands are also found in dry regions. In India, they cover a total area of about 2,48,000 sq km. The laterites are especially well-developed on the summits of the hills in the Deccan, Maharashtra, Karnataka, Kerala, Madhya Pradesh, the Eastern Ghat regions of Orissa and parts of Assam.

Originally, the name for the iron-rich weathering product of basalt in southern India, the term is now used in a broad sense for weathering products composed principally of the oxides and hydrous oxides of iron, aluminum, titanium and manganese. The laterites are red because silicates have been leached out, and iron and aluminum salts predominate. The soil horizons are unclear and the nutrient status of the soil is low. The laterites are soft but harden rapidly when exposed to the air and acquired a brick-like hardness. As a result, these are used more for non-agricultural purposes like clay for puddling, for making tiles, and as mortar in rough work.

The laterites usually have poor soil quality full of hard concretionary lumps and are infertile because the potash and the phosphates have been removed in solution. They are also very poor in lime and magnesia, and deficient in nitrogen. There is a substantial erosion hazard on these soils, particularly because they often occur on slopes. The compact B-horizon inhibits root penetration. The moisture retention is relatively low and the organic matter content is also low. The pH ranges from 4.8 to 5.5 and the base-exchange capacity is low. Consequently, the laterites respond well to the application of lime and potash as well as fertilizers in general.

The agricultural value of soils with laterite depends largely on the thickness of the overlying soil. With laterite at more than about 50 cm depth, soils can be moderately productive for paddy and other cereal crops. The laterite soils are suited for annual crops like maize, tobacco, cotton and yam. However, as the work done by Kerala Agricultural University and Central Plantation Crops Research Institute shows, plantation and horticultural crops like rubber, coconut, cashew, arecanut, pepper and mango have also been found suitable for cultivation.[2]

Conservation works and the maintenance of good organic matter status are necessary to make these lands productive again. Short fallowing (with a fallow to cultivation ratio of at least 1:1) is necessary, together with green manuring, a rotation that includes legumes, and the application of manure or fertilizers.

In Andhra Pradesh, a network of NGOs have supported community efforts to make laterite wastelands productive by cultivating local millets, thereby meeting the food and fodder needs of the poor (Box.5.5).

Box 5.5: Orphan Crops on Laterite Wastelands Provide Food Security

Zaheerabad Mandal in Medak District of Andhra Pradesh is largely an un-irrigated rainfed area with red laterite soil. Yet, villages around Zaheerabad look green because farmers have cultivated the wastelands distributed to them by the state government. Most of these wastelands have been used to grow different varieties of local millets, suited for dryland cultivation. Community efforts in some villages in the Zaheerabad Mandal have resulted in the cultivation of orphan crops like sorghum, pearl millet, finger millet, foxtail millet and local varieties like *proso* and *kodo* millets. Women farmers mainly cultivate these crops in the wastelands of this dryland area. "We have been able to use the wastelands for our food and fodder,'' said Sattamma, a dalit woman farmer.

Helping the farmers in marketing their produce and getting remunerative prices is a coalition of 10 NGOs and farmers—the Andhra Pradesh Food Sovereignty Network (AFSN)—which has set up community-owned grain and seed banks that sell seeds to farmers and distribute grains to the poor.

Source: Sharma, 2007

Conclusion

The chapter has focused on just two of the problem lands and some of the problems being encountered by the poor communities residing there. It has described a few solutions that have potential. Practitioners working in these areas will need to take expert advice and at the same time develop forums for formal and informal researchers to come together so that more creative solutions can be found through participative technology development (PTD) processes (See Chapter 8).

End-notes

1. Except where stated, this section is based largely on Raychaudhuri, 1980.

2. See www.kau.edu/pop and http://cpcri.nic.in/agroecology.htm for information on the package of practices for these crops.

6 Livelihood Strategies for Distress Hotspots

Introduction

The growing incidence of farmers' suicides in certain pockets of the country has drawn attention to the growing distress among farmers in these areas. Most of these areas like Vidharbha in Maharashtra, Anantpur in Andhra Pradesh, Bundelkhand in Uttar Pradesh and several districts of Chhattisgarh are rainfed areas, where farmers have adopted chemical intensive technology to cultivate cash crops.

The suicide deaths have exposed the economic failure and the non-sustainability of chemical intensive farming in these regions. A number of concerned developmental agencies have tried to study the nature of the problem in these distress spots and have come up with suitable solutions based on their analyses of the causes. In this chapter, we look at some of the strategies that seem to have produced positive results. It should be mentioned that although these solutions hold promise, it will need the combined efforts of the government and the civil society, not to mention the private sector, to bring about substantial results. More importantly, the lessons drawn from these experiences are likely to hold the key for making agriculture sustainable in other regions as well.

Distress Hotspots and Farmers' Suicides

In Anantpur District, 758 farmers' suicides have been reported over the past decade. The practice of continuous monocropping of groundnut as a cash crop and the use of toxic agro-chemicals led to increased costs while yields remained stagnant. The dependence on a single crop has increased production and market risks. Farmers frequently suffer severe losses due to failure of the monsoon, erratic rainfall pattern, pest attacks, market price fluctuations, etc. This has led to a high level of indebtedness. Whereas banks are unwilling to provide credit due to history of defaults, moneylenders charge exorbitant rates of interest. Unable to bear the social stigma of indebtedness, many farmers choose to end their agony by committing suicide. Ironically, the very pesticides that forced them to mount large amounts of debt became handy to bring an end to their agony.

The Vidarbha region grows cotton as a cash crop — mostly under un-irrigated conditions. It experienced a spike in suicides in 2006 (recorded 222 suicides) when the state government lowered its minimum support price (MSP) from Rs 2,500/100 kg to 1,750/100 kg and abolished the practice of paying a bonus. In effect, the state government reduced the procurement price at the all-India level in order to reduce the Rs 5,000-crore loss for the procurement agency, Maharashtra Cotton Producer's Marketing Federation.

Down to Earth (April 1, 2009) reported that Chhattisgarh has the highest rate of farmers' suicide per lakh population in the country. As many as 1,573 farmers committed suicide in 2008, according to the data provided by the state police to the National Crime Records Bureau. The distress hotspot covers a contiguous area, covering the districts of Raipur, Mahasamund, Dhamtari, Durg, Bilaspur and Janjgir.

Strategies to Minimize or Eliminate Distress

Although the etiology of the phenomenon is rather complex, it could be stated in general that the adoption of chemical intensive technology to cultivate cash crops under mono-culture in a potentially high-risk rainfed situation led to the creation of distress in these regions.

Both innovative farmers in these regions as well as concerned civil society agencies have tried to find solutions to reduce the distress of the farmers. The answers lie in reducing and reversing the very sources of distress by:

- Diversifying the cropping pattern to reduce production risks,
- Adopting perennial crops that are water efficient and using water efficient irrigation systems,
- Investing in water conservation and harvesting systems that provide life-saving irrigation to crops,
- Reducing the cost of production by adopting non-chemical/organic farming and reduced mechanization,
- Dealing with market risks through better market intelligence and collective marketing of produce,
- Introducing weather insurance schemes to mitigate production risks,
- Improving access to credit by initiating savings and credit SHGs, and
- Making available formal credit to farmers and adopting measures to free them from the clutches of moneylenders

The farmers are facing problems on multiple fronts and it may take considerable effort and an integrated approach to reverse the trends. A few initiatives are described below from which others can draw inspiration.

Innovative Farmers of Vidarbha

In an article in *The Indian Express* in 2009, Deshpande profiled three innovative farmers, who had demonstrated that agriculture in the Vidarbha region could not only be a viable but also a lucrative proposition.

i) Abasaheb Deshmukh of Rautwadi shifted to horticulture in 2000. He had the good fortune of having access to a perennial stream. He used drip irrigation to cultivate grapes in two acres and pomegranate in 1.25 acres of land. Shunning mono-cropping, he grew a variety of field crops like gram, wheat, cotton, soybean and groundnut on his remaining 8 acres of his land. Another farmer Anil Rathod of Bhatamba village chose to cultivate papaya and pomegranate on his 14 acres of land.

ii) Bhagorao Rathod continued to cultivate cotton on his 16-acre farm. However, he shifted to Bt cotton, which does not require the use of chemical pesticides against bollworms. He also adopted drip irrigation. He recorded a yield of 35 q/acre in a region where yields seldom crossed 20 q/acre in irrigated fields. He used the telephone support technique to hold the boll-laden plants aloft with ropes. As a strategy for increasing agricultural production, genetically modified crops are presently not considered safe. However, opinions are divided (Box 6.1).

These farmers are relatively better off and were able to mobilize funds from banks to invest in productive assets like the drip system, the power tiller and the telephone props system. They also had access to irrigation. The replication of these ideas, therefore, would be limited. However, the concepts of, a) diversifying the cropping pattern, b) improving water-use efficiency and c) shifting to crops that do not need chemical inputs can well be emulated by small and marginal farmers.

Box 6.1: Genetically Modified Crops: Boon or Bane?

According to Louise O Fresco, Assistant Director-General FAO, Agriculture Department, “Genetically modified organisms (GMOs) are here to stay. Scientists in both public and private sectors clearly regard genetic modification as a major new set of tools (to increase productivity of crops) while industry sees GMOs as an opportunity for increased profits.” (Fresco, 2003) This position in favour of biotechnology is, however, being strongly challenged by many, including scholars and environmental activists. Bio-safety is a major issue raised against GMOs. Gene transfer, weediness, trait effects, genetic and phenotypic variability, expression of genetic material from pathogens and worker safety are some of the issues that still need to be settled satisfactorily among scientists. Although considerations about bio-safety have led to an international understanding called Cartagena Protocol in January 2000, compliance remains an issue (Iyengar, n.d.).

The legal introduction of GM crops in India began with genetically modified cotton that is resistant to bollworm attack. This was introduced by Mahyco Monsanto Biotech Ltd. (MMB), which has a 50:50 partnership between Mahyco and Monsanto. So far Bt cotton remains the only GM crop that has been allowed for sale in India. Bt or *Bacillus thuringienesis* is a common soil bacterium, which produces a toxin found effective against a wide range of insect pests. Bt is used as a spray and is an important component of biological pest control. In Bt cotton, the gene responsible for producing the toxin is introduced into the genome of the crop plant so that it can produce the toxin within its system, making it resistant to pest attacks. The company claims that Bt cotton will reduce the use of harmful pesticides considerably, cultivation costs will come down drastically, and farmers will profit. Studies show that whereas, on an average, farmers experienced an increase in net profits of about Rs 3,125/acre, the results were not uniform, with some farmers in AP reporting total failure to control pests. Other scientists have predicted that cotton bollworm, the major cotton pest, will develop resistance to the toxin within 6-10 generations. Strategies of dual gene system (where if one toxin fails the other would act) will prove rather expensive (Iyengar and Lalitha, 2004). According to Dr Pushpa Bhargava, the Supreme Court-appointed special invitee to the 30-member Genetic Engineering Approval Committee (GEAC), there is scientific evidence to prove that GM crops have harmful effects. In India, after the introduction of Bt cotton, cases of allergy were reported. In Warangal, several cows died after eating Bt cotton plants. Many countries have said no to GM crops (Raveendran, 2009).

The debate gets more intense when GM food crops become the issue. As of 2009, 169 varieties of 41 GM food crops are in various stages of trial (Mishra and Avasthi, 2009). In April 2009, when GEAC was on the verge of clearing Bt brinjal, the first GM food crop in India, it met with resistance from several quarters. Orissa and Kerala are two states that have opposed its introduction, with Orissa proposing to ban the technology in its state. On the other hand, a few countries have already gone ahead with GM food crops and found the experience positive. Philippines, for example was quick to adopt the technology to boost its economy. Bt corn has been under cultivation for about five years now. The yield has increased three-folds, bringing prosperity to small farmers. Besides Bt corn, the country has cleared Bt cotton, maize, potato, soybean, argentine canola and sugar beet. According to Saturnina Halosa, Chairperson, Biotechnology Advisory Team of the Department of Agriculture, the human body does not have receptor cells for the Bt toxin and, hence, it is safe to consume GM food. After corn, Philippines plans to introduce a biotech rice variety called golden rice (Deshpande, 2009).

Many believe that in developing countries, like India, the risk is multiplied by the fact that we lack the testing and regulatory mechanisms to implement the technology with all the necessary precautions needed to minimize the risk. However, with the Green Revolution running out of steam and the country facing a major crisis in food security, it may be forced to make difficult choices and emulate the example of countries like the Philippines.

Reviving the 'Pata System' in Vidarbha

Yavatmal District of Maharashtra—a part of the distress hotspot region of Vidarbha—had a traditional practice of allowing the women of the house to cultivate vegetables in a small portion of the farm called *pata*. The *pata* was like an oasis in the middle of large cotton and soybean farms. It provided the food basket of the family because it included a large diversity of vegetables, fruits, spices and pulse crops that supplied food for almost 8 months of the year. Traditionally, *pata* signifies a woman's space for agriculture (Pallavi, 2009).

The practice, however, was discontinued following the Green Revolution and the commercialization of agriculture. Most farmers with an average landholding of two acres did not want to divert plots for *pata* and lose income. A survey by the NGO, Dilasa, showed that, in 2005, only 15 families in the district were practicing *pata* cultivation. Dilasa helped 750 women farmers in 31 villages to restore the *pata* system by negotiating for about three per cent of the land with the farmers. In kharif 2008, the women planted 11 varieties of crops on their *patas*, the seeds of which had been pooled and multiplied the previous year. The revival of *pata* system had a positive effect on the health of the family as well as the farm. The families could eat vegetables between July and November without having to spend money. The women were able to revive traditional delicacies like *til ka laddu* made from sesame seeds and *jowar lahya* (puffed crispy sorghum seeds). The *patas* helped women to save Rs 3000-5000 per annum while providing for a variety of nutritious food. The loss in cash crop, if any, on account of the diversion of land was compensated by a reduction in pests, on account of the increased bio-diversity on the farm. Some women had planted marigolds on their *pata* which acts as a pest trap. Marigold plants also yield flowers, fodder and compost. Following the initial success, Dilasa has scaled up the initiative in 180 villages, covering 8,000 patas in kharif 2009 (Pallavi, 2009)

NPM Movement in Andhra Pradesh

M S Chari, Senior Advisor to the Center for World Solidarity,[1] coined the term Non Pesticide Management (NPM) in 1998. NPM does away with synthetic pesticides in agriculture and replaces these with various homemade concoctions from herbal and organic material. It also uses biological pest control methods, including the use of pheromone traps to assess the pest population. Farmers save up to Rs 5000/acre without any significant drop in crop yields (*Down to Earth*, January, 2009).

The Society for Elimination of Poverty (SERP) was created by the state rural development department to implement anti-poverty programmes in AP. In 2005, SERP was entrusted with implementation of a state-wide programme called Indira Kranthi Patham, in which women's SHGs were provided credit. NPM was included in this scheme. In this way, 3,40,000 farmers in over 3,000 villages in 18 districts across the state took up NPM (*ibid.*).

SERP believes it has triggered a movement for NPM in the state. Starting with 400 acres in 2005, the outreach has increased dramatically to cover 14,00,000 acres. One of the outcomes of adopting NPM has been a reduction in medical bills. Most farmers used to suffer from acute effects of pesticide contamination while spraying pesticides (giddiness, skin problems, breathlessness, burning in the eyes, etc.) Some even needed hospitalization. All these are things of the past now (*ibid.*).

Shifting to Organic Farming: Encouraging Experiences

While NPM shuns chemical pesticides, organic farming does away with the use of all synthetic chemicals, including fertilizers. It relies on the use of green manure, compost and crop rotation, inter-cropping, etc., to enhance soil fertility. It allows friendly weeds and insects to grow and restores the pest-predator balance nature.

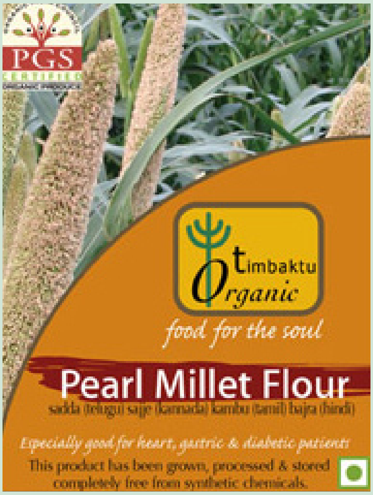
Source: serp.ap.gov.in

Enabavi Village in Warangal District of AP stopped using pesticides 10 years ago and adopted organic farming about 5 years later. It has now become a reference point for organic farming and is famous as a chemical-free village. The Center for Rural Operation Programmes Society (CROPS) is a low-profile NGO that has been supporting and guiding the transformation at Enabavi (*ibid.*).

Another village, Ramachendrapuran, shifted to organic farming in 2005. The villagers claimed that, within two years of the switch, many of them were in a position to free their mortgaged land! The village was nominated by SERP for the Citi Bank's Change Maker's Award (given by Ashoka Foundation) after it became completely debt free.

In Anantapur, another interesting initiative to promote organic farming through a community-based organization called Adikthi Mutually-aided Thrift Cooperative Society is underway. Under the guidance of Timbaktu Collective, a voluntary organization, 3200 rural women initiated a collaborative venture in 2005. The objective was to enhance the income and food security of the member households through eco-friendly organic farming methods, which build on the traditional knowledge of farmers and utilize locally available resources like biomass, livestock and labour. The cooperative has adopted the Participatory Guarantee System (PGS) for Organic Certification, which is being promoted by the Organic Farming Association of India, Goa, and the Food and Agriculture Organisation (FAO), New Delhi (Box 6.2).

Box 6.2: Participatory Guarantee System for Organic Certification



Source: organic.timbaktu.org

According to the International Federation of Organic Agriculture Movements (IFOAM), Participatory Guarantee Systems (PGS) may be defined as locally focused, quality assurance systems. It certifies producers, based on the active participation of stakeholders, and is built on a foundation of trust, social network and knowledge exchange. The PGS is an internationally applicable organic quality assurance system (like ISO 9000), implemented and controlled by committed organic farmer-producers, through active participation, as well as consumers, in a process based on verifiable trust. It is not an 'inspection raj' certification system but, rather, one that is based on personal integrity and peer pressure. Integrity is honesty when no one is looking over your shoulder to see what you are doing. The farmer pledges that the production process is free from manufactured chemicals (fertilizers, insecticides, herbicides, hormones, etc.) and lives by his word of honour. A 'Local Group' of five or more organic farmers is the fulcrum of the self-regulatory support system of PGS.

The PGS Organic India Council was set up after a consultation process in 2006. It functions as an informal coalition of voluntary organizations or NGOs committed to the promotion of organic food production for domestic consumption in India. Export is presently not a priority with the Council. It harmonizes quality assurance standards and permits the use of its PGS label as a mark of quality. The Council's website provides step-by-step information for participation in the PGS certification programme.

Source: http://www.pgsorganic.in/

To minimize market risks and realize better prices, the cooperative has established a storage and processing unit with a capacity of 60 tonnes. The unit processes oilseeds into oil, millets into *rava* and flour, and pulses into split form. For more details, see the case study in Part 3 of this volume.

In the orchard areas of the hills of Himachal Pradesh too, farmers are realizing the benefits of shifting to organic farming. The Himachal Organic Farmers Forum (HOFF) has 7,000 members, who have adopted organic farming in 1,000 ha of orchards (Box 6.3).

Box 6.3: Organic Apples and Apricots: Now Made in India

Source: gournet.com

Himachal Organic Farmers' Forum (HOFF) was established in mid-2008 with the help of the state agriculture university and the Agricultural Department, which have been actively promoting organic agriculture. The Forum has 7,000 farmers, who together own 1,000 ha of orchards that cultivated apples, almonds, plums, apricots, lichees and vegetables with the use of chemical pesticides or fertilizers. By 2008, 56 farmers had obtained organic certification whereas 2,200 more were expected to procure the same soon. By shifting to organic farming, they have been able to save about 80 per cent of the cost of cultivation. Yields have also gone up. For example, 100 apples grown by using chemical inputs weigh 20 kg whereas, the same number of apples grown through organic farming weigh 24 kg. The fruits have more flesh and taste better. They also remain fresh for a longer period. Not surprisingly, farmers are getting better prices and are making profits. Soil fertility too has improved in the orchards of the members across the state. HOFF is planning to sell its produce to other states under its own brand name. It has not yet thought of exporting because the domestic market itself is quite large.

Source: As told by Gopal Mehta, President, HOFF, to Down to Earth, January 1–15, 2009

Natural Farming: The Path Shown by Krishi Sant

A term that is often erroneously used interchangeably with organic farming is natural farming. Natural farming takes the farmer even closer to nature than organic farming. The differences, though subtle, are worth taking note of (Box 6.4). Whereas organic farming is gaining momentum, there are few takers for natural farming.

Natural farming was pioneered by Masanobu Fukuoka of Japan, who explained his revolutionary methods and philosophy in the epoch-making book *'One Straw Revolution'* (1976). In the meantime, Bhaskar Save, a contemporary of Fukuoka was quietly developing his own methods of *Sajiv Kheti* (living agriculture, also interpreted as non-violent agriculture) on his farm in south Gujarat, with similar results. Though lesser known, *Sajiv Kheti* has greater relevance for Indian farmers because it has been developed in our own context.

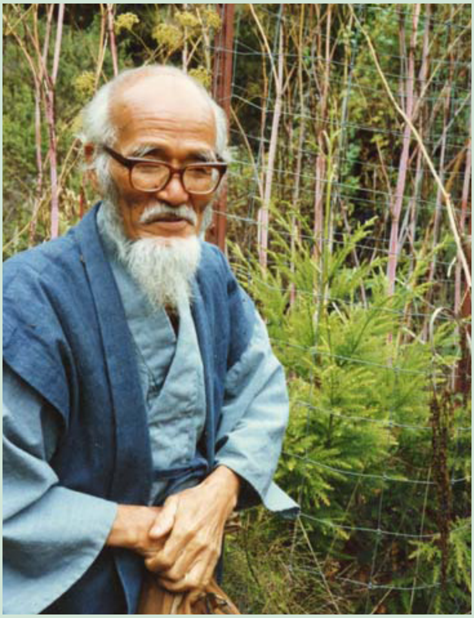
Box 6.4: Organic vs. Natural Farming

Organic farming relies on the use of organic fertilizers instead of chemical fertilizers and non-chemical pest control methods in place of pesticides. Natural farming does away with the ploughing and weeding operations. It even does away with the use of composts and relies instead on recycling all the biomass into the field, in order to complete the nutrient cycle. The striking similarity between the methods devised by Fukuoka and Save is seen in the summary below:

Technology Element	Natural farming — Masanobu Fukuoka	Sajeev Kheti — Bhaskar Save
Ploughing	No ploughing	No ploughing
Fertilizers	No chemical fertilizers or organic compost	No chemical fertilizers; recycle farm waste to complete nutrient cycle
Weeding	No weeding by tillage or herbicides	Weeds may be suppressed but should never be removed
Pest control	No dependence on chemicals	No chemicals, facilitate biological control
Irrigation	Frugal use of water	Frugal use of water – only moist soil needed

Source: Fukuoka, 1976; Pastakia, 1998

Source: onestrawrevolution.net



The difficulty with natural farming/*Sajiv Kheti* is that it that it is hard to practice. In his own village, few farmers follow Save, euphemistically referred to as *Krishi Sant* by farmers of the region (Box 6.5). The reasons are not far to find. Although termed as the 'do-nothing' method of farming, natural farming is highly knowledge intensive and calls for a close understanding of the natural processes as well as the agro-ecology of the farm. It also calls for lifestyle changes and commitment to nature and future generations. Such thinking is difficult to internalize in the present-day culture of hankering after short-term gains.

Box 6.5: Krishi Sant: Saint Without Followers

As early as 1957, Bhaskar Save realized the long-term implications of chemical farming and started experimenting with non-chemical methods. Over the next 30 years, he developed and perfected *Sajiv Kheti* (living agriculture), the art and philosophy of an indigenous method of natural farming.

In 1984, Ashok Sanghvi, an industrialist from Mumbai, requested Save to help reclaim his wasteland, located in the same village. So impressed was he at the techniques used by Save that he took upon himself the task of popularizing *Sajiv Kheti*. Save was happy to take advantage of the support extended by his new partner.

According to Sanghvi, by 1994, they had received over 10,000 letters of inquiry from India and abroad. Save and Sanghvi decided to make every Saturday a field day for visitors. They also started accepting invitations to give talks at various farmers' meetings and public forums. Save argues his case both from a normative as well as pragmatic view point: "It becomes our moral duty to leave behind soils in a living condition for future generations to use." Such a *Sajiv Kheti* can be practiced only with kindness and not with cruelty or non-violence." He is quick to point out the cost- and drudgery saving aspects of natural farming. He also argues convincingly about the favourable, long-term economics of his techniques.

In recognition of his achievements, Save has received various national and international awards, the most recent being " One World Lifetime Achievement Award" (2010) from IFOAM, Germany. The farmers of Maharashtra informally conferred on him the title of '*Krishi Sant*' (agricultural saint). Strangely, the only followers of his technology and philosophy are a handful of absentee landlords of Mumbai. In his own village, most farmers continue to follow chemical-intensive methods. This may imply that although Save has become a reference point for non-violent and clean farming practices, most farmers still feel it will be too difficult to emulate him.

Source: Pastakia, 1998 and http://www.savesanghavi.com/awards.html (accessed Nov, 2010)

Conclusion

The above strategies show that non-chemical and organic farming strategies have provided instant success in these distress hotspots. Chemical farming and mono-cropping were the major sources of stress on the otherwise fragile eco-systems. Removing these stresses and restoring the nutrient cycle, the water cycle and pest-predator relations have worked wonders in rejuvenating the land and its agriculture.

Organic farming is likely to gain greater importance as a livelihood strategy in the years to come.

i) In rainfed areas, large tracts of farmlands are organic by default. The farmers there are too poor to afford chemical inputs and the markets are not developed. In these areas, organizing the farmer for the collective marketing of organic produce could become a viable option to minimize market risks and improve price realization. So far, the cost of organic certification was a major constraint. However, with the popularization of the PGS, this may become a viable option.

ii) In irrigated areas where chemical intensive farming is still practiced, and where productivity has stagnated and the factor productivity of chemical inputs is progressively going down, it is only a matter of time before farmers realize that they need to get off the chemical treadmill[2] before it is too late.

AME Foundation is one of the various institutions that promote eco-friendly sustainable farming in the country. The foundation works with small and marginal farmers in the Deccan plateau region by generating farming alternatives, anchoring knowledge base, training, linking developmental agencies and sharing experiences. The AME Foundation publishes *Low External Input Sustainable Agriculture* (LEISA) India, a quarterly, in collaboration with ILEIA (Center for Information on Low External Input and Sustainable Agriculture).

End-notes

1. Center for World Solidarity is an NGO that helped solve the problem of the red hairy caterpillar in the red gram crop in the Telengana region.

2. Refers to the 'addictive' effect of chemical inputs, especially pesticides, whereby farmers end up spending more and more on these inputs to attain the same or diminished levels of pest control. This happens because of a variety of reasons, including the development of resistance among pests, the elimination of natural predators and the stimulation of egg laying by certain pesticides, leading to a resurgence of pests and a decline in the factor productivity of pesticides.

7 Livestock-based Livelihood Strategies

Introduction

India leads the world in milk production with a production of 92 million tonnes/year, valued at Rs 1,10,085 crores (2003). This is largely attributed to the successful dairy cooperative movement launched by NDDB on the Amul cooperative pattern across the country. In addition, India produces 54,424 crores worth of meat. Livestock provides year-long employment to 16 million people, of which 70 per cent are women (Hegde, 2006).

Different species of livestock are acclimatized to different agro-climatic conditions. The broad pattern of suitability of different types of livestock to different climatic conditions is indicated in Table 7.1.

Table 7.1: Agro Climatic Preferences of Different Livestock Types

Livestock type	Arid	Semi-arid	Sub-humid
Traditional cattle breeds			
Cross-bred cattle			
Sheep			
Goat		(Close to forests)	
Buffalo			
Camel			
Poultry			
Pig			

India ranks first in cattle and buffalo population, second in goat, third in sheep and seventh in poultry. The population, as on 2003, and growth rates of different species are shown in Table 7.1 (Hegde, 2006).

Table 7.2: Livestock Population and Growth

No.	Species	Livestock Census (Million)		Growth Rate (%)
		1997	2003	
1	Cattle	198.9	185.2	-6.89
2	Buffalo	89.9	97.9	8.91
3	Sheep	57.5	61.5	6.96
4	Goat	122.7	124.4	1.38
5	Other animals	16.34	16.05	-1.77

Source: Hegde, 2006

The data shows:

i) There has been a significant increase in the population of sheep and a marginal increase in the population of goats. This is attributed to the decrease in the size of the landholdings and the recurrent droughts, forcing many small farmers to shift from larger animals to small ruminants.

ii) The buffalo population has increased by 8.91 per cent with a corresponding decrease of 6.89 per cent in cattle.

In terms of productivity, however, India is far behind countries like Israel, Japan and the European countries. A large population of draft animals and nondescript cows, which are hardly milked due to low yields, account for 80-85 per cent of the cattle population (Hegde, 2006). However, they compete for fodder and feed, resulting in huge shortage of these resources. The situation of fodder and water scarcity is most acute in the arid regions, leading to malnourished cattle with low productivity.

In this chapter, we discuss the strategies adopted for augmenting this most important livelihood, in both semi-arid and arid regions. Strategies for strengthening goat husbandry in arid regions find special mention, owing to the high dependence of the poor on this animal for survival. In addition, poultry offers an attractive livelihood option to smallholder farms in certain areas, including the tribal belts. Though pig rearing assumes equal importance in the far-eastern states of India, it remains beyond the purview of this handbook.

Livestock-based Livelihoods in Semi-arid Regions

The situation of fodder and water scarcity is not as acute here as it is in the arid regions. Development agencies like NDDB and BAIF have been able to, therefore, pursue integrated strategies that take care of breed improvement while providing backward linkages to the farm for quality inputs, fodder and feed supply, and veterinary services on the one hand and forward linkages through cooperative dairy federations that ensure remunerative prices to the producers on the other. Such an integrated strategy, which involves the development of the entire value chain for milk and milk products, has led to what is popularly known as the White Revolution, propelling India to the number one position, in the production of milk. NDDB's success story is well documented and is, therefore, not discussed further here.[1]

In 1979, the Gandhian leader, Manibhai Desai, established BAIF in Urlikanchan, Pune. The agency developed a successful strategy to upgrade nondescript cattle through artificial insemination into crossbred cattle. These crossbred cattle, which inherited the qualities of high-yielding breeds like Holstein Friesian and Jersey, could produce 6.75 litres of milk per day as compared to 1.98 l/day for traditional Indian breeds and 4.5 l/day for buffaloes. The programme is currently being implemented in 10 states through 1,400 Cattle Development Centres. By 2003, there were 12.62 m crossbred cattle, out of a potential breedable population of 113.61 m.

BAIF's experience in strengthening livestock-based livelihoods among the marginalized and women producers through crossbreeding of nondescript cattle is presented in Part 3 as a best practice.

Livestock-based Livelihoods in Arid Regions

Animal husbandry is an integral part of a typical dryland farmer's economic portfolio. Livestock provides the much-needed nutrition to supplement coarse grains like millets cultivated in harsh arid environments. Most importantly, livestock serves as the safety net for farmers during scarcity years. For instance, in Kutch District of Gujarat, where droughts are very frequent, the livestock sustains the local population. The same is true for the Thar Desert region of Rajasthan and the arid regions of north Gujarat and Saurashtra.

In Rajasthan, in a normal year, about 20 per cent of a household's income is derived from animal husbandry. Most households follow a mixed farming system, in which livestock provides year-long employment, off-setting the seasonal returns of agriculture. Small ruminants act as a fixed deposit for poor households in emergencies. Their sale offers instant income as well as insurance during drought. About 80 per cent of the farmers in the state keep animals, contributing to around a third of the state's net domestic production.

Arid regions have developed a large variety of breeds of cattle, goat and sheep that are productive under extreme conditions. India is home to the most widely known local cattle breeds, including the Sahiwal, Red Sindhi, Gir, Tharparkar, Hariana, Rathi and Kankrej. A similar diversity of breeds is found in sheep and goat as well. The local traditional institutions managed common property pasturelands that supported this large animal population. Traditional institutions were also evolved to create and manage traditional water harvesting structures that provided drinking water to both humans and animals.

These livestock-based livelihood systems are, however, under immense pressure due to various anthropological, social and economic factors calling for new approaches to strengthen this very critical component of the rural economy in arid regions.

Factors affecting livestock in arid regions

Scarcity of drinking water

Scarcity of drinking water in arid zones is a critical limiting factor for animal husbandry. For instance, Rajasthan has only 1.16 per cent of the country's surface water and 1.70 per cent of its groundwater resource (Tiwari, Shah and Vyvs, 2008). The scarcity of water becomes acute during the pre-monsoon months, leading to mass seasonal or temporal migration of livestock. With the reduction of surface water available in recent years, intensive extraction of groundwater is also observed.

Scarcity of fodder

Common lands, forests, pasture lands and wastelands have experienced intense pressure, leading to over-exploitation and degradation. Limited access to common lands has affected the poor the most because the small ruminants owned by them cannot be sustained by stall-feeding. The productivity of the available common lands is very poor and the fodder is of low nutritive value. At present, Rajasthan suffers from an annual deficit of 11.9 million tonnes of forage (ibid.).

Erosion of traditional knowledge, degeneration of local breeds

Inappropriate policy interventions that are out of tune with local wisdom and knowledge systems have gradually led to the erosion of traditional knowledge and institutions. Local breeds have been replaced by exotic breeds and species, as well as knowledge and technology that are ill-suited to local conditions.

In summary, reduced grazing area and fodder availability, diminished water supply and increasing animal population in arid areas have rendered the livestock population under-nourished, leading to a sharp decline in their economic productivity. This has endangered the livelihoods of millions of poor in these areas.

Strategies for revival

Revival of traditional breeds

In recent years, developing local breeds is seen as a better alternative for sustainable livelihoods of the poor, particularly those living in remote, harsh and fragile eco-systems. Although perhaps not comparable in productivity with exotic breeds, these are more productive in extreme conditions characterized by low inputs and greater resistance to diseases.

Tharparkar, or White Sindhi, is a breed found in western Rajasthan and is well adapted to the extreme climate of Thar Desert and can survive on dry fodder while maintaining good milk production (2,000 l/lactation). Within the past few decades, this breed has experienced degeneration and the purity of the breed has gone down due to its mixing with other breeds often of weaker lineage. The Society to Uplift Rural Economy (SURE) has been working since 1990 to conserve the breed. SURE works in 15 villages of Barmer district, through village-level Livestock Development Committees. The members have been educated in the techniques of breed development, provision of fodder, treatment of diseases, cattle vaccination, livestock insurance and marketing of produce. A bull development unit has been established in Bijrad Village to facilitate distribution of food for Tharparkar bulls. The efforts of almost a decade have witnessed a revival of the breed, with production of 4,000 calves in 15 villages. Two generations of the breed have already demonstrated some of the original characteristics of the breed. With the third generation, SURE is certain that a substantial proportion of Tharparkar characteristics will be restored (see case study in Part 3 of this volume).

A notable feature of the intervention is the ability of the developmental agency to revive traditional institutions for managing common property resources like pasture lands and common bulls. Livestock Development Committees have been established in each partner village, which include both men and women. These committees take charge of organizing and executing all the activities under the programme.

Restoring fodder security

Among the various organizations working on the issue of fodder security, Seva Mandir, Udaipur, has concentrated on restoring common pasturelands through community action. A major obstacle has been the severe encroachment of such lands. An internal study reported that 100 per cent revenue land, 56 per cent panchayat land and 24 per cent forestland in Udaipur District had been encroached upon.

Seva Mandir works through village institutions called Gram Vikas Committees

(GVCs). One of the key functions of these institutions is to negotiate with families, who have encroached on common lands. Encroachers who agree to vacate the land, are compensated by the community in some form or the other. This has facilitated community ownership of the assets created and the better management of these in subsequent years. Seva Mandir's land development work encompassed 23,000 ha of private and common land, of which 13,094 ha was degraded pastureland. Cattle and other livestock of poor communities have benefited from improved supplies of fodder and water as a direct outcome of these activities.

Restoring drinking water security

Agencies like JBF, have been working tirelessly to restore drinking water security in 400 villages of Thar Desert. Its strategy has been to revive traditional water harvesting structures like *nadis, talabs* and *tankas* through self-help rather than relying on government provided pipelines, which often fail to provide the promised water. A three-tier system of people's institutions has been established to look after water governance. Typically, both humans and cattle draw water for drinking and domestic purposes from the same *nadis* and *talabs*. JBF is trying to bring about changes in the perception of water quality through education and awareness campaigns. Meanwhile, the increased availability of drinking water for cattle and human beings means that less people have to migrate out for fewer months in the year (Tiwari, Shah and Vyas, 2008).

Integrated strategies

Although different agencies are working on the issues of drinking water, fodder security, conservation of traditional breeds and restoration of traditional institutions to manage water and fodder, etc., few have been able to address all these issues in a holistic and integrated manner. This is because the constraints on each front are formidable and require concerted and sustained efforts over time to see significant results. In spite of all these challenges, the need for an integrated approach cannot be over-emphasized.

The efforts made by Gram Vikas Vigyan Samiti (GRAVIS) in this direction are worth noting. GRAVIS is a grassroots developmental agency working in five desert districts of western Rajasthan. It has stimulated the re-emergence of traditional water-harvesting practices in the Thar Desert thereby improving both water and fodder availability for the livestock. By 2007, about 6,791 water-harvesting structures covering 50,000 households had been created. With water as the starting point, GRAVIS moved on to other aspects of livestock management. The para-vets were trained to provide basic medical care, a service largely lacking due to the remoteness of habitation. Planting grass and saplings of fodder tree species helped to regenerate *gochars* (community pasture lands). Institutional mechanisms to govern these pasturelands as common property assets were created. Construction of 3,136 *khadins* increased fodder production substantially to reach 13,325 families (Triwari, Shah and Vyas, 2008).

Goat Husbandry

The population of goats has shown a rising trend globally. The rate of increase has been more in the developing countries (56 per cent) than in the developed countries (33 per cent) during 1975–95. The only other livestock species to register such growth in developing countries is the pig, which also grew at 56 per cent (Schilliorn, 1999). This indicates the emerging importance of goat production globally. The statistics also indicate the concentration of goats in marginal areas like mountainous regions, drylands and deserts of developing countries.

The goat, popularly known as the poor man's cow, is widely distributed and clearly associated with the poor people in India. The economic contribution of the goat is extremely important for the security and livelihood of the poor. In spite of this, the formal research and extension system has not been actively forthcoming to support goat husbandry in livelihood programmes. This may partly be explained by the mistaken perception of the animal as a threat to ecology.

A study by Sanjay Kumar and Chander, (2004), concluded that there is no scientific evidence to show that goats represent a threat to ecology. To settle the matter once and for all, the GoI constituted a task force under the chairmanship of Prof K H Rao, a leading economist of India. The task force concluded that there was no definite evidence to prove that goats posed an ecological threat. The task force further recommended that sheep and goat should not be categorized as animals responsible for the destruction of ecology. In spite of this, the prejudice among forest officials, administrative officers, financial institutions and even veterinary officers continues and serves as a major obstacle in developing this livelihood option, which is the preferred option of the poor.

PRADAN and BAIF are among the few NGOs in India that have worked to develop goat clusters in a professional way, using scientific inputs. In Dholpur, Rajasthan, PRADAN took advantage of the DPIP programme that it was implementing in the area, to facilitate the emergence of 69 goat-rearing Common Interest Groups (CIGs). The main beneficiaries were the poor women who had already organized themselves into SHGs for savings and credit activity. The intervention focused on mitigating the production and market risks of primary producers by organizing the CIGs into a three-tier structure and creating forward and backward linkages. For details of this best practice, see Part 3 of this volume.

Poultry

Poultry is a traditional occupation of the poor in rainfed areas. Rearing of poultry birds till a couple of decades ago was a backyard activity, with families typically rearing 5–10 birds. Scientific advances in genetics presented an opportunity to breed different types of poultry for specific commercial exploitation.

The poultry sector employs about three million people, of which about 80 per cent are producers. The remaining are involved in feed, pharmaceutical and other services. With India's economy rapidly expanding, growth in the broiler sub-sector is marked by a rising demand for animal protein. Poultry industry has been growing at the rate of 12 per cent annually over the last decade. The production of poultry meat in 2005 was about 2.0 million tonnes. By 2015 broiler produciton is expected to reach 2.5 million tonnes (Anish Kumar, 2007).

Chicken is the first-choice meat for the non-vegetarian population because of its wide culinary adaptability to various Indian cuisines. Chicken is also preferred over goat and lamb on health grounds because it is white meat whereas the latter is red meat, considered harmful to health. The opportunity to achieve a double-digit annual growth rate in poultry industry has essentially been cornered by the large growers, and the lot of the small farms has been worsening; their share in the total marketed production has dwindled from 55 per cent in 1970 to less than 10 per cent today (Case study, Volume II). This process of concentration of production in the hands of big producers has also been aided by the failure of small growers to negotiate with the organized poultry industry, which is increasingly becoming market-oriented and vertically integrated.

PRADAN has been involved in promoting a home-based broiler poultry model through women's poultry cooperatives in several states over the past 15 years. The initiative, which started on a pilot scale at Kesla in Madhya Pradesh in 1992, has now been replicated in several blocks of Madhya Pradesh, Jharkhand, Chhattisgarh and Orissa. The Kesla model has demonstrated that it is possible for the small farmers to participate in this growing industry. The cooperatives have been able to match the efficiency of big farmers and organized integrators. By April 2008, PRADAN was working with 5,306 women broiler-farmers, organized into 15 cooperatives and one producers' company, with a collective turnover of about Rs 400 million. This is the largest conglomeration of small-holder poultry farmers in India.

The cooperative poultry value chain helps insulate the families from the price fluctuations and supply uncertainties of the market while strengthening the production system through improved market access, better capital management, high quality production services and technical handholding. The small-holder women participating in the value chain were not affected adversely by recurrent bird-flu scares that affected the market for broilers and crippled many small producers.

The cooperatives are further federated into two state-level secondary organizations, namely, Jharkhand Women's Poultry Federation and Madhya Pradesh Women's Poultry Producers Company. The federations pass on the benefits of vertical integration, professional and technical support, economies of scale and increased bargaining power with external suppliers and regulators while providing a platform for knowledge and process-sharing between its member cooperatives. It helps the member co-operatives in a) reducing input cost for feed (a major component of total expenses) and b) ensuring supply consistency through the collective purchase or creation of in-house production facilities. This helps leverage the strengths of both the centralized and the decentralized structures. For more details, the reader may refer to the case study provided in Volume II of the handbook.

Conclusion

In spite of the growing pressures on livestock on account of degraded pasture lands and depleting forests, livestock continues to play a critical role in rainfed farming systems. It forms the critical link in maintaining the nutrient cycle and soil health. It also provides year-round employment, particularly to the poor and the women. It helps improve the resilience of the poor communities by providing them an alternative source of food security. This traditional source of livelihood of the poor cannot be ignored. Creative solutions are needed to revive traditional breeds and upgrade them, improve fodder security and develop innovative delivery systems that can help maintain the livestock of small producers with the latest available technology. Collective action can also help in dealing with markets and obtaining better prices. The chapter has focused on the nature of crises in different livestock sectors and has tried to highlight some of the innovative solutions tried by the developmental agencies.

End-notes

1. However, Volume II includes a case study of a dairy value-chain in Andhra Pradesh, which was initially established by NDDB but had fallen sick and was subsequently revived by BASIX. See also Box- 6.1 in volume II which focuses on the achievements of Dr. Vergese Kurien acknowledged widely as the father of white revolution in India.

8 Strategies Promoting Farmers' Innovative Spirit

Farmers have been known to come out with their own solutions to the solve local problems that they encounter. These solutions are often quite innovative and are based on their practical knowledge. They draw upon their own creativity and knowledge systems. However, often, the farmers in one area are unaware of the innovative solutions being used in the other areas and vice-versa. If there were a forum for the horizontal exchange of ideas and innovations, farmers across a wide spectrum would benefit.

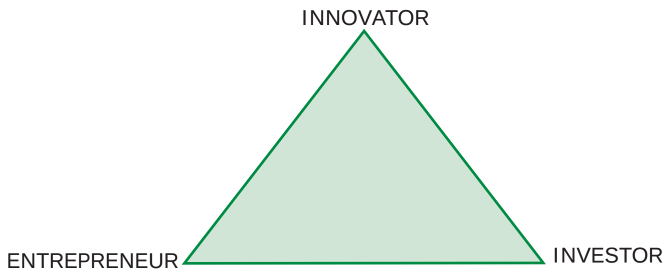
Linking innovative farmers is, therefore, a step that helps in fostering creativity at the grassroots and giving grassroots innovators a voice. Further, linking formal and informal science helps to create a dialogue between the two knowledge systems, which eventually produces new solutions to old problems, drawing from the synergy of the two systems. In this chapter, we take a look at this unique approach to inclusive sustainable development.

The Honey Bee Network: Documenting and Recognizing Farmers' Innovations

The Honey Bee Network, initiated by Prof Anil Gupta of the Indian Institute of Management, Ahmedabad, in 1989, is one such forum. The quarterly journal of the same name, published since 1990, has documented thousands of small innovations of farmers, pastoralists and other villagers in India. The network organizes an annual function to recognize and showcase the work of the outstanding innovators. Their innovations include new combinations of herbal pesticides and fertilizers, breeding and selection of new crop varieties, new mechanical devices for cultivation, and harvesting and post-harvest operations—all geared to improve resource productivity while minimizing damage to the natural environment.

Since 1990, the activities of the network are being anchored by SRISTI, a non-profit organization initiated by Prof Gupta. The main focus is on documentation, dissemination and value addition of technological and institutional innovations developed by the people without the help of outsiders. The network serves the purpose of giving voice and recognition to grassroots innovators and practitioners of traditional knowledge. It is also concerned about protecting the intellectual property rights of the local innovators. An important objective is to forge durable linkages between innovators, investors and entrepreneurs, who form the 'golden triangle of creativity' (Figure 8.1). The network also tries to restore pride in the local knowledge systems through appropriate interventions in the educational system at the primary level. Organizing biodiversity competitions among school children is one such initiative.

Figure 8.1: The Golden Triangle of Creativity



The Honey Bee Network, first initiated in Gujarat, has a unique philosophy of sharing knowledge for sustainable, inclusive development (Box 8.1). It soon captured the imagination of other researchers and activists in the country, giving rise to a number of regional networks with regional versions of the journal. (Table 8.1)

Box 8.1: The Honey Bee Philosophy

The Honey Bee Network is designed around the principle of sharing of information and knowledge to benefit the collective. The network derives its philosophy from the metaphor of the honey bee. Just as the honey bee while taking nectar or pollen away from the flower does not destroy its qualities, in the same way, when the researchers or external knowledge seekers take people's knowledge, they should not give people a cause to complain. On the contrary, the knowledge providers should get back a fair share in whatever value is added to their knowledge. By facilitating cross-cultural and multi-lingual exchange of ideas, the Honey Bee Network offers artisans, farmers and marginalized groups an opportunity to interact with formal institutions, and also add value to their creativity and knowledge.

The original English Journal has traveled to more than 75 countries, spreading its message all over the world. Over the years, the movement has grown, spawning several new initiatives and institutions to strengthen the cause.

Table 8.1: Regional Versions of Honey Bee Journal

Name of Regional Newsletter	Language	Coordinator	Headquarters
Num Vali Velanmai	Tamil	Mr P Vivekanandan	Madurai, Tamil Nadu
Hittalagida	Kannada	Dr T N Prakash	Bangalore, Karnataka
Loksarvani	Gujarati	SRISTI	Ahmedabad, Gujarat
Sujh-bhujh Aas Paas Ki	Hindi	SRISTI	Ahmedabad, Gujarat
Aama Akha Pakha	Oriya	Dr Balaram Sahu	Bhubaneswar, Orissa
Ini Karshakan Samsarikkatte	Malayalam	Fr Hubby Mathew & T J James	Peermade, Idduki, Kerala
Palle Srujana	Telegu	Brig Pogula Ganesham VSM (retd)	Secunderabad, Andhra Pradesh

National Innovation Foundation: Scaling up the Honey Bee Model

During its first decade, the Honey Bee Network had identified more than 10,000 innovations and traditional knowledge practices. However, it was not able to make much progress in the validation and value addition of this knowledge and innovative practices. A need arose for a national-level institution with legitimacy of the formal research system. This led to the formation in March 2000 of the National Innovation Foundation (NIF) by the Department of Science and Technology, GoI under the chairpersonship of Dr R A Mashelkar, Director-General, Council of Scientific and Industrial Research (CSIR). The NIF, with its headquarters in Ahmedabad, has been busy scaling up the Honey Bee experience by organizing biennial national-level competitions for recognizing and rewarding Green Grassroots Unaided Technological Innovations and Traditional Knowledge. By the end of the third round, NIF received more than 21,000 such innovations and examples of traditional knowledge from all over the country. It is in the process of setting up a national register, which will serve the purpose of recording intellectual contribution of grassroots innovators in the absence of a suitable patent system for the same.

The Fifth Biennial Competition, for the period January 1, 2005, to December 31, 2006, saw more than 37,000 practices/innovations and ideas from 31 states and union territories of the country. The award function was held at the IARI, New Delhi, on November 18, 2009. The Honorable President, Smt Pratibha Devisingh Patil gave away 72 awards for technologies related to agricultural, general machines, transport and energy. The entries of the Sixth Biennial Competition for the period January 1, 2007 to December 31, 2008 are being processed and the Seventh

National Competition is in progress and it will cover the period from January 1, 2009 to December 31, 2010. Boxes 8.2, 8.3 and 8.4 provide glimpses of a few national award winners—their innovations, motivation and vision.

Box 8.2: Moré: A Proponent of Open Access Model

Pandharinath Sarjerao Moré, Ahmedadnagar District, Maharashtra
(National Award Winner, Fifth National Biennial Awards, 2009)

The task of manual transplanting of onion seedlings is time-consuming and labour-intensive. Moré, a 66-year-old farmer and an innovator, developed an affordable, semi-automatic transplanter for timely sowing of onion seedlings. Moré's onion transplanter is a tractor drawn semi-automatic unit. It can perform three functions at a time, namely, transplanting onions, applying fertilizer and making irrigation channels.

The conventional method of onion planting is labour intensive and uses 40 people, to transplant roughly 1,70,000 to 1,90,000 seedlings per acre. In contrast, Moré's machine helps to reduce the cost of transplanting. Owing to the uniform furrow and spacing, the mechanical harvesting of onion becomes easier once transplanting has been done. This also results in uniform bulb size, which fetches a good price in the market. The machine eliminates the inaccuracy, drudgery, low yield and high labour costs of manual planting and can be used to sow seeds of cereals and pulses.

The onion transplanter costs about Rs 30,000 with a fertilizer drill, and Rs 18,000 without it. Interestingly, Moré has laid no restrictions for anyone to copy and use his technology; in fact, he wants the technology to diffuse widely for the betterment of the farmers. However, NIF has filed a patent in his name in 2008 so as to keep the legal right with him.

Over the past four decades, Moré has developed innovative solutions in the field of farm implements, agricultural machinery, electrical systems, horticulture, low-cost housing, rainwater harvesting and water conditioning systems. His efforts have been recognized at various forums. Among the awards he has received are the *Pragatisheel Krishak Sanman* of the Indian Society of Agriculture (2007) and *Krishi Bhushan Sanman* of Maharashtra Government (July 2009).

Source: NIF website, accessed in January 2009

Box 8.3: Masti ki Pathshala: Bharali's Dream

Uddhab Bharali, North Lakhimpur, Assam

(National Award Winner, Fifth National Biennial Awards, 2009)

Uddhab Bharali (45) is a serial innovator having designed and developed an entire range of mechanical gadgets and innovations. He has set up a research workshop in his idyllic hometown of North Lakhimpur, a small town on the banks of the Brahmaputra River and in the foothills of the Himalayas. His workshop aims to help local communities and industries solve their problems through the creative use of technology

In 1988, Bharali had to abandon his studies due to the sudden death of his father, who left behind a burden of debt for the family. Realizing the demand from the surrounding tea estates, he designed and developed a low-cost 'polythene making machine' at the cost of Rs 67,000. At that time, the market cost of such machines was over Rs 4 lakhs. Not only did the success of this machine enable Bharali to repay his father's debts but he also got the confidence to develop more machines.

The Pomegranate De-seeder developed by Bharali separates the outer cover of the fruit and thin inner membrane without damaging the seeds. It has a capacity of deseeding 50-55 kg of pomegranate fruits per hour. The machine has been exported to Turkey and the USA. Frustrated by the injuries caused while manually peeling the areca nuts, he also developed an areca nut peeling machine, with a capacity of peeling 100-120 nuts per minute.

Bharali has also developed a remi recortication machine, a garlic peeling machine, a tobacco leaf cutter, a paddy thresher, a cane stripping machine, a brass utensil polishing machine, a *safed musli* peeling machine, a jetropha de-seeder, a mechanized weeding machine, a passion fruit juice extractor, a trench digger, a chopper for cattle and fisheries feed, and a portable *dheki*. Currently, Bharali is working on the development of a mechanized toilet for the handicapped.

Bharali was supported by the Micro Venture Innovation Fund (MVIF) scheme of NIF for many of his machines. He also received support from the TePP scheme at DSIR, GoI.

Bharali has dreams of setting up an unconventional orphanage in his hometown, which will produce technical experts. He has designed the training module in such a way that he will devote time empowering these orphans in only technical know-how so that they can find employment in a short span of time. Once they start earning, they will be able to acquire knowledge on other important subjects like history, mathematics, sociology, etc.

Source: NIF website, accessed January 2009

Box 8.4: Saidullah: Creator of the Amphibious Bicycle

Mohammed Saidullah, Jatva-Jeneva, Motihari district, Bihar
(Winner of the First Lifetime Achievement Award, 2005)

In 1975, Champaran experienced floods, which lasted for three weeks. Saidullah had to use a boat to cross the river and, in the city, he had to use a bicycle. It occurred to him that if he could make the bicycle float on water as well as move on land, it would save him money. Within three days, he developed such a bicycle. Using this amphibious bicycle, christened '*Noor*', in memory of his late wife, he crossed the Ganga from Pahelaghat to Mahendrughat. Although the original cost of developing the bicycle was Rs 6000, he can now produce it in Rs 3000.

The amphibious bicycle is a conventional bicycle, with two extra attachments. The first comprises rectangular floats attached in pairs to the front and rear wheels. These floats are light in weight and can be folded when the cycle runs on land. The other attachment comprises fan blades attached in a radial manner on the spokes of the rear wheel. These blades push the water backward thus propelling the bicycle forward. The cycle can move backwards in water as well.

Saidullah has several other innovations to his credit. These include a mini tractor, a key-operated table fan, a fodder cutter-operated mini water pump and a spring-loaded shock absorbing bicycle. NIF has provided a sum of Rs 15,000 to him from the MVIF to develop a prototype of a spring-loaded bicycle.

Saidullah has not been able to convert his creativity into economic prosperity so far. He continues to earn a living by riding his bicycle about 30 km to the market to sell honey, earning a monthly income of about Rs 1,300. Out of sheer frustration, he once broke his fodder cutter operated water pump—the sad plight of a grassroots innovator. NIF tries to reach out to such people.

Source: NIF, India Innovates, Compendium on Third National Grassroots Technological Innovations and Traditional Knowledge Awards, 2005.

Motivation of grassroots innovators

Although the network has demonstrated beyond doubt the immense creativity at the grassroots in innovating and adapting new technology, researchers in the formal system have been slow to join hands with them. Not much is known about the motivations and methods of these 'odd balls' who work with local material and crude tools and yet come up with remarkably innovative solutions that the poor can use. The dissertation work of the first author (Pastakia, 1996), submitted to the Indian Institution of Management, Ahmedabad, is a notable exception. The study looked at the heuristics of 20 grassroots innovators, who had worked out sustainable solutions in the field of agricultural pest management and found that the heuristics used by them were not very different from those used by their counterparts in the formal system. On the other hand, the criteria for search and evaluation were strongly grounded in the eco-ethical value system. So strong was the motivation in the case of Haribhai of Junagadh that he refused to share the water from his well with neighbouring farmers who wanted to use it to spray pesticides. He would not be party to the 'sin of destroying millions of innocent living creatures'. It was this moral stance that forced him to look for alternative remedies to the pest problem in his field. Many other farmers expressed similar concerns and motivation, although the motivation varied and innovations were often prompted out of sheer necessity.

Benefit sharing model

NIF has also played a role in standardizing the procedure of the prior informed consent (PIC), which serves as a contract between the knowledge provider and the institution, spelling out the terms for using the knowledge. The PIC form provides a model of benefit-sharing among five stakeholders—the innovator, his/her community, the innovators' fund, research and development professionals/institutions that add value to the innovations, and the institutions that facilitate the whole value chain.[1]

From Innovation to Enterprise: The Role of Incubators and Micro Venture Capital

The initiative has expanded to include venture capital funding for small innovators and the linking of innovators with entrepreneurs. Grassroots Innovations Augmentation Networks (GIANs) have been established with the primary objective of converting grassroots ideas/innovations into marketable products/enterprises. The first model of GIAN was set up in March 1997 in Gujarat. Subsequently, similar institutions were established in other parts of the country—GIAN North, GIAN North-East and the promotion of GIAN Gujarat to GIAN West. GIAN now has the support of India's first Micro Venture Innovation Fund (MVIF) provided by the Small Industries Development Bank of India (SIDBI) with the intention of being partners in the ventures for commercialization of grassroots technologies. Some of the innovations that have already been commercialized through the efforts of GIAN are listed below:

- Aaruni Tilting Bullock Cart
- Cotton stripper machine
- Natural water cooler
- Foot-operated pesticide sprayer
- Auto-compression pesticide sprayer
- Auto air-kick pump
- 10 HP mini-tractor
- Bicycle hoe
- Tongs for holding heavy vessels

Villgro: on a similar mission

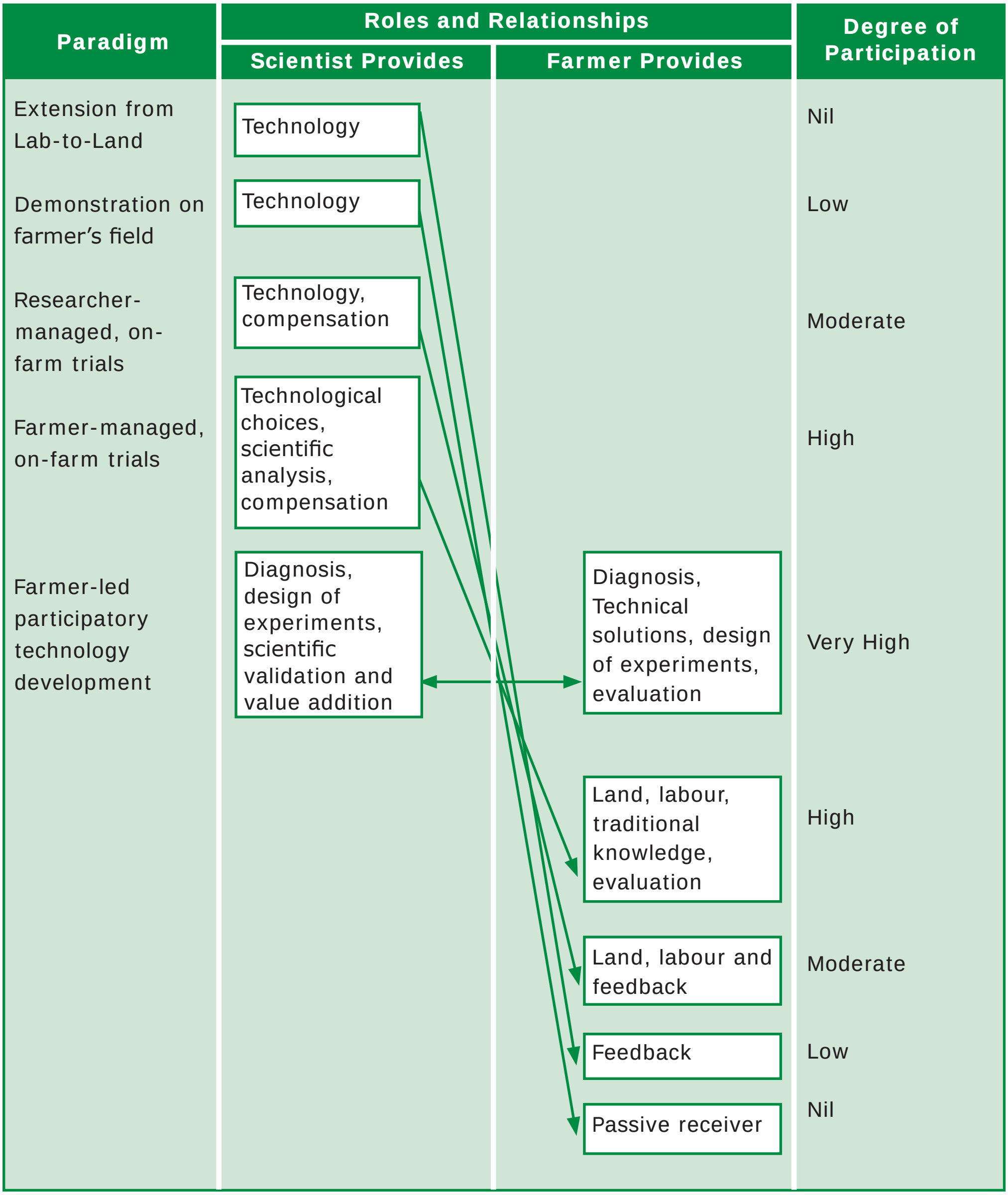
Villgro (earlier known as the Rural Innovation Network) avidly identifies and incubates grassroots innovations, which can have a significant impact on rural lives but lie untapped, in spite of their potential to transform lives. Villgro's incubation strives to make the difference between an idea that fails and one that sees the light of day (Rural Innovations Network website, Dec 2009).

With the support of the Lemelson Foundation of USA, Villgro in collaboration with the Indian Institute of Technology, Madras, runs L-RAMP, a programme to offer recognition and mentoring to innovations that can transform the lives of the underserved people. Established in 2004, the Lemelson Recognition and Mentoring Programme (L-RAMP) recognizes, connects, mentors and funds ideas that seek to serve the rural poor, with a focus on agriculture, water, energy and dairy. It supports innovations right from the idea stage and incubates them till they enter the market.[2]

Linking Formal and Farmer Research

Until recently, formal researchers tended to disregard farmers' innovations or dismiss them as being unscientific. During the late 70s and early 80s, the failure of top-down, centre-to-periphery models of development, particularly in the rainfed regions, forced the administrators and the technocrats to introspect, leading to the evolution of alternative methods and approaches to planning and research. Participatory technology development (PTD) was one such approach. Scientists first began with on-farm research, which was largely managed by researchers, but moved on to farmer-managed participatory trials and then to collaborative research. Figure 8.2 shows how with the shift in paradigm, the perceived relationships between the partners also change. From a passive recipient with low participation, in the case of lab-to-land, the farmer innovator gets treated as a partner during the process of innovation in the farmer-led PTD, in which the degree of participation is the highest.

Figure 8.2: Farmer's Participation in Different Research Paradigms



Farmer-led Participatory Technology Development

Although instances of farmer-led participatory research are rare, Pastakia, Kothari and Chand (2002) documented four such cases from western India, in which scientists tried to validate and add value to farmers' innovations. Table 8.2 summarises the contribution of farmers and researchers in these four cases. The first two involved simple validation of farmers' traditional practices. The next two went beyond validation to add value to the traditional knowledge and innovations.

Table 8.2: Examples of Farmer-led Participatory Research in Western India

Farmer's Innovation / Knowledge	Formal Researchers / Scientists	Institution	Nature of research
Use of milk to control various viral diseases of crop plants by treating seedlings with raw milk before transplanting	Dr N L Vyas and Arun Kumar	Central Arid Zone Research Institute, Jodhpur, Rajasthan	Scientific validation on Leaf Curl Virus in chilli crop with the help of on-farm trials showed better results than conventional chemical treatments.
River basin treatment with traditional water harvesting structures, leading to the revival of five rivers in the Aravalli hills	Dr R N Athwale	Retired scientist of the National Geophysical Research Institute, Hyderabad	Scientific validation and explanation
Design of *johads*—traditional micro-water harvesting systems	Dr S C Mahnot and P K Singh	College of Technology and Agricultural Engineering, Rajasthan Agricultural University, Udaipur	Value addition by developing improved low-cost designs for a variety of micro-climates and local material
Local meteorological knowledge used by local experts for annual prediction of monsoon, used extensively by farmers of Saurashtra for crop planning	Dr P R Kanani	Gujarat Agricultural University, Junagadh Campus.	Validation and value addition, establishment of a network of local meteorologists, who coordinated their efforts with the University and made joint predictions based on observations from different sites.

Two veterinary doctors at the University of Agricultural Sciences (UAS), Bangalore, Dr Veena and Dr Narendranath validated an ancient Egyptian method of detecting pregnancy in cows. The method involved allowing wheat seeds to germinate in the cow's urine. In yet another case from Karnataka, Hittalgida documented an innovation by Purushothama Rao, an organic farmer at Thirthalli, which comprised using *Panchagavya* (a mixture of milk, curd, ghee, cow's urine and dung) as a pesticide formulation. Traditionally, the mixture is considered a body purifier and sold at temples. The pesticide was reported to be effective against wilt disease in the pepper crop. Dr H R Ramachandra Reddy and his student Padmodhaya, at the UAS, Bangalore, validated the pesticidal properties of the mixture. They further modified the composition and made it more effective, thus adding value to the original innovation.[3]

Conclusion

Although PTD is far from becoming popular among formal research institutes, isolated examples have demonstrated how such an approach can help in coming out with new solutions when both formal and informal systems had failed in their individual capacities. The achievements of the People's Learning Centre at Bhavnagar promoted by Utthan Trust cited earlier were made possible only because of the dialogue that the centre could facilitate between the formal and the informal science. The benefits of participatory varietal selection and promotion have been amply demonstrated by GVT and ASA in central India, as discussed earlier. MSSRF has shown how tribal women of Orissa can master the skills involved in participatory plant breeding and thereby help improve the yield potential of important varieties of rice in the Jeypore area of Orissa. MSSRF has also documented the unique contributions of the tribal families to genetic resources conservation and improvement, and has been instrumental in getting them recognition and reward from the National Gene and Biodiversity Funds, set up under the Protection of Plant Varieties and Farmers' Rights Act and the Biodiversity Act. (Arunachalam, et al., 2006). However, examples are few and far between. This is an area in which more development agencies need to take interest if the pace of development in rainfed areas has to be accelerated.

End-notes

1. For more information on these initiatives see www.honeybee.org, www.sristi.org; www.gian.org; www.nifindia.org, www.indiainnovates.com and www.techpedia.in

2. Based on information provided on the websites of Villgro and L-RAMP

3. Dr Prakash T N and Tejaswini reported the above instances of farmer-led participatory research in Hittalgida, the Kannada version of Honey Bee, in 2000. Dr Prakash facilitates the network in Karnataka from the UAS, Bangalore.

9 Social Capital for NRM Interventions

Introduction

In recent years, development agencies have realized the importance of social capital both as a vehicle as well as an end product of development. Although social capital covers institutional arrangements in a variety of forms (including networks, reciprocal relationships, community norms, etc.) for practical purposes, we will take it to imply the stock of people's institutions (either formal or informal, traditional or modern) available to implement developmental projects and programmes. People's institutions are also of strategic importance because of their power to transform social structure, processes and values. Given the crosscutting importance of this theme, we have devoted an entire volume to it, wherein principles, strategies and best practices are presented in detail. In this chapter, we provide a brief account of people's institutions associated with NRM initiatives.

Traditional vs. Modern Institutions

Most communities have evolved traditional institutions that help govern the social, political and economic aspects of life. Traditional institutions that govern and manage common property resources (CPRs) are of particular interest from the NRM point of view. While many of these have become extinct or are on the verge of being so, several such institutions continue to survive and co-exist with their modern counterparts.

There has been a proliferation of modern institutions in the economic domain having been created to implement various livelihood augmentation projects and programmes or to look after newly created economic assets or manage collective enterprise. Such institutions are also known as *crafted institutions* because of the critical role of the external agencies in initiating and facilitating their emergence.

Traditional institutions have attracted the attention of researchers worldwide because of their cultural diversity. On the other hand, crafted institutions do not evoke the same sentiment presumably due to their predictable nature and uniformity. Although found uninteresting by researchers, the need for practical guidelines and theories in promoting crafted institutions remains a long-standing concern among practitioners.

A few studies of crafted institutions have shown that the same type of institution can express itself differently in different cultural and ecological settings.

The challenges of creating crafted institutions that genuinely empower local communities and enable them to chart their own developmental trajectories are enormous. Modern institutions are expected to perform many functions that go far beyond the management of a common property resource such as:

- Accessing credit
- Accessing markets
- Accessing knowledge and information services
- Accessing new technology, adapting new technology, participating in technology development through trials, innovation and PTD processes
- Managing collective enterprise
- Aggregating institutions and building the capacity of member institutions
- Promoting new institutions and technology through people-to-people extension processes
- Empowering marginal groups and women

Modern institutions differ considerably from their traditional counterparts. The German social scientist P. Tonnies drew attention to the fundamental differences between traditional (*Gemeinschaft*) and modern (*Gessellschaft*) institutions. *Gessellschaft* is defined as a group of people characterized by a high degree of individualism, impersonality, contractualism and proceeding from sheer interest. In contrast, *Gemeinschaft* refers to a community encompassing all forms of relationships, characterized by a high degree of personal intimacy, emotional depth, moral commitment, social cohesion and continuity in time (Nisbert, 1966, in Heredero, 1989). The latter is sacral, traditional and wedded to a total way of life whereas the former is flexible, future-oriented, secular and limited in its scope.

Drawing upon this typology but contextualizing it in the Indian situation, the differences between traditional and modern institutions may be summarized as in Table 9.1. The basic difference between the two forms is in the value systems. Wherever the traditional system draws upon the caste ideology, it is usually male-dominated. There is scope for consensual decision-making but consultations are held only within the leadership. Modern institutions seek to institutionalize modern values of a secular democratic society. The traditional system is sustainable by design because it is based on leadership through inheritance. In modern institutions, sustainability has to be built into the design. Second- and third-generation leaders have to be nurtured carefully to ensure sustainability.

Table 9.1: Comparison between Traditional and Modern Institutions in India

Criteria	Traditional	Modern
Nature of relationships	High degree of personal intimacy, affective states, habits and traditions	High degree of individualism;
Commitment	Moral	Contractual
Motivation	Social cohesion and continuity in time	Proceeding from own volition, that is, sheer interest
Espoused (stated) norms and values	Sacral, traditional, rigid, male dominated, emphasizing communal harmony and equitable growth. Notions of equity coloured by caste ideology in most areas other than the tribal, wedded to a total way of life, usually strong respect for nature and sustainability values, including concern for future generations	Flexible, secular, democratic, inclusive, gender sensitive emphasizing common goals and vision of equitable development for all members, limited in scope, depending on the objectives of the institution, committed to the sustainable use of natural resources
Leadership	Through inheritance	Based on knowledge and skills
Autonomy	Total	Strong influence of external agencies
Power and Influence	Very powerful. Can use powerful social sanctions such as social ostracism, power based mostly on social status but could also include leadership traits	Power limited to domain and not to social life. Can expel a member from the institution but cannot ostracize from the community. Social status not the only consideration; knowledge, skills and leadership traits more important
Governance	Hierarchical, scope for consensual decision-making restricted within the leadership	Democratic, representative, consensual decision-making considered important
Sustainability	Sustained by tradition and passing down of leadership from father to son.	Sustainability has to be built into the design of the institution. Transparency and accountability important considerations. Conscious effort to nurture second- and third-generation leaders.

Both traditional and modern institutions can co-exist and preserve their distinct identities. More importantly, both have a strong potential to influence and learn from each other (Heredero, 1989). In fact, when modern institutions are initiated in traditional settings, the fusion of values is inevitable and, often, the resultant institution has imbibed the characteristics of both. Often, we find the interlocking of institutions on account of common leadership. In such cases, the scope for influencing traditional institutions, leaders and norms through modern institutions is truly great.

Traditional Institutions for NRM

A fascinating variety of traditional institutions exist in the economic/ecological domain. The influence of these is more pronounced in the interior areas that are not yet affected by modern civilization and modern education in the western mould, which trends to discount traditional knowledge and wisdom.

Although traditional NRM institutions cover a number of functions, as shown in Table 9.2, table, these can broadly be classified under the following groups:

a) CPR institutions

b) Culturally embedded norms, beliefs and institutions

c) Reciprocity arrangements in the use of natural resources

CPR institutions

CPR institutions are of the greatest interest to developmental practitioners because these show how definite natural resources can be self-managed on a sustainable basis by definite groups of people. Traditional CPR institutions are found in most parts of the world. Riya Sinha et. al. (1997) carried out a meta-analysis of over 70 studies of CPR institutions from across the globe. In Table 9.2, we have tried to draw upon examples from our own country. CPR institutions were found to meet the following purposes:

- Resource maintenance
- Resource protection and conservation
- Sustainable use of resources, including the collective restraint on the use of common resources during stress conditions
- Risk management during outbreak of diseases
- Risk management to cope with scarcity during lean years

Table 9.2: Traditional Institutions for NRM: Typology and Examples

Institution type	Purpose	Example	Duration	Level
CPR institutions	Resource maintenance, sharing and sustainable use	Management of community bull and community pasturelands in the arid lands of Rajasthan and Gujarat (Chand, 1994)	Perennial	Village, hamlet or group
		Management of common tanks in Karnataka (World Bank, 2009)	Seasonal	
		Traditional water users' associations such as the khools of Bhutan and the gonchi system of Andhra Pradesh (Kolluru, n.d.)	Seasonal	
		Randomization rules for hunting (as in the Chenchu tribe of Andhra Pradesh) (Gupta and Gangadharan, 1982)	Seasonal	
		Rotational grazing (as in Rajasthan) and quota system for fishing in many fishing communities (Jodha 1996)	Perennial	
	Resource protection/ conservation	Sacred groves in various states (Honey Bee 2000), oran lands of Rajasthan (see Best Practices, this volume, Part 2)	Perennial	Village
	Risk management during outbreak of diseases	Quarantine institutions to prevent spread of disease in cattle in North Gujarat (*Honey Bee* , 1995)	Episodic	Village / clusters
	Risk management to cope with crop failures and lean years	Kallar system of community fodder bank in Kutch, grain bank, seed bank in various parts of the country (Pastakia, 2004)	Perennial in drought prone areas	Village/ hamlet
Culturally embedded Institutions	Resource protection/ Bio-diversity conservation	Sacred rivers such as the Ganga and the Narmada, sacred trees such as the pipal and the asan, etc.(Maneka Gandhi, 1989)	Perennial	Society
		Beej Khatni Tyohar (seed selection festival) in Madhya Pradesh and Chhattisgarh[1]	Seasonal	Village

Continued...

Institution type	Purpose	Example	Duration	Level
		Plants used in Ganesh Pooja (Khedkar and Kareem, 1997)		
		Community sharing of herbal tonic—an annual ritual reported from a tribal village in Surat, Gujarat (Honey Bee, 2000)	Annual	
		Pata system of cultivation of vegetables, pulses and medicinal crops in small patches exclusively reserved for women, in Maharashtra (Pallavi, 2009)	Seasonal	
	Welfare institutions for sentient beings	Institutions of panjrapol and gaushala in Gujarat which look after sick and dying domestic animals, especially cattle	Perennial	Village/ Cluster
		Organising of parabs (free drinking water points for human beings) and hawada (drinking water points for cattle) during droughts in Gujarat	Episodic; Perennial in desert areas	
Reciprocity	Labour sharing	Various systems of collective labour on a rotational basis	Seasonal	Hamlet
	Resource sharing	Migrant shepherds camping overnight on a farmer's field get local hospitality in exchange for the manure they leave behind in the field (widely practiced in western states of India)	Seasonal	Region
		Herders who migrate out to take care of the village cattle during drought get rewarded with one heifer per family on returning (Surendranagar, Gujarat)	Episodic	Village
		Gleaning rights of duck raisers (allowed to feed on insects etc.) in paddy fields on condition they do not damage the paddy flowers in Indonesia. Farmers benefit from natural pest control (Vondal,1984).	Seasonal	Village/ Hamlet
		Variety of share-cropping arrangements all over India	Seasonal	

Whereas most of the CPR institutions are either seasonal or perennial in nature, the example of quarantine institutions shows that institutions can also be episodic having been designed precisely for a specific condition or risk. The institution remains dormant most of the time but is activated when the situation of risk arises. Significantly, all these institutions are applied either at the hamlet, village or inter-village levels. Hence, these tend to be highly location-specific.

These institutions bring out the traditional wisdom of local communities, which devised rules for the sustainable use and harvest of natural resources and maintenance of common property through contributions (in cash, kind, labour, etc.) by members.

Culturally embedded institutions

Culturally embedded institutions have played a crucial role in the conservation of natural resources, as documented by Posey (1999), Maneka Gandhi (1989), Bharata and Kapoor (n.d) and others. In India, it is common practice among farmers and tribals alike to hold certain trees, rivers, etc., as sacred. Rituals and festivals are designed in ways that conserve vital components of the eco-system and biodiversity that is considered valuable by the local population.

The *Beej Khatni Tyohar* in Madhya Pradesh and *Ganesh Puja* in Maharashtra are examples by which farmers preserve diversity of crop varieties and wild species, respectively. The *beej khatni* ritual and other cultural beliefs and practices of farmers in Madhya Pradesh, Chhattisgarh and Maharashtra offer *de facto* mechanisms for conservation of varieties and land races within the village.

In villages of Bastar district, before sowing paddy in May, every farmer is expected to select one out of his/her collection of varieties and take a handful of seeds to the temple or central place of worship. Each farmer places his/her variety separately in front of the priest. After performing various ceremonies, the priest sanctifies the offerings and gives back each farmer a handful of seeds. The farmers take these seeds and plant them in their respective fields. In this way, the varieties get exchanged within the village. Another variation of the same practice was found in the adjoining state of Chhattisgarh. The farmers take bowls of rice and place them in front of the priest. The latter uses a stick to indicate which bowl a farmer should pick up at the end of the ceremony (Rajeev Khedkar, per. comm.)

In Thane district of Maharashtra, farmers cultivate a purple coloured variety of paddy. Farmers plant these seeds in small spots in the field, which resemble ‘beauty spots’ when the plants mature. The widespread belief that a black mark put on a baby’s face protects the child from the evil eye forms the basis for this practice. This belief has not only helped to preserve the variety over time, but also to enable its diffusion into Raighdh district with the help of ADS (Rajeev Khedkar, per. comm.)

Khedkar and Kareem (1997) identified 21 species of flowers and leaves, used to offer puja to Lord Ganesh in Maharashtra. Each of these species, when examined for its uses, was found to possess valuable medicinal properties.

The *pata* system in Eastern Maharashtra helps not only to conserve crop diversity but also to create a space for incorporating women's preferences in crop selection and provision of food for the family. Traditionally, *pata* signifies a woman's space in agriculture. Women would plant small strips of land with vegetables, fruits and spices between the main crops such as wheat, sorghum and pigeon pea. They would maintain and harvest them, depending on family needs. Typically, the *pata* supplied the family platter with fresh fruits and vegetables for about eight months in a year, and with pulses and oilseeds for the whole year. The *pata* ensured nutritional variety (Pallavi, 2009).

Posey contributed significantly towards establishing the link between culture and conservation in the Brazilian context. He also spearheaded a global movement that recognizes the contribution of tribal and local culture in the conservation of valuable resources. Similar studies are wanting in the Indian context. A notable exception is that of Maneka Gandhi (1989), who has traced the mythological and cultural beliefs surrounding valuable tree species of India. Similarly Bharata and Kapoor (n.d.) have documented the sacred trees of India and the various gods and goddesses associated with the worship of these species (Table 9.3 has an illustrative list).

The *Honey Bee Journal* has been documenting cases of culturally embedded institutions over the years. As Gupta (1992) pointed out, many of the traditional CPR institutions in India are also culturally embedded. Dedicating patches of forests to deities is one of the many ways of worshiping nature. These pockets are referred to as *sacred groves*. A study of 29 sacred groves in the dry land sanctuaries of Gujarat initiated by Gupta showed that the size of such groves ranged from one to seven acres (Gupta 2000).

Charitable institutions for sentient beings are a reflection of societal values in dealing with nature. The institutions of *panjrapo*l and *gaushala* in Gujarat were developed to look after the old and diseased animals because it was considered inhuman to either kill such animals or to leave them to fend for themselves. Culling of unproductive cattle is an integral part of modern animal husbandry in many countries.

Table 9.3: Sacred Trees and Associated Gods/Goddesses in India

No.	Name of god/goddess	Name of species
1	Lord Shiva	Bel (Aegle marmelos),
		Rudraksa (seeds of Elaeccarpus),
		Ber (Zizyphus jujube)
		Bargad or banyan (Ficus glomerata)
		Amala (Phyllanthus embilica)
		Deodar (Polylathis longifolia)
2	Lord Vishnu	Sala (Shorea robusta)
		Pipal (Ficus religiosa)
		Amla (Phyllanthus embilica)
3	Lord Krishna	Kadamba (Anthocephalus cadamba)
4	Lord Hanuman (son of wind god)	Mango (Mangifera indica)
		Sami (Ficus benjamina)
5	Kamadeva	Ashoka (Sereca indica)
6	Goddess Lakshmi	Red silk cotton (Bombax malabaricum)
		Pipal (Ficus religiosa)
7	Varuna (Lord of waters)	Coconut (Cocos nucifera)
8	Goddess Sitala	Neem (Azadirachta indica)
9	Lord Ganesha	Arecanut

Source: Bharat and Kapoor (n.d)

However, in Hindu dominant societies, the practice of cow slaughter is not acceptable because the cow is venerated. Such animals end up in the *gaushala*. Society takes upon itself the cost of providing for these animals. In fodder scarce areas, maintaining such institutions is proving to be a challenge because productive animals compete with animals from such institutions for valuable fodder resources.

The traditional *chabutara* is a structure erected in public places or common property land where birds can be fed grains. The *parab* is a community managed drinking water point organized especially during years of water scarcity. Drinking water points for animals (called *havado* in Gujarat) are especially designed for cattle and domestic animals in arid regions.

Reciprocity

Reciprocity forms the basis of many economic activities that are linked to access and use of natural resources in rural areas. Reciprocal relations in sharing labour, land, water and animal resources have been documented. Sharecropping continues to be a common practice in India and plays the role of adjusting demand and supply of land

and labour resources from season to season.

A wide range of collective and rotational labour practices are found at the hamlet level, to either complete works of common good or to tide over peak labour stress periods.

Most of the reciprocity institutions are informal and seasonal in nature. These are not restricted to the village alone, as can be seen from the example of reciprocity between migrant shepherds and farmers owning land on the roadside. This form of reciprocity is quite common in the western states of Gujarat and Rajasthan, where animal husbandry is an important component of livelihood security.

Modern Institutions for NRM

An equally wide range of modern institutions has come into existence over the past two decades in the economic/ecological domain (Table 9.4). This can be attributed to a proliferation of programmes promoted by government and donor agencies, each one promoting its own brand of institution. Many of these institutions fold up soon after the project or programme is completed because the promoting agency moves on to other areas. Such agencies do not have a long-term vision for the institutions they promote. The more durable institutions are the ones that survive beyond project periods and continue to grow and contribute to village development. This happens when developmental agencies are committed to providing long-term capacity building support to the institutions they promote.

Aggregation of modern institutions for NRM has made it possible to bring larger ecological units under the purview of community based management. Aggregation is also a proven way of strengthening PIs and improving their bargaining capacities. Hence, when classifying modern PIs for NRM, it also becomes useful to examine the level at which the PI is operating. In Table 9.4, we not only classify modern institutions using the same functional heads as for traditional institutions but also classify them across three levels, viz., hamlet/group, village and cluster/area. An additional function of accessing resources through self-help institutions is added to list of functions.

Table 9.4: Modern NRM Institutions: Typology and Example

No.	Functions	Levels		
		Group/Hamlet	Village	Cluster/ Area
A	**CPR Institutions**			
1	Resource protection/ conservation	Forest protection committee; Fodder protection committee	Micro-watershed development committee	Watershed development committee; Arvari Sansad, a river basin forum in Rajasthan
2	Resource maintenance, sharing and sustainable use	User group for check-dam; group well etc.	Village tank committee; Micro-watershed development committee	APFAMGS, a ground water management forum in Andhra Pradesh; Agricultural implements library managed by women's federation in Netrang, south Gujarat (Chabadia and Mehta, 2006)
3	Risk management during lean years	Community fodder/ food bank; Public institutions providing relief	Drought proofing initiatives through village development institutions; Public institutions	Drought proofing initiatives through federations; area level institutions developing own insurance schemes; Public institutions
4	Risk management during outbreak of diseases	Public institutions	Public institutions	Public institutions
B	**Culturally embedded institutions**			
1	Resource protection; bio-diversity conservation	Socio-religious movements like Swadhyay, reviving traditional values and institutions	Socio-religious movements; Revival of pata system in Maharashtra by Dilasa (Pallavi, 2009); Revival of oran lands in Rajasthan by KRAPAVIS (Best Practices, Part 2, this volume)	Socio-religious movements; Revival of traditional CPR institutions to revive Tharparkar breed in Rajasthan by SURE (Best Practices, Volume I)

Continued...

No.	Functions	Levels		
		Group/Hamlet	Village	Cluster/ Area
2	Welfare of sentient beings	Philanthropic and religious trusts that engage in welfare activities	Same as for hamlet level	Same as for hamlet level
C	**Reciprocity**			
1	Reciprocity between institutions at same level	Between SHG and CIG	Between WDC and Gram Panchayat	Between women's federation and men's federation
2	Reciprocity between institutions at different levels	Between SHGs and cluster level federation;	Between SHGs and WDCs	Between Lift irrigation cooperative and Federation of LICs
D	**Self-help institutions to access resources for livelihoods**			
1	Accessing credit	SHGs for micro-finance	Credit cooperative	SHG federation; Credit cooperative
2	Accessing markets	CIGs	Trading cooperative	Producer company;Production/ marketing cooperative- e.g. Irula Snake Catchers' Industrial Cooperative (Sarat Kumar, 2008)
3	Accessing information/ technololgy	Village knowledge centers (VKCs); CIGs	Village development committee overseeing VKCs	Village resource centers (VRCs); Community managed resource centers (CMRCs) promoted by Myrada (see best practices, Part 2); Women's federation promoted by AKRSP(I) that introduced post-harvest implements to reduce drudgery of women and improve efficiency

CPR Institutions

Even in modern times, CPR institutions continue to remain significant. At the hamlet/group level, these may take the form of UGs to manage newly created assets such as group wells (Box 4.1) and check-dams. Some assets at the village level, such as village tanks and village woodlots may have to be managed by a village-level institution such as the gram panchayat or a VDC. The creation of area-level institutions through the aggregation of smaller units has made it possible to manage area-level CPRs such as entire river basins or ground water within a given area. This was earlier not possible with traditional institutions. Examples include the management of Arvari river in Rajasthan by *Arvari Sansad* (Box 2.1), and community based, ground water management in Andhra Pradesh by the APFAMGS project (Box 1.2).

A somewhat different kind of CPR management has been demonstrated by a women's federation at Netrang, South Gujarat. Since 2005 the *Navjeevan Adivasi Mahila Manch* in Sagbara has been managing an agricultural equipment library, to provide such equipment on rent to small and marginal farmers of the area. The project had provision for purchasing a tractor and trolley mounted with a plough, cultivator and thresher. A provision for purchasing water-lifting machines with pipes was also made so that farmers, who had old wells on their land, could access the water for irrigation. For promoting other improved agricultural practices, a chaff cutter, soil-testing kit, etc., were also included. To improve the access to information, a computer was purchased. The total cost of equipment purchased was Rs 8.18 lakhs.

Significantly, some of the traditional institutions for risk management have become weak after independence. This space has been taken up by the government, public and private institutions that provide relief during natural calamities. Drought proofing initiatives promoted by a few NGOs typically work to conserve soil, water and biomass in arid regions while developing livelihoods in the non-farm area so that dependence on natural resources may be minimized. A few SHG federations have developed their own low-cost insurance schemes because the premiums charged by private and public insurance companies are very high. Recent innovations in weather insurance may make these schemes more attractive to the small and marginal farmer. These federations and NGOs are now collaborating with insurance firms to provide better and affordable insurance cover to farmers.

Culturally embedded institutions

These are nothing but traditional institutions and values that are being revived because of their relevance in modern times. A few NGOs have been involved in reviving specific institutions that used to manage traditional resources such as Dilasa (See Box 3.3).

In a few cases, socio-religious movements such as the Swadhyay movement initiated by Shri Pandurang Shastri Athavale, helped to revive traditional values of non-violence and respect for nature and community institutions, as a safety net for the poorest of the poor. Many of the traditional welfare institutions for sentient beings are still alive. The remaining gap is filled up by philanthropic and religious institutions.

Reciprocity

Reciprocity is a way of life in rural India. Old forms of reciprocity give way to new forms, depending on the changing circumstances and needs of different social groups. One form of reciprocity that is evident is the collaboration among PIs. These are of two types among a) institutions at the same level and b) institutions across different levels of aggregation. This kind of reciprocity and collaboration is important for strengthening the emerging social capital in rural areas.

Self-help institutions to access resources for livelihoods

This represents a new category of institutions and assumes the greatest significance for livelihoods augmentation. The SHG movement has made it possible for the poor to access micro-finance like never before. Similarly, CIGs formed around specific livelihood activities are able to access information, technology and markets. CIGs at the hamlet level are useful for comparing experiences with other small producers and for aggregating produce. The area-level institutions provide the much-needed bargaining power while accessing markets or technology. An interesting example of a tribal community gaining access to markets by leveraging a tradiitional skill is that of the *Irula Snake Catchers Industrial Cooperative Society*. The traditional skill of catching snakes among Irula tribals of Tamil Nadu has helped them to establish a thriving venom collection cooperative and to make a living out of it. This skill, which was previously used to hunt snakes for their skin, has become a boon, which aids the production of anti-venom serum and helps conserve the snake population of the area. In 2007, the cooperative had a total of 351 members, who trapped 8,500 snakes. The total sale of venom was Rs 13.59 million whereas the profit stood at Rs 5.58 million.

Area-level institutions for collective enterprise such as producer companies and cooperatives can access credit, technology and markets together. For instance, the Siddi women on the periphery of Gir forests, began to gain access to credit, technology and markets after getting organized into small *Mahila Vikas Mandals* (Women's Development Groups), and later aggregated into a women's federation (Box 9.4, Volume IV). These institutions, although based on local natural resources, move beyond NRM into the realms of collective enterprise. These institutions function differently and are therefore discussed separately in volumes II and IV.

Institutional Strategies for Sustainable NRM

So far, we have reviewed the range of NRM-related PIs at the hamlet, village or area levels. The main institutional strategies deployed by developmental agencies in promoting sustainable, inclusive management of NRM while promoting rural livelihoods can be summarized as follows:

i) Reviving traditional institutions that are relevant in modern times.

ii) Adopting existing modern/traditional institutions for a new purpose.

iii) Creating modern institutions of different types:

- Sectoral institutions
- Village-level umbrella institutions
- Aggregated institutions at the area/cluster level

iv) Creating an eco-system of mutually dependent PIs.

Revival of traditional institutions

Development workers are gradually realizing the importance of some of the traditional NRM institutions because these were usually founded on the principles and values of sustainability. There are a few instances of developmental agencies trying to revive traditional institutions because they find these equally relevant, if not more so, in the present-day context.

The following are a few examples.

a) Dilasa, an NGO in Yavatmal, is trying to revive the *pata* system of growing vegetables by women in a small part of the farmer's field, (Pallavi, 2009).

b) The Tharparkar breed of cattle is being revived, by an NGO called SURE, through the revival of traditional CPR institutions, to manage pasture lands and by using common bulls as CPRs (See Best Practices, Part 3, this volume).

c) The sacred *Oran* lands of Rajasthan are being revived through traditional institutions by KRAPAVIS. Over 400 ha have been revived in 40 villages so far through 100 such institutions (Best Practices, volume IV).

d) *Wavli* is a unique traditional institution of tribal communities in South Gujarat, which ensures the exclusive right of tribal women over their own earnings. In the early eighties, BAIF decided to revive this institution as a means to empower women through its Tribal Rehabilitation Project at Vansda. Women's groups took up economic activities such as nursery raising, mushroom cultivation, vegetable cultivation, etc., under the *wavli* system of management by women (BAIF, 2006.)

Adopting existing institutions for a new purpose

Often, the village has sufficient history of collective action. There may be existing institutions created in the past for a particular purpose, for instance, implementing a government project. Such institutions may either be still active or may have become dormant. If the governance structure and previous experience matches with the new project/objective on hand, it makes sense to revive the dormant institution or add an additional objective to the existing institution. When creating village knowledge centers (VKCs) in Tamil Nadu and Pondicherry, as CPRs, the MSSRF felt it necessary to have the centres governed by village institutions. Instead of investing a large amount of resources in creating new parallel institutions, it decided to harness existing institutions such as temple trusts, VDCs and panchayats, to take up the responsibility of managing the VKCs. The general purpose developmental institutions at the village level, promoted by agencies such as Seva Mandir and AKRSP(I), are ideally suited to take up new projects and objectives that lead to the development of the village.

Creation of new institutions

In many cases, revival of traditional institutions is either not possible or not desirable. Nor is the existing social capital suitable to take up the new activity being planned. Under such circumstances, there is need to create new PIs to fill the institutional gap. More often than not, large projects/programmes specify the type of grassroots level institutions that need to be created. At other times, a developmental agency may facilitate the creation of institutions based on its own approach and philosophy. When creating new institutions, in an area where the agency plans to work for an extended period of time, one strategic decision that it has to take is whether to create separate institutions for separate programmes/sectors/resources or to create one village development institution, which serves as a conduit or an umbrella institution for various projects in the village. The decision may be influenced by various factors, including the expertise of the institution, its approach (whether holistic or sectoral), its long-term commitment to a particular area, etc.

Creating sectoral institutions

Specific sectors/natural resources have their own peculiar characteristics that call for specialized institutions. For instance, protecting a village woodlot may call for different kinds of rules from those needed to manage a mountain stream for equitable and sustainable distribution of water. When designing sectoral institutions, one can draw upon the rich and varied experience of traditional institutions and learn from them. Self-organizing institutions are known to give unto themselves rules and norms that govern their behaviour and enable the sustainable management of CPRs through the system of mutual monitoring. Modern water users' associations and lift irrigation cooperatives have adopted many of the design principles of traditional water distribution systems. Modern schemes of managing common pasture lands and common forests are also based on similar principles.

Creating village-level umbrella institutions

To implement integrated NRM programmes, it becomes necessary to create an umbrella institution that brings together all stakeholders such as a micro-watershed association. However, care should be taken to initiate SHGs and SAGs prior to the integrated NRM intervention so that the weaker sections may get a head start and be ready to participate in the larger village body when the time comes.

Creating aggregated institutions at the cluster/area level

Forming area-level watershed associations when micro-watersheds are treated contiguously is beneficial for taking up area-level NRM issues. Similarly, aggregating SHGs in order to give them the strength of numbers and enabling them to take up more ambitious projects at an area level is also a widely practised strategy. The models for aggregation vary, depending on what functions the federated body is expected to take up, at what level aggregation is attempted, etc. These are matters of design, discussed in the next chapter.

Creating an eco-system of mutually dependent PIs

Care should be taken that the plethora of modern institutions working at the grass-roots level do not end up working at cross-purposes. Sequencing, aggregating, inter-locking of institutions and the creation of mutual dependence among them are strategic aspects of social capital building, which must be borne in mind by the developmental professional when facilitating PIs.

In this chapter we have discussed the different types of PIs that operate in the NRM domain. We have also identified key strategies for building social capital for NRM based livelihood Initiatives. Readers interested in getting a deeper understanding of designing and facilitating PIs may refer to volume IV of the handbook.

End-notes

1. Personal communication with Rajiv Khedkar during a workshop at Academy of Development Sciences, Kashele, Karjat,17-19 September,1996.

10 Summary and Conclusions

Micro-watershed development has emerged as the most potent strategy for integrated development of natural resources, leading to livelihood augmentation in rainfed areas. Although a number of ecological and other variables come into play in developing a micro-watershed development plan, the approach is generally applicable to most parts of rainfed areas. The approach may vary somewhat as we move from arid to semi-arid and sub-humid climatic conditions. Specialized NRM strategies are needed for problem areas like salt affected lands, laterite lands, etc. and to strengthen livestock based strategies that form an integral part of both the farming and food security systems. Tackling the livelihood problems in suicide hotspots will call for integrated strategies that seek to rebuild agro-ecosystems and insure farmers from production and market risks. Learnings from these interventions are also likely to prove useful for making agriculture more sustainable in green revolutions areas.

Improving Productivity

Arid lands

In the arid regions where water for irrigation is in short supply, the main source of livelihoods is usually animal husbandry rather than agriculture. In most arid lands, the traditional institutions that controlled common grasslands and community forests have broken down. Due to immense biotic pressure, fodder has become scarce and animal husbandry alone can no longer support the family. Most families have had to take recourse to migration or to working in mines and industries, if these are available, in the vicinity of their village. Drinking and domestic water scarcity is another problem that induces distress migration and affects the health and productivity of the people. In such conditions, the focus should be on ensuring drinking water security, strengthening livestock-based livelihoods and exploring opportunities in the non-farm sector. In desert ecologies, women are generally skilled in handicrafts and this skill can be exploited to manufacture new products for distant markets (see case studies on promoting handicrafts, Volume II). New opportunities also exist in the ICT and the service sectors (see Volume III).

Semi-arid lands

In the semi-arid regions, agriculture still remains the main occupation. Here, particularly in the undulating lands, land-based interventions are likely to succeed the most, and provide the initial boost from which the economy can diversify. The focus here continues to be on drought proofing by levelling the uneven distribution of rainfall, increasing cropping intensity and recharging groundwater, which can be used during lean years for a subsistence crop. Adopting new technology for resource-use efficiency, aggregating produce for better marketing and aggregating demand for bulk purchase of inputs are some of the measures that enhance the livelihoods that are essentially farm-based. Livestock too plays an important supportive role and helps to mitigate the risk during scarcity.

Sub-humid

In the sub-humid and humid regions, the problem is not one of water scarcity but one of managing the water, which is abundant but not uniformly distributed over time and space. Water accumulated in the valley may have to be pumped to the upper reaches for optimum utilization of the resource. Infiltration pits help the sub-surface flow of water and improve the distribution of soil moisture. Fisheries can also be a subsidiary occupation. Many farmers could be producing crops for the market rather than just for home consumption. There will, therefore, be many opportunities for developing value-added products for the market. Some sub-humid areas are rich in forests and bio-diversity. Here, the focus could be on protecting and rejuvenating forests and building the economy around minor forest products. Here again, getting organized to deal with the market forces becomes important in order to avoid exploitation by middlemen. Many sub-humid regions are hotspots of crop and varietal diversity. Conservation of landraces and participatory technology development are important to maintain and enhance the farming systems.

Lands with problem soils

In the coastal saline regions, drinking water is often a major constraint, preventing people from concentrating on livelihood activities. The groundwater is saline and salinity ingress poses problems for agriculture as well. Specialized natural resource treatments like sub-surface check dams in rivers, recharging of wells, etc., have proved effective in arresting salinity ingress and reducing groundwater salinity. Technologies like reverse osmosis, water pyramids and dew harvesters are now being tried to address the drinking water problem in regions with non-potable, saline groundwater. The watershed approach can also be used to augment surface water resources for agriculture in coastal regions. In addition, new technology can go a long way in improving the fish catch of fishing communities and in opening up new vistas in the field of marine aquaculture on the coast itself.

Laterite soils are problem soils because they have lost most of the nutrients and have been left with deposits of iron and aluminum. These soils, however, can be reclaimed and made productive through interventions that conserve soil nutrients and maintain good organic matter status.

Livestock productivity

Livestock represent a key component of farming systems. Different types of animals are suited to different agro-climatic conditions. In arid and semi-arid areas livestock such as cattle, sheep and goat represent a major livelihood activity helping to reduce vulnerability against droughts and scarcity years. This source of livelihoods has come under tremendous stress especially in arid lands. Creative solutions are needed to revive traditional breeds and upgrade them, improve fodder security and develop innovative delivery systems that help maintain the livestock productivity with the latest available technology. Collective action also helps in dealing with markets and securing better prices. Integrated approaches are needed to make the best impacts as demonstrated by a few agencies such as SURE, GRAVIS and PRADAN. Small holder poultry using the latest scientific management through cooperatives can also provide a viable alternative to the poor in sub-humid areas as demonstrated by the poultry cooperatives facilitated by PRDAN.

Sustainability of Agriculture

The problem of distress hotspots located mostly in the rainfed areas, which have adopted chemical farming to cultivate rainfed cash crops, has drawn attention to the larger issue of non-sustainability of chemical intensive faming, even in irrigated conditions. A few innovative initiatives indicate that the way out for reducing distress in these areas is to diversify cropping pattern, revive traditional systems that were more diversified and eco-friendly, adopt perennial crops like horticultural crops combined with resource-efficient methods of applying water, give up the use of expensive chemical inputs, and adopt non-chemical or low intensive external input farming methods. Weather insurance schemes and mechanisms to access credit from formal systems will need to be the integral parts of the solution. Collective marketing and access to market intelligence can be adopted to mitigate market risks. The production of organic food and the collective marketing of the same offer tremendous potential for reviving agriculture in distress hotspots, as evident in the Timbaktu Organic case.

A number of steps need to be taken before the local community can move from the NRD stage to the livelihood augmentation stage. This includes investments in assets to access the newly created or conserved natural resources, and the creation of village-level institutions to access new technology, credit and markets. Investments in building the capacity of local people are needed to enable them to run the new institutions that will make this happen. Investments in the software component of a watershed project should match the investments in the hardware component in order for the institutions to be durable and for the structures to be maintained over time. The success of a watershed programme or for that matter any NRM based programme, should be measured not by the number of structures created but by the extent to which existing livelihoods have been strengthened and new livelihood options created.

Last, development agencies should actively facilitate local innovators and entrepreneurs. Facilitating people-to-people interaction and dialogue between formal and informal science has demonstrated how creative solutions can be found to difficult problems in remote areas. If such an approach is made an integral part of NRM and livelihood promotion strategies, it could greatly accelerate the pace of development in the rainfed areas.

Post Harvest Wastage

Another major issue impinging on food security is the callous amount of post-harvest wastage in the country, which nullifies all efforts made on the productivity front. For a country reeling under unprecedented food crisis, India loses an alarming Rs 55,600 crores worth of crops each year after harvesting (*Times of India*, April 2008). According to rough estimates food grains worth Rs 16,500 crores (10 per cent of the production), pulses worth Rs 2,000 crores (15 per cent of the pulse crop), fruit crops worth Rs 13,600 crores (30 per cent of the fruit production), vegetables worth Rs 14,100 crores (30 per cent of the production), and livestock and fisheries produce worth Rs 8,400 crores are lost annually. Whereas a certain percentage of the loss is considered natural, the high rates prevailing in India are close to those of the African nations and leave much to be desired. Some of the causes, which are controllable/ preventable to some extent, include inappropriate harvest timing, inefficient machinery, lack of storage facilities, contamination, inordinate exposure to heat cold and inappropriate moisture levels. Processing levels are very low with around two per cent for fruits and vegetables, 26 per cent for marine products and 6 per cent for poultry, etc. (*ibid.*)

This area represents a massive challenge for Indian agriculture in general, and rainfed agriculture, in particular. Among the various issues dealt with in Volume II, this is the most important one.

References

Action for Social Advancement. (2009). *Stop Dam: A Small Wonder.* Madhya Pradesh: State Planning Commission.

Agarwal, Anil and Sunita Narain. (1997). *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems.* (Fourth Citizen's Report on the State of India's Environment) New Delhi: Center for Science and Environment.

Agarwal, Anil, Sunita Narain and Indira Khurana. (2001). *Making Water Everybody's Business: Practice and Policy of Water Harvesting.* New Delhi: Centre for Science and Environment.

Andhra Pradesh Farmer Managed Groundwater Systems. (2008). http://www.apfamgs.org/Default.aspx (accessed June 2008)

Anon. (2010). Arvari sansad (Parliament): The voice of common people. http://www.tarunbharatsangh.org/programs/water/arvariparliament.htm (accessed May 2010).
———. (2008). Maldharis find bread in cheese. *Civil Society* (January): 8–9.

Arunachalam V., S. K. Sarangi, Trilochan Ray, B. P. Mohanty, V. A. Nambi and Smita Mishra. (2007). *Participatory Plant Breeding: Precept and Practice.* Chennai: M. S. Swaminathan Research Foundation.

———. (2006). Rising on *Rice: The Story of Jeypore.* Chennai: M. S. Swaminathan Research Foundation.

Bhatt, Vishnu and P. N. Vinod. (2008). *Development of Sea Farming in India—Perspectives from an Export Angle*. Kochi: The Marine Products Export Development Authority, Government of India.

Chabadia, Dinesh and Hiten Mehta. (2008). Women-managed farm equipment *library: The case of Navjeevan Adivasi Mahila Manch,* Sagbara. Case study prepared for presentation at the AKF Summit on Gender, on behalf of AKRSPI.

———. (2008). Impact of post-harvest technologies on women: A case of tribal societies of South Gujarat. Paper prepared for AKF Summit on Gender.

Chambers, Robert. (1992). *Rural Appraisal: Rapid, Relaxed and Participatory.* (125). Sussex: Institute of Development Studies. Reprinted in 1997 by PRAXIS—Institute for Participatory Practices—and ACTIONAID India.

Chopde, Sashikant, A. R. Pastakia and Girish Bhardwaj. (2002). A community responds to droughts: Learning from community based initiatives in water harvesting and watershed development. (Unpublished report by Winrock International).

Choudhary, Shubharanshu. (2009). All idiot farmers commit suicide. *Down to Earth*, (April 1): 49–51.

Chundawat, B. S. and S. K. Gautam. (1993). *A Textbook of Agro Forestry. 188*. Navsari: Gujarat Agricultural University.

Cole, Shaure, Jeremy Tobacman and Petia Topalova. (2007). Weather insurance: Managing risk through an innovative retail derivative. http://www.cid.harvard.edu/neudc07/docs/neudc07_s4_p04_cole.pdf (accessed May 2010).

Daniel, J. N. (n.d.) *The Practice of SRI on Rainfed Marginal Lands.* Pune: BAIF Development Research Foundation.

Deshpande, Vivek. (2009). Reaping riches in suicide zone. *The Indian Express*: Ahmedabad. February 12.

——— (2009). How Philippines mountain slopes were converted into rich Bt corn fields. *The Indian Express*: Ahmedabad. October 22.

Development Support Centre. (2008). Annual Report. (Unpublished).

Dwivedi, A. P. (1992). *Agro Forestry: Principles and Practices.* Jodhpur: Oxford and New Delhi: IHB Publishing Co. Pvt. Ltd.

ENVIS. (2008). The Sukhomajri Watershed Management Project: A success story of participatory approach. http://www.punenvis.nic.in/water/ case1.htm. (accessed June 2008)

FAO. (2007). Coping with water scarcity in Andhra Pradesh: Farmer management of water resources helps turn the tide. http: www.fao/newsroom/en/2007/1000521/article_100052en.html (accessed June 2008).

Fresco, Louise O. (2003). Which Road Do We Take?- Harnessing Genetic Resources and Making Use of Life Sciences, a New Contract for Sustainable Agriculture". EU Discussion Forum on *Towards Sustainable Agriculture for Developing Countries: Options from Life Sciences and Biotechnologies,* Brussels. January 30-31.

Fukuoka, Masanobu. (1992). *The One-straw Revolution: An Introduction to Natural Farming.* (184). Mapusa, Goa: The Other India Press (originally published in 1978 by Rodale Press Inc.).

Government of India. (2008). Common guidelines for watershed development projects. http://dolr.nic.in/CommonGuidelines2008.pdf (accessed May 2010).

Grameen Gyan Abhiyan. (2008). *Report of the First Annual Convention of Grameen Gyan Abhiyan.* Chennai: M. S. Swaminathan Research Foundation.

Hegde, N. G. (2006). Livestock development for sustainable livelihood of small farmers.

National Symposium on *Energising Rural India—A Challenge to Livestock Industry* at Manesar, Haryana, organized by the Compound Livestock Feed Manufacturers Association of India.

Heinrich, G. M. and J. Rusike. (2003). Increasing productivity: Final report, sorghum and millet improvement programme (SMIP). In Wani, Rockstrom and Oweis. (2009).

Hemani, Rushabh and Manju Ravi. (2004). D*rinking Water Security in Watershed Villages.* Ahmedabad: Development Support Centre.

Heredero J. M. (1989). *Education for Development: Social Awareness, Organisation and Technological Innovation.* New Delhi: Manohar Publications.

Hirway, Indira, Shital Lodhia, Alka Palrecha and Sanjay Rode. (2008). Status of salinity and its impact on livelihood in coastal India: An exploratory study. (Unpublished report). Ahmedabad: Centre for Development Alternatives.

Honey Bee. (1995). Traditional episodic institutions for dealing with foot and mouth disease. 6 (4) (October–December): 17.

InterCooperation and SDC. (2003). *Water Harvesting and Management: Practical Guide Series* (6.). New Delhi: Swiss Agency for Development and Cooperation.

IWMI. (2006). Promoting micro-irrigation technologies that reduce poverty. IWMI Water Policy Briefing, Issue 23. September. Colombo: International Water Management Institute.

Iyengar, Sudarshan and N. Lalitha. (2004). GM cotton in Gujarat: General madness or genuine miracle? Paper presented at the International Seminar on Biotechnology and India's Development, Bangalore, November 22–24.

Iyengar, Sudarshan. (n.d.) *Biotechnology in Agriculture in Asia: A Social Scientist's Concerns.* Surat: Centre for Social Studies.

Jayanthi, G., Janet Geddes, Utpal Moitra and Ashis Mondal. (2007). A *Handbook on Using Participatory Monitoring and Learning Tools.* (65). New Delhi: Academic Foundation in association with Action for Social Advancement (ASA), Bhopal.

Jodha, N. S. (1986). Common property resources and rural poor in dry regions of India. *Economic and Political Weekly,* 21: 27.

Joshi, P. K., A. K. Jha, S. P. Wani and T. K. Sreedevi. (2005). Meta-analysis to assess impact of watershed programme and people's participation. In Wani, Suhas P., Johan Rockstrom and Theib Oweis (eds.). (2009).

Kakade, B. K. (2005). *Watershed Manual: A Practical Guide for Watershed Development Practitioners and Trainers.* Pune: BAIF Development Research Foundation in association with Lead India, New Delhi.

Kumar, Anish, H. K. Deka, Pankaj Das and Pawan Ojha. (2007). *Livelihood Opportunities in Broiler Farming: A Livelihood Resource Book.* New Delhi: Professional Assistance for Development Action (PRADAN).

Kumar, Sanjay and Mahesh Chander. (2004). Is goat farming a threat to ecology? *Himalayan Ecology, ENVIS Bulletin.* 12(2): 13–16.

Kumar, Sarat G. V. (2008). Irula snake-catchers' industrial cooperative society: Honing traditional skills for livelihoods. *Transforming India.* July: 23–24.

Lal, Ratan. (1994). Methods and guidelines for assessing sustainable use of soil and water resources in the tropics. *Soil Management Support Services,* Technical Monograph No. 21. Washington, D.C: US Agency for International Development.

Mahnot, S. C. and P. K. Singh. (1998). Revival and refinement of *johads* in Rajasthan: A case of scientists' efforts at augmenting traditional water harvesting structures. In Pastakia, A. R., Brij Kothari and Vijaya Sherry Chand. (eds) 1998.

Mehta, Gopal. (2009). Fruits get organic tag. *Down to Earth.* January 1–15: 38.

Misra, Soumya S. and Kirtiman Avasthi. (2009). Test tube brinjal. *Down to Earth.* April 1-15: 29–34.

Misra, S. Soumya. (2009). Made it. *Down to Earth.* January 1–15: 31–35.

——— (2009). No pesticide no debts. *Down to Earth.* January 1–15: 36–38.

Munshi, K. M. (1952). *The Gospel of the Dirty Hand.* New Delhi: Ministry of Information and Broadcasting, Government of India.

MYRADA and IIRR. (1997). *Resource Management in Rainfed Drylands: An Information Kit.* Bangalore: MYRADA and International Institute of Rural Reconstruction, Silang, Cavite, Philippines.

Naturol Bioenergy Ltd. (2007). http://www.naturo-bio.com (accessed October 30, 2009).

Neelam, G. S., B. K. Kakade and A. S. Jape. (2008). *Water User Groups: Baif's Experience towards Equitable Water Use.* Pune: BAIF Development Research Foundation.

Nisbert, R. A. (1966). *The Sociological Tradition.* New York: Basic Books.

Pallavi, Aparna. (2009). Women grow food basket: Maharashtra district revives an old farm practice and tackles drought. Special Report in *Down to Earth,* November 16–30: 24–25.

Participatory Guarantee System (PGS) India. (2010). http://www.pgsorganic.in/ (accessed May 2010).

Pastakia, Astad. (1996). Making nature your guru! *Honey Bee.* 7 (January-March): 17–19.

——— (1996). Grassroots innovations for sustainable development: The case of agricultural pest management. (Dissertation, Indian Institute of Management, Ahmedabad).

——— (1998). Grassroots ecopreneurs: Change agents for a sustainable society. *Journal of Organisational Change Management.* 11(2): 157.

Pastakia, Astad, Brij Kothari, and Vijay Sherry Chand. (2002). *Farmer-Led Participatory Research: Cases from Western India.* (112). Bangalore: Books for Change.

Pathan, Bashir. (2008). Now, a drinking water programme managed by communities." *The Indian Express,* Ahmedabad, February 9.

Pisharoty S. B. (2010). Cleaner and greener. http://www.thehindu.com/mp/2010/01/28/stories/2010012850470300.htm (accessed May 5, 2010)

Planning Commission. (2009). *Tenth Five Year Plan—2002–2007 (Vols. 1, 2, 3).* New Delhi: Planning Commission, Government of India.

Prahalad, C. K. (2006). *The Fortune at the Bottom of the Pyramid.* New Delhi: Dorling Kindersley (India) Pvt. Ltd.

Rajora, Rajesh. (2002). *Integrated Watershed Management: Field Manual for Equitable, Productive and Sustainable Development.* (616). Jaipur: Rawat Publications.

Raveendran, Renitha. (2009). There is scientific evidence to prove that GM crops have harmful effects. *The Indian Express:* Ahmedabad. October 22: 10.

Raychaudhuri, S. P. (1980). The occurrence, distribution, classification and management of laterite and lateritic soils. *Cah. O. R. S. T. O. M. Sếr Pếdol,* XVIII(3–4) 249–252. http://horizon.documentation.ird.fr/exl-doc/pleins_textes/cahiers/PTP/1423.PDF (accessed May 2010).

Reddy G. N. S, C. Doreswamy, K. Raghunath, and S. B. Kumar. (2001). Networking farm ponds. In Anil Agarwal, Sunita Narain and Indira Khurana (eds.) 2001.

Rural Innovations Network. (2009). http://www.rinovations.org/People/the-rin-team and http://www.rinovations.org/l-ramp (accessed December 2009).

Satish P. V. (1997). "Dalits, women, tradition and watersheds: Can there be a harmony?" Hyderabad: Deccan Development Society. http://www.ddsindia.com/www/dalitwtrshds.htm (accessed June 2008).

Sharan, Girija. (2006). *Dew Harvest.* Environment and Development Series. Ahmedabad: Centre for Environment Education in association with Foundation Books Pvt. Ltd., New Delhi.

Sharma, Ashok. (2007). Community effort springs life into orphan crops. http:// www.ddsindia.com/www/dds_news/Community%20effort%20springs%20life%20 into%20orphan%20crops.htm (accessed May 2010).

Shilliorn Von Veen, T.W. (1999). Agricultural policy and sustainable livestock development. *International Journal of Parasitology* 25: 7–15. In Sanjay Kumar and Chander. (2004). Is Goat Farming a Threat to Ecology? *ENVIS Bulletin: Himalayan Ecology* 12(2) 13–16. http://gbpihed.gov.in/envis/HTML/vol12_2/sanjayakumar.htm (accessed May 2010).

Singh, P., P. K. Agarwal, V. S. Bhatioa, M. V. R. Murty, M. Pala, T. Oweis, B. Benli, K. P. C. Rao and S. P. Wani. (2000). Yield gap analysis: Modeling of achievable yields at farm level. In Wani Suhas P., Johan Rockstrom and Theib Oweis (eds.) (2009).

Srinivasan R. K. Indian railway's experimentation with eco-friendly toilets. *Down to Earth,* March 31, 2008: 40–41.

TERI. (2007). TERI develops TERI Solverter to address the needs of reliable power supply in rural India. New Delhi: The Energy and Resources Institute, October 23, http://www.teriin.org (accessed, June 2008).

The Hindu. (2007). Swaminathan Foundation launches mobile fisher friend project. December 27.

Tideman, E. M. (2000). *Watershed Management: Guidelines for Indian Conditions.* New Delhi: Omega Scientific Publisher.

Times News Network (TNN). (2008). Rs 55,600 crores worth crop wasted every year. *The Times of India:* Ahmedabad. April 18.

Tiwari, Shailendra, Ronak Shah, Vivek Vyas. (2008). *Making the Herd Survive!* Udaipur: Seva Mandir.

Varma, Samyukta, Shilp Verma and Regassa E. Namara. (2008). Promoting micro-irrigation technologies that reduce poverty. Water Policy Briefing Series, Colombo: International Water Management Institute. www.iwmi.cgiar.org/waterpolicybriefing/index.asp (accessed June 2008).

Vihol, P. B., A. S. Jape, P. K. Pradhan and J. N. Daniel. (2004). The SMART Model.

http://www.baif.org.in/aspx_pages/pdf/Agriculture/SMART.pdf (accessed May 2010).

Wani S.P., P. K. Joshi, K. V. Raju, T. K. Sreedevi, J. M. Wilson, Shah Amita, P. G. Diwakar, K. Palanisami, S. Marimuthu, A. K. Jha, Y. S. Ramakrishna, S. S. Meenakshi Sundaram and Marcella D'Souza. (2008). *Community Watershed as a Growth Engine for Development of Dryland Areas: A Comprehensive Assessment of Watershed Programmes in India.* Patancheru: International Crops Research Institute for Semi-arid Tropics (ICRISAT) and MoRD.

WOTR. (n.d.) *Technical Notes.* Training Manual, Ahmednagar: Watershed Organisation Trust.

Yunus, Mohammad. (2007). *Creating a World without Poverty: Social Business and the Future of Capitalism.* New York: Pereus Books Group.

Zachariah, Reeba. (2009). After Nano, Tata switch to 'Swach'. *The Times of India:* Ahmedabad. December 8.

Part-3

Best Practices

1. **Technical and Social processes in Micro-watershed Development**
2. **Reducing Salinity through River Basin Treatment**
3. **Participatory Varietal Selection and Promotion**
4. **Meeting the Challenge of Drinking Water Security in the Marwar Region of Rajasthan**
5. **BAIF's Wadi Model**
6. **Sadguru's Lift Irrigation Initiative**
7. **Livestock and Local Breed Development in Barmer**
8. **Timbaktu Organic**
9. **Promotion of Goat Husbandry in Dholpur by PRADAN**
10. **Improving Livelihoods by Making Vermi-compost**

The views expressed in these case studies are those of the authors and do not reflect the official opinion of the institutions studied.

1 Technical and Social Processes in Micro-watershed Development : The Seva Mandir Experience

Background

Since 1969, Seva Mandir[1] has been working in the six tribal blocks in Udaipur and Rajsamand Districts of southern Rajasthan. The area is encircled by the Aravalli Hills and *Bhils* constitute 37 per cent of the total population of the two districts. Agriculture and wage labour are the two main sources of livelihood. Seva Mandir's programmes focus on rural livelihoods, basic health, primary education, and 'gender-just' development. Seva Mandir creates village-level institutions, which can function autonomously.

The area where Seva Mandir works receives an annual rainfall of 640 mm. The rainfed is erratic and unevenly distributed. Much of the water runs off because the terrain is highly undulating. Only 18 per cent of the land is under agriculture; this is mainly rainfed. A vast majority of the land in this area is under state control, in the form of forests, pastures and revenue lands. The local community manages the state-owned commons; a significant proportion of the population depends on the commons for meeting its livelihood requirements.

The commons has been degraded due to a number of factors. The important causes of this degradation are the commercial felling of trees, the increase in human and cattle population, the failure of the forest to regenerate, the practice of open grazing and the breakdown of the community management system. The ever-increasing need for land for agriculture, coupled with ownership disputes and lack of proper demarcation, has worsened the social cohesion among the people.

Against this background, Seva Mandir initiated its natural resource development (NRD) interventions, with the ultimate objective of impacting livelihoods. It has so far successfully treated about 11,000 ha of land, enabling 3,500 households to augment their livelihoods. The interventions have led to 20-30 per cent increase in productivity, depending upon the prior condition of the land in the watershed. This case study focuses on the planning process that made such achievements possible.

Physical Interventions

The well-being of the poor in the region is closely linked to the productivity of the natural resources. However, the overall productivity of natural resources is very poor in the region. Seva Mandir initiated work on NRD in 1986. Within the framework of watershed development, Its activities include wasteland and pastureland development, joint forest management, soil and water conservation, agricultural extension, crop development and small-scale lift irrigation (LI) schemes. Its land development and water conservation activities are described here in brief.

Land and vegetation development

The major constraints affecting agricultural productivity are soil erosion, encroachment upon commons and disputed land ownership rights. Interventions vary according to the types of land whether it is commons, forest or private land.

Common lands and private wastelands of interested farmers were first enclosed with stone walls. Grass seedlings and *Jatropha Carcus* were planted on the trenches to prevent soil erosion. Anicuts were constructed on the drainage line and in the valley areas. Gabion structures were put up where water rushed at great speed. Community protection of forests under Joint Forest Management (JFM) programme were undertaken on the available forest lands. Agricultural extension and horticultural activities were also undertaken.

Once the common and the private wastelands were enclosed, the appropriate vegetation was planted, depending on the slope and soil depth. By enclosing some parcels of land, free grazing was prevented, leading to the natural regeneration of these lands. Horticultural crops were planted in irrigable wastelands.

Water conservation activities

Frequent spells of drought, uneven distribution of rainfall, high volume and high speed of run-off water are major problems in the area. Earthen bunds and check dams were built, contour trenches were dug, loose stone masonry and gabion structures were put in place, and anicuts were constructed to conserve moisture and water. Once these measures were in place, LI systems were installed in a few anicuts, and wells were dug for groups of farmers, ensuring efficient utilization of water for irrigation.

Planning and Implementation Process

Seva Mandir gives equal importance to both social and technical planning because watershed development work requires a techno-social approach. If technical suitability and viability conflicts with the social expectations, implementation can be delayed and only partial benefits would accrue from the project. These issues are examined carefully during the preparatory phase to avoid problems in the end.

Preparation and Planning: Social

- The demand for taking up watershed development must come from the villagers.
- Participatory rural appraisal is conducted to obtain adequate information about the watershed area.
- Joint meetings are conducted to finalize gross planning as well as specific activities, making sure that the technical requirements of the watershed development are congruent with the villagers' social aspirations.
- Training (social, technical and managerial) is given and exposure visits are arranged for the *Gram Vikash Samuhs* (Village Development Associations) and their representative committees.
- Contested issues (for instance, caste divisions and encroachment) and their possible solutions are identified.
- Participation of the community is ensured during the planning, implementation and monitoring levels.

Preparation and Planning: Technical

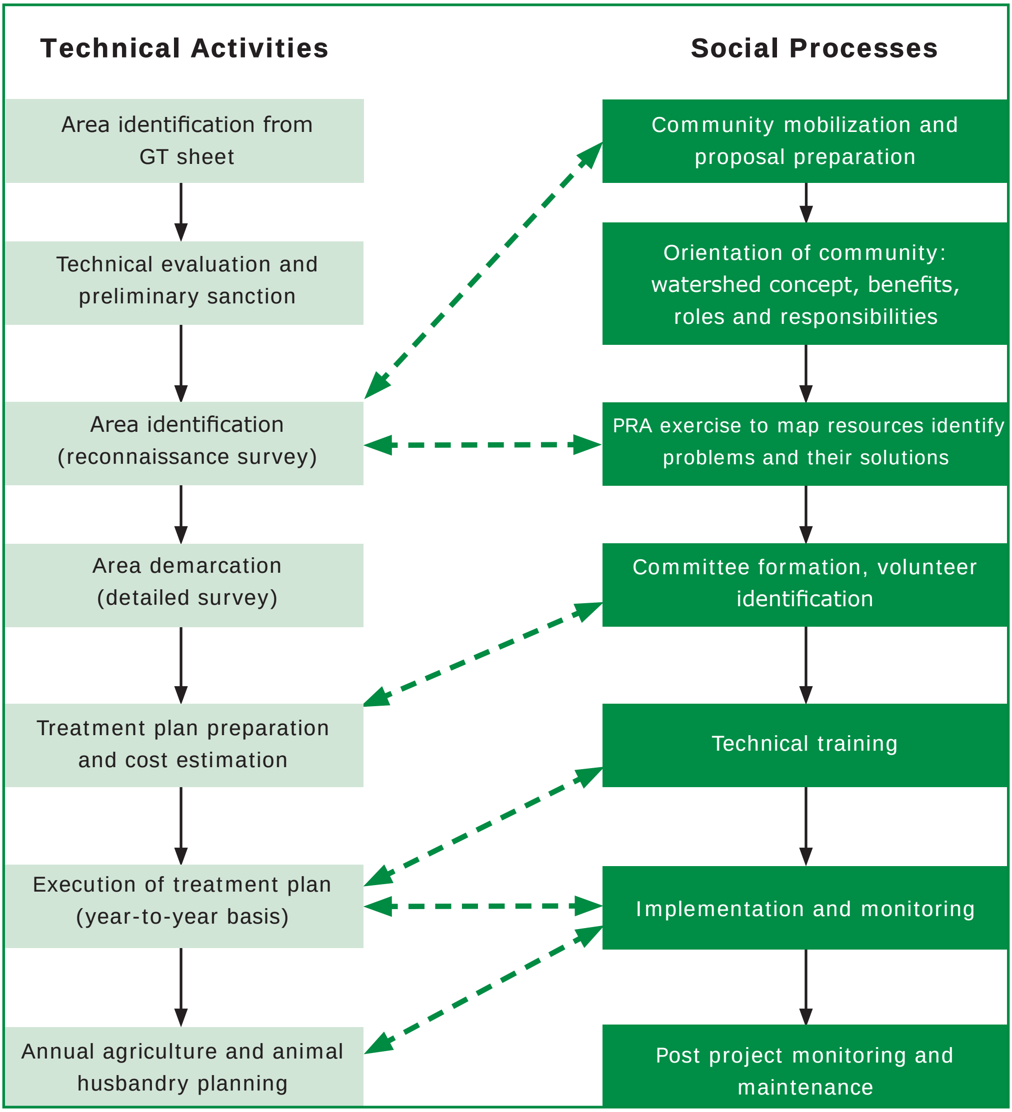
- The watershed area is identified from the Geographical Topo Sheet (GT Sheet). Its boundaries are fixed from this exercise.
- Land use and ownership of the area to be covered by the watershed is determined.
- Soil and water conservation treatment is planned and budgeted.
- Watershed plus activity and its funding are planned.

The interaction between the technical and the social aspects of the planning process is captured in Figure 1. As the diagram shows, the process is an iterative one, in which the technical staff of the project implementation team interacts intensively with the local community while preparing the treatment plan and, subsequently, at the time of implementation.

Monitoring and Evaluation Systems

When the work is going on, the zonal staff, supported by the block-level staff, monitors the day-to-day progress and guides the villagers. The resource units situated at the head office are responsible for technical monitoring.

Figure 1: Interaction between Technical and Social Processes in Watershed Development



In order to assess the impact of the watershed project, certain indicators are developed on which data are collected on a continuous bases. To assess the impact on the level of the ground water, data are collected regularly from five randomly selected wells twice a year (May and December), before and after the watershed intervention. Improvement in crop productivity is assessed by regularly collecting the productivity data of different crops in a given season from the selected farmers. Evaluation is done midway through the project and at its end, to assess the impact of the project, make necessary course corrections and improve the project design.

Conclusion

Often, practical problems arise. For instance, it may not be possible to target all farmers, who fall within the watershed area, as beneficiaries of the proposed treatment. A second problem arises when the total area under the watershed is not available for treatment, which is often the case. In addition, the developmental agency is faced with a number of constraints:

- The range of activities that can be undertaken depends on the funds generated.
- The extent of detailed planning and preparation for the project depends on the organization finding time for it, the availability of resources (manpower, machinery, vehicles, experts, etc.) and the negotiating power of the organization vis-à-vis the government, the panchayat and the community, with reference to the area treated.

In spite of these constraints, Seva Mandir has been able to make significant impact on the livelihoods of the people in Udaipur and Rajsamand through its intervention. The farmers have benefited through the treatment of land and harvesting of water, and the landless have found better employment opportunities in the village on account of the overall development of agriculture. The women have benefited from the increase in the availability of water, fuel and fodder, leading to reduced drudgery in the collection of these items for daily use. Their economic and social emancipation was promoted through the organization of Self-Help Groups (SHGs) and projects on health and sanitation.

End-notes

1. Seva Mandir is a non-governmental organization (NGO) working for the development of the rural and tribal population in Udaipur and Rajsamand Districts of southern Rajasthan. The work area encompasses 626 villages and 56 urban settlements. In all, the organization reaches out to about 70,000 households, influencing the lives of approximately 3,60,000 persons.

2 Reducing Salinity through River Basin Treatment: Meghal River, Junagadh District [1]

Introduction

For agricultural communities, water is literally the lifeline. This case study documents the efforts made to restore the Meghal River, the lifeline of Maliya block of Junagadh District, Gujarat.

Known as the groundnut bowl of India, Junagadh District in Gujarat has become a 'dark zone' (an area where groundwater is overexploited), mainly because a large quantity of water has been extracted to irrigate cash crops like vegetables and groundnut. In the coastal areas, the problem is further compounded by seawater intrusion, which increases the salinity of the groundwater and the soil. Moreover, we find that, close to Maliya Block, a major river of the region, River Meghal (70 km long with a catchment area of 471 sq km), which had enough water for drinking and irrigation for 60 villages of the block till late, is drying up. It was a perennial river till 70s; but by early 1990, water flowed for only 4-5 months in a year. Being a semi-arid region, the area also needs drought-proofing measures because the rainfall is meagre (less than 800 mm) and the pattern of rainfall is erratic.

The watershed approach was adopted in the district to address the issue of quantity and quality of water but it had only limited success. Watershed projects are isolated projects and their gains are limited to project-defined beneficiaries. In early 2001, the Aga Khan Rural Support Programme-India (AKRSP-I)[2], therefore, tried the river basin development approach in the district, with remarkable success. A river basin is the portion of land drained by a river and its tributaries. It encompasses the entire land surface drained by streams and creeks that flow downhill into one another and eventually into one river, and finally into the ocean. A watershed, on the other hand, is an area that drains to a small stream, lake or wetland. Essentially it is a sub-region of the river basin and, hence, much smaller in size. When government programmes focus on building large reservoirs to irrigate lands downstream, the problems of catchment areas often remain unaddressed. A river basin approach (RBA) is more inclusive; its benefits reach a larger community. The present case covers a river basin, which is home to 54 villages.

Initial Processes: Involving the Community

The AKRSP-I found that unless the entire community gets involved, no project achieves all its goals. As a first step, towards involving the entire community, a core group was formed from among those village representatives, who were really interested in working for the development of the river basin and taking a leadership role in his/her own village.

The core group was made aware of the new approach first. One of the most important tasks it had was to spread awareness about the approach among members of their communities. A variety of forms of communication—workshops, seminars, exposure visits to successful models, *padyatra* and *nukkad natak*—were used to propagate ideas. Gradually, communities began getting involved in planning and site selection.

The core group took part in planning and, gradually, took over all other responsibilities monitoring, decision-making, implementation, supervision, crisis management, conflict resolution, and maintaining accounts and book keeping. The core group formed various sub-committees, each with a specific role.

After creating awareness about the RBA in the community, useful and relevant information was imparted: how the technical intervention would work and how it would address the problem of salinity ingress were explained. The importance of maintaining the sequence of activities and not leaving any patch untreated was brought out. There were lessons on water management for efficient and effective irrigation.

Institutional Structure

Jal bachavo juths

Jal Bachavo Juths (JBJ) or Water Conservation Groups, were formed in every village. A village would have several JBJs, each representing a specific area. A JBJ spreads awareness about the need to save water; it regulates water consumption by adopting water-efficient practices and monitors the water table in the designated area. It participates in the micro-planning for the region and in the implementation of the programme.

Gram jal bachavo samiti

The JBJs got together to form the *Gram Jal Bachavo Samiti* (GJBS) at the village level. The GJBS coordinates the activities of the JBJs, establishes links with the taluka-level government officials and NGOs, and helps implement water harvesting and recharging activities.

One of the long-term objectives in this approach is to create institutions at increasingly higher levels, for instance, at the taluka or sub-stream level, with varying tasks and responsibilities. An important function of these more encompassing institutions is to influence policy at the district level.

Semi-technical teams

From every village, two or three persons were trained in semi-technical aspects. These semi-technical teams not only support the core group but also help in maintaining the momentum of the programme, and continuously monitor the qualitative aspects.

User groups

Several small groups called user groups (UGs) were formed, one for each technical and structural intervention. UGs are responsible for controlling, monitoring and maintaining structures. Water management groups were also formed.

Women's groups

Keeping in view the fact that women do 60 per cent of agricultural work and have the responsibility of securing drinking water for the family, special efforts were made to ensure their participation. A drinking water programme was planned and implemented through women's groups. Large-scale participation of women was ensured in both wealth-ranking exercises and capacity building programmes.

Implementation

When the implementation of the programmes began, the focus was first on water conservation. A series of water conservation measures were taken up by making sure that there were no gaps in the physical structures like check dams and diversion ditches, and by deepening and widening the rivulets. A mention must be made of an innovative, temporary water harvesting structure, *bori bandh* ('sack dam'). A bori bandh costs very little and is very simple to build. It is constructed by filling soil in plastic bags and arranging them in two rows across a *nullah* or a stream. More soil is packed between the rows to compact them. A *bori bandh* is constructed just around the last spell of the rain when the run-off is not strong, rapid or voluminous. It can hold water for 8-9 months, raises the height of water storage and is not likely to flood the fields. The AKRSP-I constructed 80 such structures in 48 villages at the total cost of Rs 2,51,168, which stores 55.56 million cft of water.

Simultaneously, interventions on the water management front were started; agronomic and irrigation practices, which reduce the use of water, were promoted.

Ensuring Transparency, Promoting Ownership

During the implementation stage, funds were transferred to UG accounts, which now carry out all transactions. This process ensures transparency and enhances the sense of ownership of the structure by the UG. The sense of ownership was further consolidated when beneficiaries contributed—in cash or kind—towards costs. It varied from 10 per cent to 70 per cent, depending on the nature of work and benefits.

Impact

The impact of the treatment became visible from 2006 onwards.

- Earlier, water in the Meghal River used to flow only during monsoon but, after the treatment, the flow period has increased to about six months. (Annexure A)
- The water in the river has raised the water table in wells in the command areas, which means more water is available for irrigation.
- Drinking water has become available throughout the year, thereby reducing women's drudgery, and improving the health of the human beings and the animals in the area.
- Earlier, the total dissolved salts (TDS) level in the region was 3,000–8,000 ppm. This went down to 1,500 ppm during the monsoon and 2,500 ppm in the summer after implementation.
- Oil content in the groundnut crop rose by 6-8 per cent, fetching farmers a higher price in the market.
- The rate of migration went down. People did not migrate to other places to make investment; they invested in their own villages.
- The programme changed people's ways of thinking. They developed a sense of ownership towards various components and they began thinking at the regional level instead of limiting themselves to thinking at the individual or household levels.

Annexure

Water Flow Measurement in the Meghal River Basin

No.	Village	Name of Point	River	Discharge in m3/sec (2007)	Water Flow in m3 in 24 hrs	Discharge in m3/sec (2008)	Water Flow in m3 in 24 hrs
1	Itali	Meghapat	Vrajmi	0.41	35,424	0.64	55,296
2	Vadiya	Jangivad	Vrajmi	0.54	46,656	0.55	47,520
3	Kadaya	Khodiyar ghuno	Vrajmi	0.79	68,256	0.86	74,304
5	N. Dhanej	Near village causeway	Vrajmi	0.42	76,032	0.9	77,760
6	Gadu	Meghal CD	Meghal	0.07	36,288	0.48	41,472
7	Maliya	Lathodariya CD	Meghal	NA	NA	0.1	8,640
8	Vadala	Near village causeway	Meghal	NA	NA	0.25	21,600
9	Khorasa	Bhutnath	Kalindri	NA	NA	0.05	4,320

Rainfall in 2006 was 825 mm, and in 2007 it was 1,216 mm
Discharge measured on 6/3/2007 and 6/3/2008

End-notes

1. Abstracted by Dr. Rohini Patel from a full-length case study of the same title, authored by Umesh Desai and Pankaj Joshi.

2. AKRSP-I is a professional NGO that works intensively with rural communities in about 800 villages in Gujarat, Madhya Pradesh and Bihar; it helps the communities to organize themselves and manage their land and water resources to increase income and improve the quality of their lives.

3 Participatory Varietal Selection and Promotion: Bridging the Gap between Lab-to-Land and Land-to-Market:[1]

Introduction

Action for Social Advancement (ASA)[2] has been experimenting with the Participatory Varietal Selection and Promotion (PVSP) since 1998, in central India. This case study presents ASA's unique experience in bridging the gap between lab to land through PVSP and land to market through farmer seed producer companies (FSPCs).

What is PVSP?

PVSP is a method to understand the felt and the perceived needs of farmers for suitable varieties, and to allow them to test, identify, adopt and spread their preferred varieties from a basket of choices provided to them.

Over the years, ASA has implemented several seed improvement programmes with the participation of farmers and scientists, both in the high production potential systems (HPPSs) and in the low production potential systems (LPPSs). As a result of this experience, ASA has been able to standardize the approach, which has the following critical stages:

- Identifying farmers' needs with respect to improved varieties through participatory methods.
- Searching for suitable alternatives from within the available pool of released varieties, which have attributes close to those identified by farmers.
- Making available small quantities of these varieties as a basket of choice to farmers and facilitating them in testing these varieties under their own crop husbandry practices.
- Documenting farmers' assessment of the performance of these varieties under a large number of trials conducted in a wide range of micro-climates.
- Promoting farmer-preferred varieties by producing seeds locally and disseminating them in similar agro-ecological and socio-economic conditions.

PVSP in HPPS Areas: Some Early Lessons

Krishak Bharati Cooperative Limited was among the first to implement PVSP programmes in India. Between 1997 and 1999, it implemented Phase I of the project on participatory crop improvement in HPPS areas. ASA implemented Phase II of the project from 2000 to 2003, in Lunawada Taluka, Godhra District, Gujarat. Phase II was an extension of Phase I in 12 villages, in which the PVSP programme was tried out on crops like irrigated rice, wheat, moong bean, chickpea and maize. A total of 2,279 farmers carried out 821 trials on 35 varieties. The following observations were made, based on the trials:

- The gains of yield over local varieties, in all crops tested, ranged from 20-40 per cent (50 per cent in some villages in case of paddy; 30-42 per cent for wheat).
- The cost of production for paddy decreased by about 25% because expenditure on pest control, irrigation and other costs was less.
- Early maturity made it possible for the farmers to carry out early sowing of wheat and chickpea in the rabi season, thus saving one pre-sowing irrigation. The early sown crops had better quality and low incidence of pests, and fetched a higher price.
- In spite of this very favourable response, the spread of farmer-preferred seed was limited due to the strong influence of private seed companies, which dictated the terms of trade, keeping their own business interests in view.

Extending PVSP in LPPSs

During the same period, ASA sought to try out PVSP in dry-land areas, with financial support from the Aga Khan Foundation, India. This experiment was carried out in 12 villages of Jhabua and Dhar Districts of Madhya Pradesh with rainfed crops such as maize, black gram, soybean (kharif) and gram (rabi). The project vindicated the usefulness of PVSP in dry-land areas. The following are LPPS-specific observations, gleaned from the experience in Madhya Pradesh:

- Due to recurrent droughts, the PVSP cycle was usually longer in HPPSs than in LPPS.
- The priorities of farmers practising subsistence agriculture were rather different. Farmers in these areas often traded off yield for early maturity, taste or cooking attributes.
- In the areas selected, the impact of PVSP could be improved substantially by simultaneously focusing on other technological interventions like soil management to increase the moisture-holding capacity of the soil, which in turn would increase the drought resistance of the crop.

- In Jhabua and Dhar, the intervention was made in the wake of watershed development when farmers were looking for a change in varieties, in order to take full advantage of the augmented water supply and soil moisture. Therefore, the resource-poor farmers were inadvertently left out from the larger benefits of the project.

Scaling Up PVSP in MP and Jharkhand

The need to cater to the requirements of small and marginal farmers and women (who carry out much of the agriculture-related work in dry-land areas) was realized towards the end of the above project. This was subsequently addressed when ASA a took up PVSP in other districts of the state like Chhattarpur. Later it was scaled up in 14 districts through the District Poverty Initiative Programme (DPIP), which was being implemented by the state government with financial assistance from the World Bank.

By the middle of 2007, ASA was instrumental in facilitating over 13,000 trials in 550 villages of 24 districts in three states. The approach has been adopted for 12 different crops of semi-arid, rainfed regions and over 20 farmer-preferred varieties have been diffused on a significant scale. The increase in yield of these varieties over local checks was as high as 30–40 per cent. The adoption led to multiple benefits to the farmer like reduction in the cost of inputs, improved quality of produce, risk mitigation due to the short duration and greater sustainability due to the higher varietal diversity. (Table 1)

Table 1: Some Successful Preferred Varieties

Crop	Varieties	Advantage over local popular variety*
Soybean	Kuber, P-16, Samrat	Y-20%, M-15 days, Low pest
Maize	Narmada Moti, GM-6	Y-30%, M-15 days, Good chapatti making quality
Pigeon pea	BDN-2	Y-30%, M-15 days, Low pest
Black gram	TAU-1	Y-40%, M-15 days, Better seed quality
Wheat	HI-1418, HI-8498, PBW-343	Y-30%, M-10 days, grain quality
Chickpea	P-391, BG-372, C-235	Y-15%, M-15 days,
Coriander	Sympo-33, RCR-41	Y-10%, Dual purpose

**Y= Increase in Yield; M= Earliness in maturity*

It was also noticed that the rate of adoption among poor and marginal farmers was unusually high. Not much effort was needed to diffuse these varieties since these had already been tested and accepted by farmers in the PVS stage. Hence, the varieties spread rapidly through farmer-to-farmer diffusion, sometimes spreading to a distance of over 90 km within three seasons.

Quality Seeds through FSPCs

With the success and spread of PSVP, the demand for seeds of new varieties tried and tested by the farmers grew, placing unprecedented pressure on ASA and its partners to set up seed supply chains at an affordable price.

In 2005, ASA started organizing FSPCs (under the Indian Companies Act, 1956, Amendment 2003), to meet this need. The main function of the FSPC is to undertake the production of seeds of farmer-preferred varieties. Its other functions include input supply, marketing of agricultural produce, contract farming, insurance and agricultural credit.

Initially, buy-back arrangements were made with private seed companies in order to meet the demand of the farmers. Seeing the huge market potential, private companies sought to enter into a business alliance with the FSPCs. Currently, 14 such FSPCs, with membership of over 20,000 small and marginal farmers, are engaged in seed production. In 2005, these companies together produced nearly 2,500 metric tonnes of seed, which were certified by the state seed agency.

Common Interest Groups (CIGs) established during the implementation of DPIP, served as a base for building the FSPCs. These groups of farmers produce certified seeds on behalf of the company. They are also the shareholders of the company. The Board of Directors and shareholders are the key decision-makers. However, day-to-day management is carried out by a group of professionals. The company has also developed a fleet of service providers for agricultural services from among the local youth of the area. The ultimate goal of the companies is to provide backward and forward linkages, especially to small and marginal farmers, who are unable to cope with the market forces on their own.

State Initiatives to Support FSPCs

The state agriculture ministry made a key policy change in 2006, enabling an FSPC to have the seed production activity certified for all its members through a single license. This policy change has proved to be a shot in the arm for FSPCs.

Conclusion

- With the growing acceptance of PVSP among the farming community and as the scientific community, the time is ripe to mainstream this approach to crop improvement within the formal research and extension system. There is enough social capital in the states to support such an initiative through training and capacity building of the Agriculture Technology Management Agencies (ATMAs).

- The FPCs are expected to become financially viable in the long run. For now, however, they need incentives from the state, in terms of tax holiday, low interest on working capital and infrastructure support, to establish storage facilities and purchase grading and other equipment.

End-notes

1. Abridged by Rohini Patel from the original case study , 'PVSP and Seed Production by Farmer Producer Companies Promoted by ASA in Rainfed Areas of Madhya Pradesh', October 2007 authored by Astad Pastakia.

2. ASA, based in Bhopal, Madhya Pradesh, has been working since 1996 for the uplift of tribal and other socio-economically marginalized communities through the augmentation of natural resources and local livelihoods. Its various projects, including Watershed Development and Water Reseource Development, Participatory Irrigation Management micro-finance, PVSP, agriculture research and extension, and training and consultancy, are operational in about 800 villages spread across Gujarat, Jharkhand and Madhya Pradesh.

4 Meeting the Challenge of Drinking Water Security in the Marwar Region of Rajasthan[1]

Introduction

In 2003, the erstwhile Maharaja of Marwar, Mr. Gaj Singh decided to create a separate institution called Jal Bhagirathi Foundation (JBF) to take up developmental work in the Marwar region. Marwar is the most densely populated arid zone in the world. Lack of adequate drinking water for humans and livestock was the key factor that limited the development of the region. Shortage of drinking water was a main reason for high rates of migration. Family life was also disrupted due to forced migration. This affected women most profoundly because they were subjected to great stress and drudgery in trying to provide water for the family. JBF, therefore, decided to address this issue first. An initial success in this sector would then pave the way for launching into other areas of livelihood augmentation, which required community participation.

JBF's direct intervention in 200 villages of Pali, Barmer and Jodhpur Districts covered two main activities:

- Reviving traditional water conservation systems, and
- Mobilizing communities and establishing decentralized systems of governance.

In addition, JBF has created a network of developmental agencies, working in the Marwar region. It plans to reach all the villages of the region through this network by taking up common issues and building the capacities of partner institutions.

Financial assistance was arranged through the UNDP, from the Italian Development Cooperation (IDC) and other funding agencies. UNDP provided an initial grant in 2004, which enabled JBF to experiment with the pedagogy and to set up a team of professionals, which would facilitate the development process. The IDC grant of about Rs 165 million has been the mainstay for reaching out to the 200 villages in a period of four years. These four years have witnessed dramatic changes in the attitude of the people through their participation in the programme. JBF has also been effective in influencing policy at the state level, which has now accepted the strategy of reviving traditional water harvesting systems to overcome the crisis of drinking water in the state. This case study describes how JBF mobilized the people and operationalized this strategy.

Reviving Traditional Water Harvesting Systems

The Marwar region, like many other parts of Rajasthan, had a strong traditional system of water harvesting and protection of *oran* (common pasture) lands. The *oran* lands also served as the catchment for *talabs* and *nadis* (community tanks and ponds), which were the main source of drinking water for human beings and animals. The habitats were often scattered; therefore, many people built *tankas* (underground water storage structures with closed top and a small catchment to harvest rainwater), which were used to store water drawn from the *talabs* and *nadis*. The water could be stored for about 1 to 4 months, depending on the size of the tanka. Over time, these traditional institutions became weak; *oran* lands were encroached upon and community tanks were either silted or in a state of disrepair. JBF decided to revive and repair the traditional water harvesting systems and create new modern, decentralized systems of governance.

By 2008, 190 water-harvesting structures consisting of community *tankas*, school *tankas,* community *beris* and *nadas/nadis/talabs* were created in 131 villages and 43 *dhanis* (hamlets).

Mobilizing People around Drinking Water Issues

JBF was inspired by the work of Mr. Rajendra Singh in Alwar, whose efforts at mobilizing people in Alwar district to restore traditional water harvesting systems received international recognition[2]. Mr Gaj Singh, the Chairperson, invited him to join forces and guide JBF in mobilizing the people so that a movement for self-reliance could be created, followed by the establishment of a new system of governance, to replace the traditional ones that had become defunct.

A number of campaigns, camps and events were organized (initially with guidance from Rajendra Singh) on the themes of water and environment. Whereas some of these created awareness, others imparted information, mobilized people and built capacities through training. In all, 12 project-level, 37 block-level, and 190 village-level campaigns were organized, resulting in a great deal of awareness. These campaigns generated demand for the creation and renovation of more water harvesting systems.

The awareness of the right to drinking water as a community asset went up as a result of these campaigns. This was further heightened with the demonstration of water harvesting and storage structures created in different villages through the efforts of Jal Sabhas. The demand for more structures continues to increase in spite of the fact that the people are expected to contribute at least 30 per cent of the capital (as compared to none in government schemes). As the awareness about the need for water conservation grew, people began to realise the need to become self-reliant rather than dependent on the government. They began to understand the need to conserve their own water rather than to depend on pipelines.

Establishing Decentralized Systems of Governance

Local Governance for Water

A three-tier structure of local governance for water has been established. At the village level, the bottom tier is the Jal Sabha, formed when at least 30 members representing different sections of the village community get together. These members then select/ elect six office bearers, one of which must be a woman. So far 190 Jal Sabhas have been established.

At the cluster level are the Jal Samitis. These are formed from selected representatives of different Jal Sabhas. A Jal Samiti must have at least 10 members. As of now there are four such Samitis and their task is to scrutinize micro-project proposals and forward appropriate ones to the Jal Parishad for final sanction.

The Jal Parishad is the third and the highest level in the structure. There are 16 members in the Jal Parishad, comprising people's representatives as well as experts from reputed resource institutions and members nominated by JBF. The Jal Parishad meets on the first of each month to review projects and sanction new ones, based on the presentations made by the JBF staff. It also takes policy decisions and reflects on strategic issues. One of its functions is to nominate suitable members to the Jal Samiti, based on leadership qualities demonstrated at the Jal Sabha level.

Besides this, an annual meet, called Jal Sansad, of all stakeholders is organized in January. More than 300 participants attended the Jal Sansad in 2008. The purpose of this meeting, besides networking, is to reflect on policy issues for the project area and the state.

Women's SHGs and Participation in Water Management

Another dimension of social capital is the creation of Jal Mandals—women's SHGs, which initially has taken up savings and credit activities. As of now, there are 53 Jal Mandals. The women leaders from Jal Mandals in two cases were instrumental in forming all-women's Jal Sabhas, to implement water harvesting and storage structures. In due course, JBF hopes that the women will be sufficiently empowered to take up much of the work related to the creation and management of the drinking water systems in the village.

The Jal Sansad has taken a stand of positive discrimination towards the backward communities. More than 80 per cent of the community *tankas* have been created for backward communities, including SCs/STs and OBCs. These communities also have fair representation in the Jal Sabhas and actively participate in decision-making. JBF insists that there will be no discrimination on the use of water from the community tankas. This condition has been found acceptable to the upper castes not only out of enlightened self-interest but also because of the charismatic leadership of Mr Gaj Singh, whom they still consider as their Maharaja and leader.

Norms for Equitable Distribution of Water

Different norms and mechanisms have been evolved, depending on the nature of the water source, to attain equitable distribution of water.

Nadis and talabs

Most of these are used by multi-caste people and managed by multi-caste Jal Sabhas. All castes and communities from specified villages are allowed to take water at a pre-determined rate per tractor. The poor people of the village generally draw water directly if the source is nearby. Given the low precipitation (250–400 mm) and the rolling topography of the region, the catchment areas are often very large and water security for 5 to 8 villages may depend on just one *talab*. Hence, norms have been

developed to allow dependent villages to draw water with the help of tractor drawn tankers. In order to meet the maintenance of the tanks, a number of Jal Sabhas have started charging a small fee of between Rs 50 and Rs 100 per tanker. The charge for the people from the village is less than half that for the outsiders.

Beris

These are traditional, narrow, well-like structures, which serve the purpose of collecting moisture in the sub-surface soil. The water can be used for drinking. It is usually located in sandy regions and close to a large water tank. Earlier, access to these beris was caste-based; with the coming of the JBF scheme, access to many of these beris is open to people of all castes.

Tankas

Usually, the members of the same caste use *tankas* and, often, they belong to the same family. Hence, the norms for equitable sharing of the water and contributions for maintenance are relatively easy to implement.

Norms for maintenance of structures

The money raised through annual contributions and fees charged per tanker is kept in a *jal kosh* as maintenance fund. Money is also raised for the maintenance of *tankas*. A system of *shram dan* (voluntary labour) was used once or twice a year for cleaning the *agores* (catchment areas). De-silting of feeder channels and tanks is carried out before the monsoon. People are usually allowed to carry silt for free.

Norms for people's contribution

The project requirement was that the people contribute in cash, kind or labour at least 25 per cent of the investment expenditure and take full responsibility for the maintenance of the water harvesting and storage structures. Significantly, upper-caste people were expected to contribute 50 per cent of the project cost. In all sites, contributions exceeded the project requirement. As per JBF's norms, the grant money was released only after the Jal Sabha completed the structure, submitted its accounts, and the site was inspected by the JBF staff and found to meet the quality standards.

Impacts of Intervention

The impacts of the intervention have been many:

- Access to water has improved significantly for all, especially for the poor.
- The number of months when water is in short supply has gone down by 3 to

6 months.

- Distance travelled by women to fetch water has decreased in many cases from 3–4 km to a few metres.
- The quality of water has also improved inadvertently because harvested rainwater is stored in the *tankas.* This lasts for four months. After this period, water is taken from the tanks/*nadis* before cattle, contaminated it, and stored. (Due to acute water scarcity in the region, human beings and cattle share the same tanks for drinking water purposes). This is likely to reduce the incidence of water-borne diseases, considered to be high in the region. The cost of water supply has come down to less than half the cost before intervention.
- The new system of water governance enables resolution of conflicts through a dialogue. As a result, the incidence of conflicts around drinking water has reduced significantly.

All the above show how drinking water security has been restored in the project villages, simultaneously raising the confidence of the people in their own abilities and institutions.

End-notes

1. Based on information provided by JBF in April 2008.

2. Mr. Rajendra Singh, locally known as "Paani Baba" had received the prestigious Magsaysay Award in 2001.

5 BAIF's Wadi Model[1]

Introduction

In Vansda, Maharashtra, when livelihood options began to shrink as a result of denudation of forests, the tribals had to migrate. In its efforts to find alternative means of livelihood for the tribals so that they can remain in their own villages, Bharatiya Agro Industries Foundation (BAIF)[2] embarked upon Dhruva, a tribal rehabilitation project in 1982. The core programme of Dhruva is the development of orchards (locally known as *wadi*) on degraded lands. The programme has three main components that work in close harmony: a) the primary production system, which comprises individual owners, who raise horticultural and other crops in their *wadis*; b) the procurement and primary processing system, which is organized by the village-level committee called *Ayojan Samiti,* and c) the marketing system, which is managed by the fruit and vegetable processing cooperatives. Whereas developing markets and maximizing returns for the local produce is the commercial objective, the social objective of the programme is to augment livelihoods of the tribal communities by converting wastelands into viable orchards. BAIF believes in holistic development; therefore, it supplements the *wadi* programme with other programmes in the health and education sectors as well.

BAIF's wadi programme has become a model for the development of the tribal areas in the entire country. Although the programme has multiple dimensions in this case study, we focus only on the wadi component, which deals with natural resource management and not on the commercial and welfare aspects of the programme.

Developing an Orchard

Farmers in the area typically own 3–5 acres of wasteland. The surface runoff during monsoon is generally high because of the undulating nature of the land. Water becomes a scarce resource during the non-monsoon months. Farmers cultivated paddy during the kharif season only. During interactions with the farmers, Manibhai Desai, the founder of BAIF, realized that the farmers had both skill and experience in growing mangoes. But what they needed was a working model that would be able to transform the land of each farmer into a mango orchard. Dhruva became instrumental in evolving such a model, which later became popular as the *wadi* (orchard) model. *Wadi* is a market-led livelihood intervention, aiming at linking individual tribal farmers to the market. The production unit is the individual-owned wadi, a one-acre land with 20 mango and 40 cashew plants as well as other plant species to meet various needs of the family.[3]

Developing an orchard required high investment. Therefore, this was supported with grants whereas marketing, a commercial activity, was carried out with the help of technocrats and management professionals. Both required tribal farmers to achieve the goal of self-sufficiency.

Manibhai Desai's credibility as an agricultural expert and his assurance that each tribal could own an orchard persuaded some tribals to take up the activity. Dhruva started with the tried-and-tested soil and water conservation methods and compensated farmers, who took up these activities on their own land. They were paid wages till the wadi began to generate income.

Before planting mangoes, Dhruva experimented with various combinations of trees for maximizing returns and reducing risks. Mango varieties were chosen with the market in view, and grafted saplings were used to increase the sturdiness and adaptability of the plant to the local terrain. A German agricultural expert surveyed the area and recommended that cashew too could be included. Understanding the need for fodder in the cattle-rearing area, fodder plants were planted around the border. Some thorny species were planted on the outer boundary to serve as a live hedge-cum-windbreak. Eventually, the farmer also grew a kitchen garden for his family's consumption.

Dhruva uses a combination of methods to motivate farmers: exposure visits, free input supply and technical expertise, and assurance of income during the initial phase. The mango and cashew cross-subsidize each other in case of a glut in either market; the fodder grown supports the dairy activity and the intercropped kitchen garden provides subsistence-level nutrition for the family.

Accessing Markets

The *Ayojan Samiti* procures the produce of the wadis—the mango and the cashew. The quantities of mango are notified wadi-wise to the *Ayojan Samiti,* which fixes the date and time for the produce to be delivered for processing at the primary processing centres. This ensures that the fruit does not perish due to lack of facilities on the premises—the village schools in this case—in which it is temporarily stored. On receipt of the semi-processed product, the marketing cooperative routes the payment to the individual *wadi* owners. This completes the production phase in the life cycle of the produce. The processing phase then begins, followed by the marketing phase.

A large number of tribal cooperatives have been established to process fruits and vegetables in the project areas. The Vrindavan Fruit Processing Cooperative, the oldest society in Vansda, established in 1989, processes the produce from the wadis and markets the mango pulp, cashew kernels and pickles. The wadi farmers' cooperatives supplied 300 tonnes of organically grown mangoes and sold them to an export house in 2006–07. The cooperative in Baghpura, Rajasthan, processed 80 tonnes of amla into candy and *morabba*, which have a good local demand. The Vrindavan Cooperative sold 50 tonnes of mango pulp, 60 tonnes of cashew kernels and 300 tonnes of pickles. The SHGs of Maharashtra organized the collection, and supply of maize and onion for private industries.

Impact on the People

As the trees start bearing fruit, a family with 0.4 ha (1 acre) of orchard is able to earn a net annual income of Rs 25,000–30,000 after about 4–5 years. During the gestation period, supplementary income from the intercrops, vermi-compost, mushroom, fodder, etc., sustains interest and ensures food security. Over 23,000 families from 400 villages adopted the model. The Dhruva model is being scaled up and replicated in other areas, with the help of National Bank for Agriculture and Rural Development (NABARD).

The *wadi* model fulfills the stated purpose of preventing migration of tribals by creating opportunities for livelihood in villages. It has also generated other positive outcomes. These include:

- **Generating Income for the Landless and the Women**
  Though primarily aimed at providing income to the farmer who owns land, the landless tribals also earn an income by raising saplings of mango, cashew, etc., in nurseries. The landless (and the women) have learnt to graft mango saplings for planting in the *wadis.* The saplings were earlier brought from outside at great cost.

  Women's SHGs, organized by Dhruva, supply some inputs that the wadis need in bulk, for example, vermi-compost. The surplus compost is sold to orchard owners, who are not in the *wadi* programme. In addition, through these groups, micro-credit is availed of, to meet consumptive and production needs.

- **Empowering Women**
  The wadi model has renewed a unique tribal custom locally known as wavli,

which allows women to enjoy exclusive rights over the income generated from backyard vegetable cultivation. In the wadi men allow women to keep the income from vegetables grown as intercrops as well as sale of saplings raised by them in the nursery. In addition to fetching a good income for women, this ensures the regular maintenance of the orchard and better nutrition for the family.

- **Creating the Multiplier Effect**
  The programme has succeeded in linking the profit from the wadi to different suppliers of goods and services locally, reducing costs of networking and transport while leveraging local capability and buying power. Linking their income to a common goal ensures that the entire community is working towards increasing the returns from the wadi, creating a multiplier effect.

Scaling Up the Model

Over 0.1 million tribal families have established *wadis* on over 40,000 ha in six states (Table 1). The *wadi* model assumes importance in view of the fact that the livelihood options of more than 100 million tribals representing 250 communities in India have been shrinking rapidly as a result of severe denudation of forests. No wonder then that the NABARD has created a special Tribal Development Fund to replicate the wadi programme approach in various states and made BAIF a resource organization to facilitate its implementation by project implementation agencies (PIAs). At present, the programme is being implemented in 15 states by 20 PIAs and further expansion is on the anvil. These initiatives convinced the Ministry of Tribal Affairs, Government of India, to recommend the *wadi* approach in the draft National Tribal Policy. A scheme was launched to promote *wadis* in all the states and provided Special Central Assistance Funds. The Ministry supported BAIF in setting up a resource agency to provide technical back up to the PIAs.

Table 1: Scaling Up of Wadi Model

State	Districts	Major Fruit Crops
Gujarat	Valsad, Navsari, Dangs, Bharuch, Surat, Ahmedabad, Vadodara, Junagadh	Mango, cashew, guava, custard apple, *amla*, lemon, *sapota*, drumstick
Maharashtra	Thane, Nashik, Ahmednagar, Jalgaon, Pune, Raigad, Nandurbar, Chandrapur, Dhule, Yavatmal, Nanded, Amravati, Gadehiroli, Nagpur, Gondia	Cashew, mango, guava, *amla,* lemon
Karnataka	Mysore, Hassan, Tumkur, Dharwad, Uttar Kannada, Gadag, Chikmagalur, Chamrajnagar, Haveri, Bijapur, Gulbarga, Bellary	Mango, cashew, tamarind
Rajasthan	Bundi, Udaipur, Banswara, Baran, Bhilwara, Chittorgarh, Dungarpur	*Amla*, mango
Uttar Pradesh	Pratapgarh, Gonda, Kanpur (rural)	*Amla*, mango, *bel*
Madhya Pradesh	Betul, Barwani	Mango, *amla*

Conclusion

The *wadi* model has turned out to be a vital avenue for the regeneration of livelihood options and degraded natural resources, and hence has been implemented extensively by the government and NGOs alike. The different regions grow a variety of fruits, according to local conditions. The seeds of the cashew are seeds of hope for them and the saplings of mango may some day grow into a *kalpataru*.

This unique model was showcased at the EXPO 2000 in Hanover, Germany, and presented as a Replicable Model for Poverty Alleviation at the UNDP Forum of Ministers for Poverty and Environment, New York. NABARD was awarded the Skoch Challenger Award for Social Impact for its role in scaling up the model in tribal districts of India. Closer to home, recognition has come in the form of the *Indira Priyadarshini Vrikshamitra Award* of the Ministry of Environment and Forests and the *Adivasi Seva Sanstha Award* from the Government of Maharashtra.

Some of the key success factors can be stated as follows:

- **Creating a system of interdependence**
  The organization is working towards building a strong, interdependent local economy. It makes efforts, therefore, to identify economic opportunities in the

local area for different groups of people and build appropriate support systems for each of those elements of the local economy. For example, whereas the landed could treat their undulating land and produce mangoes and cashew, a group of landless people, trained in primary processing, purchase and process the fruit, adding value locally to the farm produce. Similarly, a group of landless women were trained to produce vermi-compost and supply manure to the orchards. Groups such as the local traders and transporters were also included in the project. For instance, local transporters had to play a role in marketing the produce locally.

- **Bringing technology into the public domain**
  Trained local people provide the required technical support service of water and soil conservation as well as accounting. The technology became part of public domain, not needing expert input after the first round of wadis had begun to bear fruit.
- **Turning a funded activity into a commercial one**
  The critical inputs for the wadi programme include grafted mango saplings, vermi-compost, and technical know-how for soil and water conservation. Input supply was initially funded; slowly it became a commercial activity, thus making the activity economically viable and sustainable.
- **Adopting an eco-friendly approach**
  Although *wadi* involves intensive multi-storey cultivation of crops, it is by design not chemical intensive. Eco-friendly inputs such as vermi-compost are used and ecological diversity is promoted. This makes the system ecologically sound and sustainable.

End-notes

1. Prepared by Dr. Rohini Patel based on 'Dhruva', a case study by Sankar Datta, Annapurna, and Mihir Sahana, prepared in March 2007 as part of the Livelihood Learning Group (LLG) activities of the Livelihood School, BASIX, Hyderabad.

2. BAIF is a public charitable trust and a recognized research organization founded by the late Gandhian, Dr Manibhai Desai. Based in Pune, Maharashtra, BAIF's mission is to create opportunities for gainful self employment for rural families, especially the disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life and good human values. BAIF is a non-political, secular and professionally managed organization.

3. In practice, it varies from 0.4 to 1.0 ha in size.

6 Sadguru's Lift Irrigation Initiative: Lifting the Spirits of Tribal Communities in Western India[1]

Introduction

Sadguru Foundation[2] has earned, over a period of three decades, a national reputation for promoting large-scale lift irrigation (LI) systems, which are eventually run and managed by the tribals themselves. Sadguru's model of LIs has worked where many similar initiatives in different parts of the country have failed.

The initiative covers 22,271 families, in a total command area of 43,706 acres in Gujarat, Rajasthan and Madhya Pradesh (MP). It is managed by a two-tier system of cooperatives comprising 305 Lift Irrigation Cooperatives (LICs) and four federations of LICs. The federations were created at the block level to help the LI cooperatives become relatively independent in the running and maintenance of the LI schemes.

This case study examines the unique features of the Sadguru model and shows how a federation plays an active role in providing critical services to member cooperatives, maintaining the LI systems on a sustainable basis.

The LI Intervention: An Overview

Sadguru's LI initiative has come a long way since the first three LI schemes were launched in 1976 and 1977 on an experimental basis. Impressed by the functioning of these schemes, the government officials, in particular Anil Shah, Secretary, Rural Development and Sanat Mehta, Finance Minister, encouraged Sadguru to take forward the scheme on a much larger scale, with the support of the government. By 1980, a total of 39 schemes were in operation. At that stage, a change in the government policy, requiring NGOs to contribute 20 per cent of the cost of the scheme, forced Sadguru to look for financial support from donor agencies. A number of donor agencies, both foreign and Indian, came forward at various points in time, providing the necessary support to leverage government funds for further expansion of the LI programme.

By then, Sadguru had mastered the technique of establishing fairly large-sized check-dams. The average designed command was more than 150 acres, which was much higher than that of the LI schemes being implemented elsewhere in the country. The largest check-dam was constructed at Baneshwardham, with a capacity of 350 m cft at a total cost of Rs 4720 m. The dam was constructed within a span of seven months.

A major scaling up effort took place from 1994 to 2001, by which time 206 LI schemes had been installed. In 1993, LIs were first started in Banswada District of Rajasthan and, in 2003, Smt Vasundhara Raje, Member of Parliament, who later became Chief Minister of Rajasthan, prevailed upon the directors of Sadguru to start a similar intervention in her constituency in Jhalawar. The project initiated in Jhalawar District with headquarters in Chaumahela, has been progressing well with the full cooperation of the Rajasthan Government. The cumulative position of the LI intervention as on March 2008 is in given Box 1.

Box 1: Fact Sheet on LI Intervention (March 2008)

Coverage	
Number of families	22,271
Number of people	1,33,626
Command area (acres)	43,706
Area irrigated by recharged wells (acres)	36,156
Natural capital augmented	
Total no. of check dams constructed	316
Total no. of LI schemes constructed	319
Wells recharged (no.)	17,177
Capacity of check dams: (Range in Mcft)	30-350
Micro-watershed Development (acres)	59,138
Actual irrigation in rabi 2007–08 (acres)	69,661
Institutional capital created	
Informal check dam management groups	239
Total no. of registered LI cooperatives created	305
Total no. of functional LI schemes under Sadguru's control	195
No. of federations	4
No. of cooperatives covered by federations	136

It is worth mentioning that of the 305 LICs created, 33 are monitored by other NGOs for which Sadguru provided the expertise to create the LI schemes. As on January 2009, of the 272 LICs being monitored by Sadguru, 195 are functioning satisfactorily, whereas 77 had some problems. Among the non-functioning LICs, 31 were new, awaiting electricity connection, 18 faced temporary problems and 23 were in danger of permanent disconnection (PDC) of electricity due to non-payment of dues by the cooperatives during consecutive years of drought.

The problem of PDC is restricted to Gujarat, which has a tariff policy that goes against the interest of the tribal cooperatives. Sadguru has taken up the issue at the highest policy making level but has so far not been successful in bringing about a change. Three LICs have become defunct because the internal problems in those villages could not be resolved. Twelve villages have internal problems, mostly in the nature of factional fights, especially in the wake of different elections. The federations are now playing an active role to facilitate conflict resolution. They are also working on a strategy to ensure that the cooperatives do not lose their electricity connections due to non-payment of electricity dues for the period when the conflict was being resolved through mutual negotiation.

A spatial comparison of performance shows that the LICs in Gujarat and Rajasthan are by and large performing well. The performance in Madhya Pradesh has been severely hampered due to the following reasons:

a) Failure of the state to provide a minimum duration of power supply per day on a reliable basis—the power supply came down to between 3 and 6 hrs/day, and was erratic in nature.

b) Absence of institutional capital of the type set up by Sadguru Foundation in the other two states. As a result, maintenance and repairs did not take place with the kind of efficiency that was possible in the other two states.

Due to the above factors, Sadguru was not considering expanding LI activities in the state.

Irrigation Efficiency

The actual irrigation through the LI schemes, in rabi 2007–08 was reported to be 69,661 acres. The LIs are not able to perform at their full potential due to unreliable and inadequate supply of power. The overall achievement of irrigation as a percentage of the designed command for all three states was 74 per cent the highest was for Jhalawar at 92.14 per cent (*Annual Report,* 2008).

Adjusting cropping pattern

These efficiencies have been maintained at a high level by the LIs by adapting to the situation of less power supply through changes in the cropping pattern. The recourse to cultivating more water efficient crops like gram, maize and wheat implies less profits compared to the earlier cash crops like onion, coriander, etc. Operating at this level, LIs help the tribal population to achieve food security but may not be able to provide the kind of returns that was possible in the earlier years when power supply was not an issue. Keeping this in view, Sadguru has started exploring alternative sources of energy to supplement power supply to the LIs.

Adopting drip irrigation

Sadguru Foundation's internal documentation shows that farmers opting for horticulture and floriculture enjoy high returns while maintaining high water-use efficiency because they have adopted drip irrigation. Horticulture can earn a farmer a net profit of about Rs 40,000 per annum and with floriculture profits can go as high as Rs 70–80,000 per annum. The case can be argued for adopting drip irrigation for field crops as well, especially for cash crops and in LIs when either water or electricity is in short supply. At the moment, the costs of converting from the flooding system to micro-irrigation appear to be prohibitive.

Federation as Service Provider

Table 1 provides a brief profile of the four federations. A fifth one is also visualized to cover the remaining LICs under the supervision of Sadguru Foundation. The functioning of the Jhalod federation is discussed in detail because it has existed for more than 9 years and has shown the way to other federations.

Table 1: Profile of LI Federations (2009)

No.	Name of Federation	District / State	No. of LICs (Current	No. of LICs (Near Future)	Registration Year
1	The Jhalod Taluka LIC Federation Ltd., Jhalod	Dahod, Gujarat	60	75	July 5, 1999
2	The Banswara Taluka LIC Federation Ltd., Banswara	Banswara, Rajasthan	36	62	March 9, 2007
3	The Sadguru LIC Federation Ltd., Jhalawar	Jhalawar, Rajasthan	21	49	March 17, 2007
4	Divisional LIC Federation Ltd., Limkheda	Dahod, Gujarat	22	58	Being registered
	Total		139	244	

The Jhalod Taluka LIC Societies' Federation Ltd.

Some of the main achievements of the Jhalod federation, as recounted by its committee members, are as follows:

1. Service for maintenance of LI scheme

The federation has set up a system of servicing and troubleshooting for its members. Whenever there is a major fault in the LI scheme, a member cooperative can lodge a complaint with the federation by depositing Rs 100. The federation attends to complaints on a first-come-first-serve basis by sending its technicians (electrician and/or pipe fitter). The LICs find it advantageous and cost effective to utilize the service because external technicians tend to overcharge and do not supply spare parts of proper quality. On the other hand, the federation stocks spare parts of good quality and, hence, no time is lost in procuring the same. The federation has a current stock worth Rs 7.9 lakhs.

2. Dealership for micro-irrigation products

There are about 300 *wadis* (orchards) in Dahod District, which have adopted micro-irrigation. Sadguru Foundation promoted the *wadis* and the Jhalod Federation which has taken up the dealership of the Jain Irrigation Company, installed the drip systems. Sadguru has deputed a technical person to the federation, who also serves as its manager on a part-time basis. The technical person has been especially trained in Israel to plan and execute drip irrigation systems. These systems are available to the tribal community at 75 per cent subsidy from the government. The federation has to, therefore, coordinate with Gujarat Green Revolution Company Ltd (GGRC), which is the government-appointed nodal agency for the supply of these systems in the state.

The federation also provides after-sales services. In all this, no investment is required by the dealer. For its services, it earns a small commission on material costs of the drip system, for example, 6–8 per cent on PVC pipes and 8–9 per cent on field units and filters. It also earns a commission of 10 per cent on the supply of components on a cash-and-carry basis in open market sales. The federation is thus able to earn just enough to cover its administrative cost of about Rs 5 to 6 lakhs. During the current year, the federation has made a profit of Rs 1.829 lakhs. A summary of profit and loss statements over time is provided in Table 1, Annexure 1.

3. Developing wastelands through horticulture

Looking for other avenues to increase income, the federation came up with the idea of developing wastelands through horticulture and drip irrigation to achieve this goal. A small beginning was made by cultivating mango and amla (gooseberry) plantations at Vakol Village in 7 acres of wastelands in 2001–02. Encouraged by the success of this experiment, it set up a 20-acre plantation at Chasiya Village in 2003–04. This plantation is expected to start bearing fruit by the end of 5 years.. The plantation was set up with a total investment of Rs 5 lakhs, of which Rs 60,000 came from Sir Ratan Tata Trust, Rs 2,50,000 from Sadguru Foundation and the remaining Rs 1,90,000 from the earnings of the federation. The federation and the LIC in Chasiya, have an agreement for sharing benefits from the plantation, in the ratio of 70:30. The income helps the cooperative to cover its overheads. The villagers also benefit in terms of supply of grass. The LIC sold grass worth Rs 4,000–5,000 each year to the villagers. The share received by the federation will be used to set up more plantations in other LICs.

4. Supply of fodder during recurrent drought

From 1998 to 2001, Gujarat experienced recurrent droughts. The federation organized the supply of dry fodder for its members in 2000. Each LIC was supplied about one truckload worth Rs 19,250, which helped its members tide over the crisis.

5. Supply of castor cake from Mehsana

The members made a demand for supply of good quality seeds and fertilizers.

In 2002–03, the federation decided to procure castor cake from Mehsana and supply it to its members. This activity could not be continued due to lack of storage facilities and working capital. (Farmers, typically, are willing to pay the money at the time of purchase and not in advance.)

Financial status of the federation

As on 2007–08, the Jhalod federation has a total share capital of Rs 62,500. As per the cooperative law, it has built up several funds, including a reserve fund of Rs 17.16 lakhs, a community development fund of Rs 6.03 lakhs, a building fund of Rs 3.04 lakhs, a revolving fund of Rs 2.32 lakhs and other funds of Rs 5.79 lakhs. Hence, the total funds built up over the years, amounts to Rs 34.34 lakhs. (Table 2, Annexure 1) This money must be used for the purpose for which it is earmarked. Permission is needed from the Registrar of Cooperatives to use the reserve fund money. The reserve fund, however, can be used to leverage funds for working capital from financial institutions.

The federation has been giving an annual dividend of 12 per cent since 1999. It has also passed a resolution in the Annual General Body Meeting of 2007 to increase shareholding. Thus, every year, each member of the LIC will purchase 100 shares of Rs 10 each, that is, Rs 1,000 per LIC. This will enable the federation to leverage more funds for its increasing economic activities and for developing the necessary infrastructure.

The federation has received three small grants from SRTT worth Rs 8.25 lakhs during its establishment phase (2000–2004). The federation has used this money to establish its office and recruit staff for office and fieldwork so that it could function independently. During this period, the federation also provided various trainings and field exposure visits for its member farmers. From 2004 onwards, the federation has not received any grants and is meeting its expenses on its own.

Impact of the Initiative

The LI intervention has, over the years, made a positive impact on the local economy and socio-economic situation. An early study by scholars from IRMA (Dinesh Kumar et al., 1999) reported a benefit-cost ratio of 1.33:1 for a sample of six LI schemes. For an irrigation scheme, this is fairly high. A comparative analysis of the total cost of production and supply of water showed that the cost was 1.10 paise per litre for the LI schemes against the government norm of 5 paise per litre in the case of public water systems.

The agronomic and economic efficiencies of water use for the four main crops cultivated were found to be different. (Table 2) The agronomic efficiency for wheat was the highest at 1.23 kg/cu m whereas the economic efficiency was the highest for gram at Rs 7.72/cu m. The study concluded showed that the LI schemes are sustainable from the viewpoint of water use and physical systems.

Table 2: Agronomic and Economic Efficiencies of Water Use (1999)

Crop	No. of Waterings	Agronomic Efficiency (Kg/ cu m)	Economic Efficiency (Rs/ cu m)
Wheat	4–6	1.23	4.72
Gram	2–3	1.15	7.72
Maize	3–4	1.17	4.05
Mustard	3–4	0.70.	6.10

Mr. Harnath Jagawat who founded Sadguru Foundation along with his wife, mentions in his book (2005) that a number of impact studies revealed that the yield and the income of farmers had gone up between four and nine times the levels before the intervention. An International Water Management Institute -TATA research project, carried out in Mahudi and Mota Dharola Villages of Dahod, found a nine-fold increase in income. The study took into account the additional income generated by the boost in animal husbandry.

A rapid impact assessment by Mathur and Rao (2006) found an increase in the social esteem of LI members. Earlier, the men of the region had difficulty finding brides because the region was prone to drought. The situation has completely changed now. The level of indebtedness has gone down and the quality of living, in terms of food, clothing and shelter, has improved significantly. Stress migration has also gone down.

Sadguru Foundation has initiated an internal study on the impact on migration after the introduction of LIs in Jhalawar, Rajasthan, with a sample size of 121 families drawn from 8 LI schemes. Preliminary findings show a significant drop in migration of men and women (from 62.8 per cent to 33.0 per cent) as well as the number of days of migration per year (from 100 to less than 70). The proportion of women migrating continues to remain the same at about 40 per cent.

Conclusion

The LI systems promoted by Sadguru Foundation have stood the test of time except in Madhya Pradesh, where it constructed the LI only on behalf of the state government or other NGOs. Federations are being created to decentralize the system of supervision, empower the people and help in the overall sustainability of the LI intervention. The

Jhalod Federation has already established a system of providing maintenance services to its constituent members in a cost-effective way. It is also on the way to financial self-sufficiency through its own income-generation activities.

The relationship between the federations and Sadguru Foundation will change over time as the federations mature. Whereas, over time, the federations will take over most of the functions of maintaining the LICs and gain financial autonomy through its own income generation activities, Sadguru will continue to play a role in sector development and policy advocacy as long as it is needed.

References

Jagawat, Harnath. (2005). *Transforming the dry lands: The Sadguru story of western india.* Dahod: N.M. Sadguru Water and Development Foundation, p. 145.

Kumar M., Dinesh, Vishwa Ballabh, Rakesh Pandey and Jayesh Talati. (1999). "Sustainable development and use of water resources: Sadguru's macro-initiatives in local water harnessing and management". (IRMA Working Paper), Anand: Institute of Rural Management.

Mathur, Madhvi and Sudhir Rao. (2006). Rapid impact assessment of government supported water resources development programme, Jhalawar, Rajasthan. Study prepared for N M Sadguru Water and Development Foundation.

Sadguru Foundation. (2008). *Annual report*

End-notes

1. Based on information provided by Sadguru Foundation (March 2009).

2. Established in 1974, by Mr. and Mrs. Jagawat, Sadguru is a non-profit organization, promoting rural and tribal development through community-based natural resource management (NRM) in the tribal and rain-fed districts of Dahod and Panchmahal (Gujarat), Jhabua (Madhya Pradesh) and Jhalawar, Banswara and Dungarpur (Rajasthan). Sadguru's NRM programme includes water resource management, forestry and micro-watershed development. These have been integrated with biogas, agricultural diversification, off-farm income generation and other related programmes.

Annexure I Table 1: Economics of Dealership Activity for Micro-irrigation by Jhalod Federation

Year	Total Purchase	Total Sales	Total Income	Total Expenses		Gross Profit	Net Profit
				Drip	Other		
							(Columns 4–6)
2000–2001	44,077	43,587	7,21,329	0	6,35,297	–490	86,032
2001–2002	20,45,309	22,84,854	7,97,824	2,58,674	3,09,544	5,85,049	4,88,280
2002–2003	35,04,030	47,94,339	20,18,024	5,96,425	6,33,315	12,61,745	7,88,283
2003–2004	23,00,006	23,41,251	7,75,446	3,36,269	7,07,258	2,30,660	68,188
2004–2005	26,01,794	33,20,154	10,48,591	3,09,627	9,34,093	4,59,268	1,14,498
2005–2006	37,85,076	32,11,700	5,35,160	6,21,396	3,40,116	1,45,742	1,95,044
2006–2007	52,51,576	64,79,105	8,09,826	7,44,411	6,60,779	6,98,215	1,49,046
2007–2008	63,92,646	76,74,872	8,67,819	7,23,313	6,84,890	5,40,505	1,82,929
2008–2009 Up To 30-1-09	11,17,114	11,55,574	2,72,464	2,59,454	24,56,458	1,21,468	26,966
Total	**2,70,41,628**	**3,13,05,436**	**78,46,483**	**38,49,569**	**73,61,750**	**40,42,162**	**20,99,266**

Table 2: Financial Performance of Jhalod Federation

Particulars	1996–97	1997–98	1998–99	1999–2000	2000–01	2001–02	2002–03	2003–04	2004–05	2005-06	2006-07	2007-08
No. of Member Cooperatives	36	42	42	46	50	51	52	57	58	59	59	60
Share Capital	36,500	42,000	42,000	46,500	51,500	52,500	53,500	59,500	60,500	61,500	61,500	62,500
Reserve fund	36	41	41	45	50	51	13,84,336	15,81,580	15,81,917	15,82,128	1,678748	17,16,095
Community Development Fund	4,68,000	5,00,000	5,10,126	5,10,126	5,10,126	7,20,648	8,99,519	8,50,903	6,14,539	6,14,539	6,02,738	6,02,738
Building Fund	-	-	-	-	-	-	-	2,10,800	2,10,800	2,10,800	2,77,892	3,04,250
Revolving Fund	-	-	-	-	-	-	-	56,803	1,14,058	1,43,818	1,96,517	2,31,723
Other Funds	-	-	-	-	-	-	37,567	3,68,144	4,29,192	5,00,935	5,72,228	5,79,827
Profit	13,993	68,708	1,33,238	51,201	32,963	4,90,750	788,283	68,188	1,14,498	1,95,044	1,49,046	1,82,929

7 Livestock and Local Breed Development: A SURE Initiative in Barmer[1]

The concept of *local breed development* has acquired centre-stage in the contemporary sustainable livestock development policy arena. Local (often identified as indigenous) breeds are recognized as a better alternative for sustainable livelihoods for the rural poor, particularly those dwelling in remote, harsh and fragile ecosystems. India is home to some of the most widely known local cattle breeds, including the Sahiwal, Red Sindhi, Gir, Tharparkar, Hariana Rathi and Kankarej. These breeds, concentrated in a limited geographical area, have evolved over time and adapted themselves to the agro-climatic variations as well as local anthropogenic changes. Consequently, local breeds, though perhaps not comparable to imported exotic breeds in milk and meat yield under controlled circumstances, have been more productive in extreme conditions characterized by low inputs and have more resistance to the common diseases of their habitat.

Tharparkar, found in the arid tract of western Rajasthan, is one of India's best known indigenous cattle breeds. Also known as the White Sindhi, the breed is named after the Tharparkar District of Sindh province, now a part of Pakistan, where it originated. Tharparkar is a zebu type of cattle used both for milch and draught purposes. In the early 20th century, livestock keepers from Sindh had migrated to the Thar region with their live stock and settled down. The breed of cattle they brought along was productive even in the bleak desert environment and has now become a major livelihood strategy in the region. A Tharparkar cow, when maintained properly, usually produces 1,800 to 2,000 litres of milk during one lactation period. More importantly, Tharparkar is less vulnerable to the extremes of heat and cold, typical of the Thar desert and can survive on the dry fodder of arid pastures while maintaining relatively good milk production.

Decline of the Tharparkar Breed

The roots of Tharparkar's decline extend back to the partition of India. The closure of borders prevented the unfettered movement of livestock from the Sindh province and impeded the Thar livestock keepers from fetching genetically superior Tharparkar bulls and cows from their original habitat. In the subsequent decades, the region also witnessed a massive degradation of its natural resource base, particularly in the common grazing lands and water sources. These developments, along with the collapse of community livestock management systems, severely retarded livestock development. At the same time, frequent droughts worsened the availability of water and livestock keepers were forced to migrate to the surrounding districts and states, to obtain fodder and water for their animals.

Thus, within decades of the partition, the Tharparkar breed, once a lifeline for desert dwellers, greatly diminished in number. Between the drought years, when there was good rainfall, livestock keepers purchased other breeds like the Nagori and Kankrej, which were alien to the area and had difficulty withstanding the harsh and unfamiliar agro-climatic conditions of the desert.


Source: dahd.nic.in

As a result, a household possessed more cows of greater productivity in theory, but could not avail of the necessary natural or financial resources to realize the expected higher returns. At the same time, the mixing of Tharparkar cows with other breeds—many times quite weak animals—steadily pushed the local breed to the brink of degeneration.

Even as this process intensified, neither the government nor any voluntary organization showed sufficient concern to make a genuine effort to conserve the indigenous breed. By the end of the 90s, it became difficult to find a genuine cow or Tharparkar bull in the region. To make it worse, some of the animals still exhibiting some resemblance to their genetic antecedents were taken to other states for various breed development programmes.

Efforts for Tharparkar Conservation

The Society to Uplift Rural Economy (SURE) has been working since the 90s for the development of economically deprived populations in the border areas of Barmer District in West Rajasthan. The organization, recognizing that the increasing depletion of Tharparkar cattle and diminishing of livestock-centred livelihoods is a major threat to the survival of desert dwellers, initiated its conservation efforts for the breed in the 90s. In the initial period, SURE worked on drawing the attention of the government and non-government stakeholders to the critical issue. Since 1999, however, the interventions have been built into a well-designed and systemically executed programme of local breed conservation and development. The programme, taken up in 15 villages, has adopted a holistic view of livestock development. Activities are focused on raising awareness about the Tharparkar breed among communities, enhancing the capacity of the community for better animal care and management, providing scientific and technological inputs, and documenting and promoting the traditional wisdom of livestock keepers.

With the intention of ensuring direct participation of livestock-keepers and augmenting the social capital, SURE emphasizes working through Livestock Development Committees (LDC), comprising both men and women, formed in each partner village. The LDCs—all registered local institutions—are the main organizers and executers of all activities undertaken by SURE. Members of these institutions are regularly educated in the techniques of breed development, means of providing fodder, treatment of animal diseases, marketing of products, vaccination of cattle, livestock insurance and fodder distribution in their villages.

SURE has set up a *bull development unit* in Bijrad Village to facilitate the distribution of good Tharparkar bulls to livestock keepers. Here, the bulls are nurtured and distributed to the village committees, according to demand. The LDCs ensure the provision of fodder and shelter, and meet the other needs of the bulls. They ensure the proper functioning of the system established for mating Tharparkar cows, in which the cow owners have to contribute Rs 100 to the Village Development Fund for each successful pregnancy. A significant facet of the system is a thorough collection and documentation of the records of the births of calves and milk production of cows, which has assisted in identifying animals of good value and breed.

These efforts have not been without stumbling blocks. SURE has had to face stiff resistance from the communities at various junctures of the programme. For example, the communities strongly resisted the castration of those bulls, which roam freely in the villages and transfer weak genes to future generations. A continuous dialogue between SURE and the communities, and pressure from the LDCs were required to convince the villagers about the necessity of the practice. Later, these communities even supported the shifting of the bulls to cattle farms.

Results and Field Observations

After almost a decade of sustained effort, the programme has succeeded in producing nearly 4,000 Tharparkar calves in 15 villages through the distribution of Tharparkar bulls. Two generations of the breed have already been obtained. With newborn calves demonstrating some of the original characteristics of the Tharparkar breed, the organization is certain that the third generation will carry a substantial proportion of Tharparkar characteristics.

Over the years, the growing pressure to survive, the dwindling economic returns from livestock and the modernization of agriculture had led the livestock-keepers of Barmer District to disregard increasingly the significance of the Tharparkar breed in their agro-economy. The initiatives of SURE have acted as a catalyst in altering this phenomenon. Discussions with the participating communities clearly illustrate their concurrence to shifting to a Tharparkar-centric livestock development model. Villagers are satisfied with the modest but stable economic returns offered by the breed and now willingly accept the scientific and traditional methods of care and management of their animals.

A notable achievement of the breed development programme is the significant involvement of women, a hitherto highly marginalized segment of the population. The organization, recognizing the contribution of women in household livestock management as well as receiving encouragement from the lead taken by a few individual women in its programme, has made a concerted effort to extend the space for their participation. At present, through the committees, the women of partner villages are actively associated with many activities and play an important role in the decision-making process for the development of their villages.

As the impact of this is being felt, other individuals are coming forward to express interest in expanding the Tharparkar breed development programme in their communities. Livestock-breeders from outside the programme area come to the Bijrad SURE Centre to mate their cows with the Tharparkar bulls. Moreover, various panchayats, government departments and dairies have also begun their associations with the initiative. In one such collaboration, SURE is in the final stage of linking the village committees with a dairy that will provide sustainable financial benefits to livestock keepers.

End-notes

1. Reprinted with permission of Seva Mandir, Udaipur from Tiwari, Shailendra, Ronak Shah and Vivek Vyas. 2008. Chapter 5 of ***Making the Herd Survive! Four Livestock Support Interventions in Rajasthan****.*

8 Timbaktu Organic: Opening a New Path for Farmers in Distress Hotspots[1]

Introduction

The smallholder farmer of Anantapur District today is in an extreme distress situation. Over the last decade, 758 suicides of farmers have been reported from Anantapur District. This crisis has been brought about by extreme indebtedness of the farmers, which was caused as a result of the use of toxic agro-chemicals and the practice of continuous mono cropping of groundnut as a cash crop. The use of chemicals has led to increase in input costs while yields have been stagnant. Depending on a single crop has increased production and market risks, with the farmer in many cases losing an entire crop to poor rainfall, a pest attack or market price fluctuations.

In this context, the Timbaktu Collective, a voluntary organization has been trying to respond to the desperate situation and agrarian crisis in 140 villages of Chennekothapalli, Roddam and Ramagiri mandals of Anantpur District. Its experiments over a decade from the early 90s led it to believe that the way out of the agrarian crisis was to restore the farm diversity and organic practices for sustainable management of agriculture and intervene in the market for collective marketing of the produce. These strategies were brought to a head through a cooperative of smallholder organic farmers called Dharani Farming and Marketing Mutually Aided Cooperative society Ltd (henceforth referred to as the Dharani cooperative).

The primary objective of Dharani Cooperative is to procure, process and market the produce of its farmer members, if possible at a premium price. It expects more small-holder farmers to join the cooperative, be encouraged to grow food in a sustainable and organic manner and get the kind of returns they should be getting. Although it is too early to access the success of the venture, the case study examines the functioning of the cooperative and the extent to which it has been successful in motivating farmers to adopt organic farming as an economically viable proposition even in distress hotspots like Annantpur.

Genesis

The Collective began experimenting and researching productivity issues in dryland farming in 1989. From there it moved on to promoting organic farming among the local communities through various projects supported by donor agencies like Sir Dorabji Tata Trust, Evangelischer Entwicklungsdienst (EED) and European Union. By the end of 2009, about 890 families had shifted to the cultivation of organic food in a sustainable way on 2670 acres of land.

In 2005-06 Timbaktu Organic was promoted as a collective enterprise for marketing of organic produce of the smallholder farmers participating in the project. The overall purpose was to enhance the income and food security of dry land smallholder farmers of Anantapur District in the short term and improve livelihood security through sustainable agriculture in the long term. The enterprise was initiated by one of the women thrift cooperatives (Adisakthi MACTS) promoted by the Collective, which put in the initial capital for the venture. In April 2008, the participating farmers themselves were organized into a producer owned cooperative which was registered under Andhra Pradesh Mutually Aided Co-operative Societies Act of 1995. Adisakthi MACTS, handed over the venture, including the assets and liabilities, to this newly formed cooperative. Thus the business venture called Adisakthi Dharani was renamed Dharani FaM Co-op Ltd with a new board of directors. All the 890 farmers who had adopted organic farming under the Collective's earlier projects became shareholders of the cooperative.

Strategies to remove distress

The Collective felt that a producer owned processing and marketing venture would be able to address the following major issues faced by the small and marginal farmers in Annantpur:

a) Unavailability of credit,
b) Exploitative trading practices,
c) Increased market risks, and
d) Lack of access to the growing organic food market.

Timbaktu Organic adopted the following strategies to achieve this purpose:

- Promote diversification of the groundnut mono-cropping pattern into millets and pulses.
- Promote eco-friendly organic farming methods that build on the traditional knowledge base of the farmers and utilise locally available resources like biomass, livestock and labour.
- Provide cultivation loans through the cooperative to reduce the debt burden of farmers.
- Organize marketing support for the farmer's organic produce in both rural and urban markets.

The management of Timbaktu Organic is organized into two teams:

a) Farming team that ensures the production of certified organic millets, pulses and oilseeds at better yields and lower costs to the farmer, and
b) Marketing team that ensures a minimum support price for the organic millets and a premium price for the organic oilseeds and pulses grown by the farmers (members).

Implementation Processes

While the Timbaktu Collective manages the overall programme and looks after the developmental functions, the commercial functions are taken care of by the Dharani Cooperative, with management support from the Collective.

Developmental functions

i) **Formation of organic farmer groups in villages:** A group (*sangha*) of 20-30 interested farming families is formed at the village level. Each sangha constitutes both men and women members of the family. Each sangha chooses two group leaders (one man and one woman) who are jointly responsible for the overall work of the sangha. Each sangha is sub-divided into groups of 4-6 farmers, called *brindams*. The sub-divisions are based on the location of the land of the farmers, so members having contiguous patches of land close to each other are grouped together. The *brindams* are an important aspect of the organic certification system undertaken by the cooperative, as neighbouring farmers would be most aware about the use of chemicals in the farms around theirs. Each farmer must allocate at least three acres of his/her land under this programme, of which at least one acre should be under a crop different from groundnut. Some of the alternate crop options are the various millets, castor, sunflower, redgram, cowpea and horsegram.

ii) **Set-up of village-level offices and identification of volunteers:** Each sangha has an office in the village, which is used for organizing meetings, storing records, assets and organic materials stock of the sangha, display of the basic information of the sangha and activities taken up by them, and also show details of organic farming methods with photographs.

Each sangha chooses one volunteer, who is based in the village, having farming background and is literate. The volunteer is part of the block-level production teams. The volunteer conducts the sangha meetings and provides information support to sangha members regarding programme activities especially organic practices for soil fertility improvement and pest and disease management.

The village volunteer, also monitors use, if any, of toxic chemicals that would bar the member from the sangha. Basic records relating to the work of each sangha are maintained by the volunteer like a cash/bank book and a ledger, meeting minutes book, stock ledger, farmer diaries, etc.

iii) **Collection of basic baseline data:** Basic information about the farming families and their previous years' crop including economics of cultivation is collected, to compare the impact of the programmme. This is also very important for the organic certification programme.

iv) **Capacity building of farmers:** Organic farming practices in soil fertility improvement and pest and disease management, land development, biomass development, seed selection and post harvest management of crops are some of the main areas in which capacity building of farmers takes place. Capacity building is organized through trainings at both the programme and village levels, through exposure visits and through meetings with experienced organic farmers. Village demonstrations are organized in the plots of interested farmers, in which organic practices including crop rotation with crops other than groundnut is carried out as a means of demonstrating model practices. Farmers undergo training to prepare various organic inputs for improving soil fertility and managing pests/diseases. Some of these include preparation of Neem seed kernel extract, *Jeevanmrutham, Panchagavya*, hand picking and burning of larvae etc.

Capacity building of the of Board of Directors of the Cooperative, in all aspects of the programme from production to marketing is organized through trainings, exposure visits and direct participation in programme activities.

v) **Organizing seeds, organic inputs and credit support:** Prior to the beginning of the season, supply of seeds, especially of crops other than groundnut, is organized for the sanghas. The sangha members return the seed in double the quantity after the crop harvest and the seed is retained at the village office, serving as a seed bank.

Financial support for organic inputs is provided to farmers with a limit of Rs 2,000 acre over the three-year project period. Primary activities for urine collection, compost preparation and soil development are undertaken. Arrangements are made at the sangha level for sharing of cattle urine amongst farmers who do not own livestock. Credit up to Rs 3,000/acre is provided at the time of sowing and at the time of harvest. These loans are routed through the Mahasakthi MACTS Federation network[2] in the village, as every member in the sangha is also a member of the Mahasakthi network.

vi) **Land and biomass development:** At least a 1-2 months before the cultivation season begins soil and moisture conservation works are undertaken in the farmers' fields through the watershed development programme or through the NREGA in the village. Trees suited for composting and organic preparations like *Gliricidia, Pongam, Neem, Sitaphal* etc are planted at a density of about 100 plants per acre on the field bunds. These will also act as windbreakers. Measures have to be taken to prevent browsing by goat/sheep and for survival during moisture stress periods.

vii) **Monitoring cultivation of crops and crop harvest:** Regular brindam-wise visits are organized by the volunteer to monitor crop status in the farmers' fields. The yield of the crop both the main and intercrops is estimated just before the harvest. Yield estimation is a mandatory step in the certification process, as it helps to cross check at the time of procurement, that the quantity of a particular crop sold by the farmer is not more than the estimated yield.

Estimation of total organic crop output achieved is recorded just after harvest of crop, in order to be able to measure improvement in yield. Various post-

Box 1: Participatory Guarantee System

The certification system involves the following steps:

- Forming a small group of farmers and organizing their sub-groups on the basis of the location of their lands.
- Signing of an agreement with each farmer about the committments to be fulfilled by the organization and the farmer regarding the programme activities.
- Signing of a pledge by the farmer, that he/she will follow farming practices in line with the PGS National Organic Standards.
- Organizing two meetings in a month throughout the whole season, in which the use of chemicals by any farmer is discussed and verified by the village volunteer and respective brindam members, and recorded in the sangha minutes. At the time of purchase of produce, the Society checks the farmer's record of using chemicals.
- A diary is maintained for every farmer by the village volunteer, which records all details of the work done by the farmer on his/her farm, including use of chemicals if any. This record is checked in every sangha meeting.

Source: www.pgsorganic.in

harvest management measures are followed for pest control and for preventing spread of aflatoxin in groundnut and other crops.

viii) **Organic certification:** Organic certification of the sangha members' farms and crops is organized through the Participatory Guarantee System (PGS)[3] promoted by the Organic Farming Association of India (OFAI) - Goa and the Food and Agriculture Organization United Nations, New Delhi (FAO-UN)..

ix) **Research study on impact of organic farming and millets cultivation:** The farming component of the programme has two main thrusts shifting to organic and diversification of the groundnut mono-cropping pattern with millet cultivation. Using the information in the farmer's diary and the baseline surveys, for year 0 (baseline), 1, 2 and 3, the impact of this programme will be measured in terms of increased income through improved yield and reduced costs.

x) **Programme monitoring:** The Cooperative's management committee reviews the work of the marketing sub-team. The work of each sub-team is reviewed by the production and marketing team coordinator through individual team meetings respectively. At the sangha level, the work is reviewed and planned through two meetings every month. A season-end review is also conducted with each sangha, which is followed by a workshop to prepare a yearly production plan for the next season. A marketing workshop is also conducted just prior to the procurement season, to look back and plan for the year to come.

Commercial Functions

i) **Obtaining legal clearances:** Clearance from the local gram panchayat, registration from the district industries centre, factories department license registration, trademark registration, CST/VAT registration, license from civil supplies department for trading pulses, weights and measures department stamping of weighing machines are some of the legal clearances required.

ii) **Purchase of organic produce:** Produce certified as organic, is procured by the Cooperative, in collaboration with the sangha members at mutually agreed dates. A procurement plan is made every year based on the extent of organic farming area and crops sown, while the crops are still standing. Decision on the purchase price is made based on the prevailing prices in the markets nearest to the village. Purchase price varies based on the quality of the produce measured by the out turn percentage of the sample of the produce. Purchase of produce is organized from the doorstep of the sangha members. Only the produce collected from members is certified. Purchase is also organized from non-member (farmers around CK Palli mostly) for millets and groundnut pods on the basis of a declaration by the farmer of having grown the produce through organic methods of farming. This produce is classified and sold as *organic-non certified.*

iii) **Processing and storage:** Post procurement, storage and processing are the two major operations before final sale of the produce. For this purpose, a storage and processing unit, of the capacity to store about 60 tons of produce at any point of time was constructed. This included space for sun-drying, space of grading and other labour-based operations and machine-processing units for turning oilseeds into seeds and oil form, millets into rice, rava and flour form and pulses to its split form. A process journal and ledger is maintained to track the inflow and outflow of each commodity. The processing unit engages between 10-40 women every day to facilitate the processing work.

iv) **Building market linkages in rural and urban areas:** The basic business model of the program is to improve income of the farmers and to organize primary processing of the produce into basic commodities like rice, rava, flour, oil, nuts and dal, and market the produce in branded retail packets to individual and small rural and urban customer groups like retail stores, consumer networks, organic food processors, restaurants, trade fairs/exhibitions, rural self-help groups etc. This would generate an additional price premium of 10 per cent for the farmers for their pulses and oilseeds and a minimum support price for their millets.

v) **Millet food promotion:** Diversification of the groundnut mono-cropping pattern with millets is a major focus of the programme. A series of millet food workshops that involve preparation and serving of a number of a traditional and modern millet recipes are organized through the season with the village level farmer groups. A small restaurant was also constructed in the central marketplace of CK Palli to serve millet food to the local populace on a regular basis. With market development support, millet baked items can be introduced through the retail outlets of the bakers.

vi) **Raising funds towards working capital and fixed investment:** Funds required for working capital (purchase, processing, storage and sale of produce) and fixed investment towards a storage and processing unit and processing machinery was raised from a group called Friends-of-Timbaktu as loan. Loans were also taken from the Canara Bank. At the end of financial year 2008-09 the cooperative had a liability of Rs 6.14 lakhs as interest free loans and Rs 22.14 lakhs as interest bearing loans.

The Board meeting of the cooperative is usually held on the 6th of every month. Every year the managing committee makes a financial projection to understand the working capital requirement based on the consolidated acerage and yield estimation of the standing crop.

Key Achievements

i) **Processing Unit:** Construction of the Dharani processing unit was completed in June 2007. The building has a total area of 7,200 sq ft. An additional 3,600 sq ft of semi-outdoor area has been provided for transit of material and for processing work. An equal amount of space is also provided for sundrying of processed finished goods sensitive to dust. By mid 2008, 15 agro-commodities were being handled at the processing unit. With increased diversity of commodities, storage had become more complex. As a consequence a separate building with 1,650 sq ft was erected in 2008-09.

ii) **Organic certification:** In the first three years the produce of the farmers is treated as 'organic-in-conversion' and from the fourth year it gets certified as organic. As on 2008, 290 farmers had been certified organic while another 600 were in the conversion stage.

iii) **Marketing and brand building:** Pamphlets, labels and e-communications were used to sensitize the consumers about the PGS certification methodologies and the credibility of this certification system. A professional designer was engaged to develop a logo for the brand and multi-colour pamphlets. It was decided that "Timbaktu Organic – Food for the soul" would be the brand name and slogan. Multi coloured labels for different organic products, were designed and printed. Multi-coloured flex banners were designed and printed for use in the exhibition stalls. Pamphlets were sent to all the customers and distributed in the gatherings like India Organic Fair, Dastkar, Nature Bazaar, etc.

iv) **Financial achievements:**

- During 2006-07, Adisakthi Dharani recorded sales of Rs. 5.53 lakhs and a gross profit of Rs 0.46 lakhs. The expected procurement was not achieved. With fixed investment in the form of a storage and processing unit, processing machinery, electricity connection and miscellaneous assets purchased, the business was unable to recover its overheads through its sales margins.
- During 2007-08, Adisakthi Dharani recorded a gross profit of Rs 1.20 lakhs at 3.96 per cent and a net loss of Rs 1.60 lakhs at 5.28 per cent on total sales of Rs 30.26 lakhs. The organisation gained valuable experience as the production was very good and the procured commodity was large.
- During 2008-09, the Dharani cooperative recorded a net loss of Rs 0.55 lakhs at 4.16 per cent on total sales of Rs 13.31 (12.91) lakhs. The business costing done by it enabled the Dharani team to establish

correct pricing system and they found the path to overcome the loss incurred in the business.

At an average gross profit margin of 15 per cent (price minus variable cost), and a fixed cost (depreciation, interest, admin etc) of about Rs 12 lakhs a year, the breakeven sales quantity works out to about Rs 75 lakhs. The cooperative expects to reach this target within couple of years and attain financial stability by 2012.

Future Prospects

The collaborative intends to raise financial resources in the form of equity for the cooperative on lines similar to that adopted by NDDB for Amul pattern of milk cooperatives. The success of this venture will ensure better income for the marginalized dryland smallholder farmers of Anantapur District and in the long term will improve their livelihood security through sustainable agriculture methods. Investment in Dharani FaM Co-op Ltd is justified not only because it is a sound producer owned business enterprise and will give financial benefit to the shareholders but also because it is:

a) *Ecologically sustainable* - It is contributing to wards improvement of the health of the people, animals, land and environment;

b) *Socially conscious* - It is increasing income of the marginalized smallholder farmer community by getting them better prices for their produce, lower input costs, access to much needed credit, improved productivity of their lands and animals while supplying much needed healthy foods to the consumers; and

c) *Financially viable* – It is designed to become financially self-supporting in the long run through implementation of economically viable activities.

References

Ashis Panda (n.d.) "Timbaktu Organic - A case study", Transforming India at: http://transformingindia.org Retrieved on July 18, 2009.

The Timbaktu Collective (Sept 2009) *Enhancing sustainable livelihoods: In a different way.* C K Palli Village, Anantapur District, Andhra Pradesh: The Timbaktu Collective.

End-notes

1. Based on information provided by the Timbaktu Collective and other published materials.

2. The Mahasakthi cooperative thrift society network, composed of the Adisakthi, Ananthasakthi and Mahilasakthi cooperative societies, which together had a membership of 8023 women, in 2006, spread over 119 villages.

3. Details regarding the PGS system are available on www.pgsorganic.in and on the OFAI website at www.ofai.org.

9 Promotion of Goat Husbandry in Dholpur by PRADAN[1]

Introduction

Although goat husbandry is a preferred livelihood of the poor in arid and semi-arid regions, it has not received the kind of attention it deserves from the formal system. During the course of implementation of a DPIP project in Dholpur, Rajasthan, PRADAN found goat rearing to be a suitable activity for the area. The beneficiaries were largely women from the BPL families. This case shows how a traditional livelihood activity of the poor can be stabilized and upgraded by organizing professional services at the cluster level, and dealing effectively with both production and market risks.

Goat Husbandry in Dholpur

Dholpur District is made up of three distinct geographical areas: the plains, the rocky terrain of the Aravalli Plateau, commonly known as the Daang region, and the ravines of the Chambal Basin. The Sarmathura region of Dholpur District is an area with an undulating rocky terrain with some patches of agricultural land. There are large tracts of fodder land in this region and there is a problem of potable drinking water.

PRADAN started operating in the Sarmathura region in 2002 by implementing District Poverty Initiative Programme (DPIP). It initiated work by developing SHGs and later identified the households/members, who could be associated with DPIP. It also aimed at reaching out to a large number of families below the poverty line (BPL). The selection of livelihood activity for intervention was based on a matrix ranking technique. PRADAN functionaries proposed possible options in the region like bore-wells, beading, durrie weaving, poultry, dairy and goat rearing to the CIG members. Finally, the group members chose goat rearing as the preferred activity. The members were also of the view that goat rearing

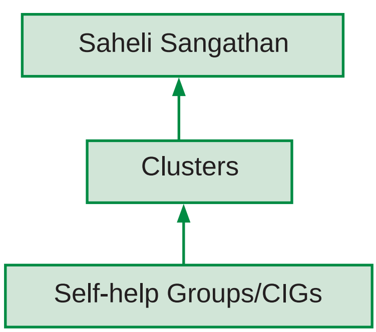
was comparatively manageable, and seemed more viable and economical than other activities. The availability of large tracts of fodder land was an added advantage.

Institutional Set-up

The project objective was to set up a strong sub-sector around the goat-rearing activity, taking all the stakeholders into the fold and building a network of backward and forward linkages. PRADAN also proposed the building of a strong women's federation to monitor the activity, making all linkages sustainable and the entire sub-sector in the region vibrant. PRADAN functionaries felt that providing services became easier with such a sectoral approach.

When PRADAN started forming clusters comprising SHGs/CIGs for goat rearing in the region, the group realised that the high mortality rate in goats and the inadequate support of insurance services were the major obstacles in the smooth functioning of the activity. The high mortality rate in goats is a result of lack of proper veterinary care. Although there is a veterinary hospital in Sarmathura, the doctor is rarely available in the hospital. PRADAN functionaries also noted that since most of the villagers were rearing goats in a traditional way, the survival of goats became a major challenge in the region. Hence, they decided to initiate the provision of veterinary support to the goat rearing CIGs. Providing veterinary and insurance support through an institutional setup seemed more feasible.To this end, PRADAN identified and trained para-vets to provide veterinary support to goat rearing CIGs in the Sarmathura region.

A three-tier institutional structure was, therefore, established, in which the SHGs and CIGs formed the base level. Representatives from these institutions formed clusters. These clusters were further aggregated into a women's federation known as Saheli Sangathan.



At present, there are seven clusters in the region. Two representatives are elected from each SHG/CIG to be members of the clusters, for a period of six months. Each cluster elects representatives, to the federation. Only those women, who are vocal and show leadership qualities, are elected as representatives. The members of the federations elect their office bearers. The President, vice president and a cashier are elected for a period of three years.

A cluster meeting is organized on the 7th of every month; issues related to the project activity are discussed at length by the members. A member, who comes late for a meeting, has to pay a late fee of Rs 5. A penalty of Rs 10 is charged for not attending the cluster meeting without prior information. A representative from PRADAN maintains the minutes of the cluster meeting. A federation meeting is held on the 9th of every month; matters of insurance, veterinary care and other group issues are taken up. PRADAN functionaries attend these cluster and federation meetings and help members to resolve issues, when necessary.

As on Aug 31, 2010 280 CIGs, across 33 revenue villages in the Sarmathura region were engaged in goat-rearing activity. These CIGs were formed between 2002 and 2010.

Backward Linkages

To support long-term economic gains from goat husbandry, PRADAN went about strengthening backward linkages, especially the veterinary care and insurance services.

Veterinary support

Due to lack of adequate and timely veterinary care in the Sarmathura region, many CIG members lost the goats they had received from DPIP. To fill this gap, PRADAN identified educated village youth with some basic understanding of animal rearing and trained them as para-vets. They were trained to diagnose, and administer drugs and vaccines to animals. Currently, 12 para-vets are providing services in the Sarmathura region. The para-vets visit the CIGs of their area once every fortnight, check the herd, collect data on the health status of goats and train the CIG members to identify diseases. The para-vets are provided three types of training:

- Animal management training (AMT)
- Medical training of short duration (three hours)
- Refresher course on AMT

PRADAN has recruited a veterinary doctor, who provides handholding support to para-vets, thereby strengthening the veterinary support. The federation also provides veterinary support to the CIG members. The CIG members contribute an annual payment of Rs 25 per goat to Saheli Sangathan specifically for this purpose. This amount is used to purchase vaccines when required. The goats require doses of 3–4 vaccines a year.

Providing Insurance Services

Although the intervention included insurance, there were problems of non-payment or delay in payment of claims made to insurance companies. The mortality rate of goats in the region is high and because the CIG members were not able to bear the loss of livestock, a *Saheli Rahat Kosh* (insurance fund) was established by PRADAN to provide insurance support. The Saheli Sanghatan manages this *kosh*. The CIG members deposit the insurance premium obtained from DPIP, in this *kosh*. Although the DPIP had fixed the rate of the premium at 2.25 per cent of the price of goats, the rate of insurance premium in *Saheli Rahat Kosh* was fixed at 5 per cent. On the death of a goat, the member is paid the insurance claim from this *kosh*. The payment is made only after verifying the claim. The decision regarding payment is based on the consensus of the Sangathan members.

Forward Linkages

Marketing support

Both goat's meat and milk has a market. At present, local traders approach the CIGs to purchase lambs. Since there is no outlet for the milk, it is often utilized for household consumption, especially by children.

The CIG members pointed out that, with proper veterinary care, the herd size belonging to some members has increased by 10–30 goats. Some CIGs reported an annual income of Rs 3,000–10,000 from the sale of goat kids. However, PRADAN functionaries also reported that, with the increase in goat supply (more than the demand), the members were not able to fetch a good price from the local traders. They were, therefore, exploring other market avenues for the sale of goat milk and lambs. They were planning to organize *haats* for the sale of lambs and had talked to some traders, regarding the purchase of goat milk for cheese preparation.

PRADAN has also tried to link SHGs/CIGs with other activities. Some CIGs members have set up vermi-compost plants and have even earned money from the sale of goat manure, which is very productive and fertile. PRADAN is supported by the SRTT, which promotes experimentation in the area of livelihoods. PRADAN is also providing marketing support for goat manure. On the one hand, it has linked traders to the CIGs for the purchase of manure and, on the other, recently PRADAN itself has purchased goat manure from SHGs/CIGs, at the rate of Rs 2 per kg for its NRM projects.

Other support

PRADAN also trains and prepares *Munshis* for maintaining group records of savings, meetings and inter-loaning. *Munshis* are educated members of the community or CIG members, interested in learning accounts and record-keeping. The services of those *Munshis*, who are not CIG members, are paid for by the groups.

A Computer *Munshi,* located in the Sarmathura office of PRADAN, compiles all the data related to the SHGs/CIGs using a computer programme called Regular Meeting Generation Set (RMGS). The SHG/CIG members visit the office once every 15 days and submit all SHGs details of meetings, savings and inter-loaning in a prescribed format.

What Has Changed for CIG members?

All the groups in the goat cluster are women's groups. Field interactions with CIG members reveal that coming together as members of a federated body has given the members a sense of group identity. The women members meet regularly and have been able to tide over household contingencies through savings and inter-loaning. The earnings from goat rearing have improved their economic status. The experience of Asha devi (Box 1) shows what this improved economic status can mean to a typical household of the region. The mobility of women has also increased and women members articulated that they go to the bank themselves for various transactions. Some cluster leaders have also gone out of their district/state to attend workshops. Women have learnt to sign their names. One of the CIG presidents has also received training as a *Mahila Munshi*.

Some of the other issues that Saheli Sangathan is trying to address are:

- Enrollment of girls in schools
- Unequal gender relations
- Access and control over income earned by women
- Reproductive health
- Violence against women

Conclusion

The cluster development in Sarmathura region is a way of setting up a governing structure to provide institutional linkage and support to the SHGs or CIGs formed by PRADAN. This structure provides a strong support to the activity of goat rearing through backward and forward linkages.

These backward and forward linkages have enhanced the quality of the groups and, simultaneously, have promoted the sustainability of livelihoods. The above case shows that the formation of cluster-level groups and their subsequent federation can greatly enhance the sustainability of groups. Federations can contribute to improving savings and loan recoveries, resolving conflicts and cases of financial mismanagement in groups, mobilizing government programmes, and addressing the common social and economic needs of villages in the cluster. In some cases, these could even act as financial intermediaries for mobilizing capital from some groups and channelling it to others. Federation membership also gives groups a sense of belonging to a larger organization.

Box 1: Bakri Meri Jaan!

Thinly built but highly vocal and assertive Asha devi, is the *Adhyaksha* (President) of *Bhairon Baba Pashudhan Vikas Samiti,* a group of 13 women, involved in savings and credit for last 6 years.

Asha purchased 15 goats and one buck under the project along with her husband from a village 22 kms from home. She invested Rs 32,000/- in this venture, out of which Rs18,320/- was provided by the DPIP, while rest of the amount was incurred by her. She arranged for this money by mortgaging some of her belongings to the local moneylender @ Rs 3 per 100 /per month.

Taking up goat rearing activity turned out to be the greatest event in the lives of this family. Initially she started with a herd of 15 goats and 5 kids. As a result of her painstaking efforts and dogged perseverance the entire herd remained free of disease and losses due to which, mortality was zero. Her herd grew to 75 goats worth more than Rs 150,000/- at the prevailing market rate. She has been selling male goats since last three years, securing an average annual income Rs 25,000 /-.

From this income she has been able to repay all the loans she took earlier. She has also constructed a new cemented house for her family. She provided financial support to another family in the village to get their daughter married off. Things changed drastically for this family in last six years. It got transformed from a family in financial crisis to a family having assets worth Rs 1.5 lakh at its disposal. She proudly says, "ye *bakri mere jaanvar nahi hai, meri jaan hai!"* (these goats are not animals for me but they are my life!).

Source: Sanjay Sharma, 2010

Significantly, the DPIP did not provide for many of the software expenses incurred like costs of building backward linkages, salaries of veterinary doctors and building the federation of CIGs in this intervention. Hence, PRADAN had to mobilize funds and human resources separately in order to make it happen.

Reference

Sharma, Sanjay (2010), "Goat rearing in Dholpur: More than a livestock based enterprise". Unpublished note PRADAN, Dholpur.

End-notes

1. Abstracted from Process monitoring note 7, prepared by the Institute of Development Studies, Jaipur, for PRADAN

10 Improving Livelihoods by Making Vermi-compost[1]

Human livelihood opportunities are often closely linked to the soil fertility conditions in dry tropical regions of India. Notwithstanding a common social background and possessing almost similar natural resources, farmers of a locality exhibit surprisingly drastic dissimilarity in their economic status. In such situations, more often than not, the factor determining the economic well-being of farmers is soil fertility. In particular, the biological component of the soil represented by living organisms and dead organic matter, is a major factor limiting the fertility of dry land soils. Therefore, improving biological fertility is usually a priority of the land development programmes. If activities designed for such purposes also afford an opportunity to earn a livelihood, the eventual benefit realized is much larger.

BAIF Development Research Foundation, based in Pune in India, has been engaged in improving the livelihoods of rural communities through land-based activities. Most of the projects implemented by BAIF are sponsored by development agencies and a majority of the targeted beneficiaries are marginal farmers. The extent of degradation of their lands is so acute that farmers are forced to seek a livelihood elsewhere, as migratory labour. Making them realize that the land they possess can be turned into a valuable asset and encouraging them to return to their farms is the primary requirement of any development initiative. In this regard, BAIF's strategy has been to introduce sustainable systems like tree-based farming and encourage practices like the use of compost to supplement the biological fertility of soil. Although several methods of composting are practised, vermi-composting has been the most popular method among participants in BAIF projects.

Vermi-composting

Composting is the process by which biomass is broken down to humas, which has several beneficial effects on the physical and chemical properties of soil. Further, the decomposition of humus releases the nutrients contained in it for crop uptake. A requirement for composting is the presence of organisms that feed on the biomass and break it down physically to finer particles and chemically less complex substances. In nature, earthworms and micro-organisms decompose dead biomass. When this process is initiated with the deliberate introduction of earthworms into a stack of biomass, it is called vermi-composting.

The quality and the state in which biomass is available with most BAIF project participants has a relevance as to why vermi-composting is preferred over other methods of composting. Of the limited biomass available, farmers use straw, leaf litter and tender stem as fodder for farm animals whereas hardy stem and coarse leaf are sources of domestic fuel. The remaining biomass is coarse material that does not break down easily. Earthworms are more effective in initiating the decomposition process of such material, paving the way for subsequent microbial action.

Another source of biomass available to farmers is cattle dung. This is an excellent substrate that undergoes composting on its own and becomes farmyard manure of very high quality. Unfortunately, the dung available with small farmers does not compost well because of the state in which it is available. Animals owned by them usually graze in the open and the dung is relatively dry when collected. It is then left in a collection pit where it loses more moisture. Therefore, dung collected from the open, unlike fresh dung, does not have the microbial population in the required numbers to decompose into farmyard manure. However, when moistened, it becomes an excellent substrate for vermi-composting.

The Method

The substrate for vermi-composting, on weight basis, is three parts of dry biomass (chopped into pieces of less than 10 cm) and two parts of wet dung. The biomass and dung are mixed well and water is added, to have an overall moisture content of 30–40 per cent. At this moisture level, a ball made by pressing the substrate particles together breaks up when dropped. If it does not break up, the moisture is too high whereas a ball cannot be made if the substrate is too dry. The substrate is made into a bed of desirable length with 100 cm width and 50 cm height, and kept covered with a wet gunny. After two weeks, 200 earthworms are introduced for every 100 kg of substrate. The substrate is stirred and turned once a week, water is sprinkled if it is too dry and the bed is remade. The vermi-compost is ready for use in about 45 days.

Livelihood Opportunity

Recognizing the potential of vermi-composting in small farm conditions, BAIF introduced it to participants in its development projects in several states of India. A component of many of these projects was to grow fruit trees on marginal land, which required filling the planting pits with manure and soil. Hence, there was need for manure like vermi-compost in these project sites. Farmers would collect dung and leaf litter from their own farms or neighbourhood and make the vermi-compost with earthworms supplied by BAIF. Surface-feeding species of earthworms like *Eisenia fetida* are very effective because of their tolerance to relatively higher temperatures prevalent locally. In order to emphasize the importance of earthworms, these were not supplied free of charge. Every recipient was required to pay an interest of 200 worms in three months for every 1,000 they received. As a result, there were sufficient worms to go round in most project locations within a few months' time.

In most farm-holdings, vermi-composting became the responsibility of the women because it required continuous involvement. It did not involve hard manual labour though. The simple production process and flexibility in terms of time needed to attend to the activity allowed the women to handle it comfortably, with their household chores. In order to take advantage of the skills of women in managing this activity and to convert the dung, leaves and other bio-wastes found littered in rural areas, vermi-compost making was evolved into an income-generation activity.

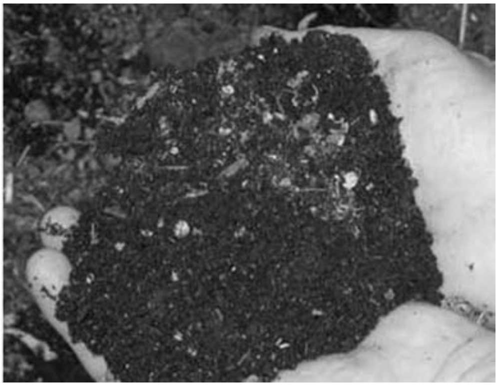
The concept of an SHG, in which 10–20 like-minded women work together with a common aim, was adopted for this purpose. The groups were provided training and it was noted that the women were quick to acquire the necessary skills and, thereafter, they managed the activity on their own. Each group received a kilogram of earthworms, worth about Rs 1,175 . Some women were very reluctant to touch the earthworms initially but the perseverance of the trainers eventually paid off. Project staff visited the groups regularly to conduct discussions and provided guidance. These interactions helped the women get over their aversion to handle earthworms. The women realized that vermi-compost production was a simple activity, that required only a few hours each day, when the entire group shared the tasks. Based on an understanding, each member collects dung and other biomass from farms, homesteads and common areas, including forests.

The vermi-compost produced by the groups was procured in most cases for BAIF-implemented projects, for use in the fields of beneficiaries establishing the tree-based system. The availability of this market outlet served as an incentive for the groups engaged in this activity. Thus, vermi-compost production as an income-generation activity has succeeded in almost all the areas where it was introduced. In a project location in Gujarat, for example, more than 250 SHGs, comprising tribal women, produced nearly 2,000 tonnes of vermi-compost in a year. The value of this is about Rs 4,00,000—a sizeable amount, considering the economic status of the local people. The members of the group share the proceeds from the sale of the vermi-compost.

Soil Fertility

The vermi-compost produced by the SHGs must be used to enrich the fertility of soils within the locality. Ideally, the biomass taken out from a farm should return to the farm, in the form of vermi-compost. However, this is difficult to ensure because the objective of the groups is income generation. As of now, the vermi-compost produced by the groups is purchased for the development projects implemented by BAIF; it, therefore, remains within the village and is used on small farms. Once the project activities are completed, there is a possibility of the produce getting sold to large farmers outside the villages. The export of biomass from the site of its origin is undesirable. It is expected that the experience and affordability of the farmers in project villages will result in their buying the vermi-compost from the groups for their farms.

The vermi-compost made by individual farmers is used for fruit trees as well as annual crops. Some farmers, who earlier used small amounts of chemical fertilizers in combination with organic manure, are now able to grow their crops with vermi-compost alone and get almost the same yield. In general, farmers are introduced to a package of improved practices, and the application of vermi-compost is one such practice. Therefore, the quantitative improvement in the productivity solely due to vermi-compost use is difficult to ascertain. But the benefits in different aspects of crop production are often evident to the farmers. An example is the observation that when long dry spells intervened during the monsoon season, the paddy crop survived in fields where vermi-compost had been applied due to an increase in the water-holding capacity of the soil.



Another instance of the successful use of vermi-compost is in a BAIF project, in which a group of small farmers in Gujarat were encouraged to adopt an intensive vegetable production model. Each farmer cultivated more than 10 species of vegetables in a year on 0.10 ha of land with irrigation. The rate of vermi-compost application in these fields is 10–15 tonnes per ha per year. In spite of heavy nutrient extraction through repeated harvests, these farms have been able to sustain their production in the past three years. Several farmers are of the view that the fertility of their land has been gradually improving because of the continuous addition of vermi-compost.

Sustainability

The sustainability goals of this initiative are two-fold: first, vermi-compost making should sustain as an income-generation activity; second, the production of vermi-compost should contribute to sustainable farming in the locality. With this in view, corrective measures are suggested regularly in the method used as well as in the functioning of the groups. In the beginning of this activity, more than 70 per cent of the material used was dry dung and the remainder was straw and dry litter. Some groups have been using the same proportion for wet dung as well. This was corrected to not more than 40 per cent dung so that a larger proportion of straw and litter can be made into vermi-compost. The aim is to maximize the recycling of waste biomass for increasing the biological fertility of soil.

Vermi-compost making through SHGs is yet another demonstration of BAIF's strategy of combining technical interventions with community mobilization.

End-notes

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Annexures

1. The Bopal Declarations

Background

Development requires technology, capital and other resources. Above all, it requires motivation and the capability of the concerned people, the stakeholders, to utilize their resources in an efficient, equitable, and sustainable manner. This participation is at the core of sustainable development. The trend was started soon after independence with the launching of the Community Development Programme, which got diluted and was almost given up later. It was re-introduced more rigorously, particularly in the economic activities of natural resource management (NRM).

The decade of the 90s saw sweeping, almost revolutionary, changes in the way rural development, particularly relating to the natural resources, crucial for the well-being of the people living in rural areas, were to be managed. This was no longer through commands coming from national or state capitals to be implemented by district bureaucracy but by the rural communities that would decide and prioritize their requirements and accordingly prepare and implement micro-plans appropriate to local conditions and needs. Joint Forest Management (1990), Watershed Development (1995), Participatory Irrigation Management in (1997) and Swajaldhara (2003) are some of the major programmes formulated on new principles.

Those working for participatory management of natural resources were hoping to strengthen and carry forward the participatory approach in 2000–2001 at the time of the formulation of the Tenth Plan. However, the trends of the 10th Five Year Plan are alarming, pointing to distortions and reversals of healthy trends, initiated in the Golden Decade of the 90s. This was forcefully brought out in the paper, 'The fading shine of the golden decade—The establishment strikes back', by Anil C Shah, Chairman, Development Support Centre. The paper is a cry of anguish, pleading that it is imperative to arrest the tendencies to revive obsolete concepts that would undermine the gains of the 90s and deny to the rural areas the benefits of liberalization that should put the stakeholders at the centre of development process. When this paper was presented to Dr M S Swaminathan and Prof Y K Alagh, they encouraged the Development Support Centre to organize national-level deliberations to voice concern at the dilution and almost reversal of the participatory approach, and at the same time present principles that would guide the formulation and modification of schemes of NRM by the centre, states or donors.

The Bopal Declarations

The text of eight declarations, adopted in the National Meeting on the January 16, 2005, at the Development Support Centre, Bopal, Ahmedabad, is given below. Further, the three important central schemes of NRM, namely, Watershed Development, Joint Forest Management, and Participatory Irrigation Management are applied to each of the declarations.

Declaration 1

i. Community Based Organisations (CBOs) of primary stakeholders, whether set up by law or enabling administrative instructions, must be at the centre of planning, budgeting, implementation, and management of all natural resources development programmes so that they have incremental ownership of the programme.

ii. The programme design, therefore, must provide adequate time for capacity building of stakeholder institutions as well as for gathering financial, technical, and administrative support, the stakeholder institutions require to take full ownership of the programme. The ability to elect its own office bearers and appoint its staff who are authorised and competent to carry out all financial transactions (instead of government officers) is the hallmark of a robust CBO.

iii. Functioning as an empowered organisation, the CBO should prove its sense of ownership of the programme by sharing the cost of the investment which is being made for its benefit. The share of the cost should steadily rise till the entire investment is made up from member's own resources and from loan funds from credit institutions.

iv. The CBOs should be closely associated with the Gram Sabha in planning, budgeting, and implementing the programme; they should also obtain the support of the Gram Panchayat so that there is convergence of all programmes in the area served by the Gram Panchayat.

Declaration 2

Natural resource development and management programmes should be considered as levers for achieving greater economic, social, and political equity. The implementing agency must keep in view the critical significance of equity considerations at all stages. Suitable mechanisms and safeguards must be incorporated into the design process and execution of the programmes so as to ensure participation of the disadvantaged.

Declaration 3

Flexibility in technical, social, and financial norms to suit varying local conditions should be facilitated through the process of decentralisation embodied in a broad-based organisation at the district level. The district level organisation must be led by a Chief Executive Officer (CEO) who is competitively selected for a fixed term with a performance-based contract and is granted full autonomy within the limits of the organisation's charter to deliver results. A governing board, constituted with strong representation from stakeholders and multi-disciplinary professionals with high levels of competence, can provide support to the CEO for effective decision-making. This organisation should provide continuity to administration in decision-making and ensure timely release of funds as approved in the action plan of the project.

Declaration 4

Rural Communities, if they are to be promoted and developed as community-based organisations, require facilitating agencies that are skilled in motivating and organising local groups to work for a common purpose. Facilitating agencies, preferably competent NGOs, should be selected through a rigorous and transparent process as indicated in the guidelines to be formulated by the respective national board of each major programme. The facilitating agencies should have a multi-disciplinary professional team supported through financial resources. They should motivate and organise local groups for participation in development processes and activities, thus build up locally empowered communities.

Declaration 5

A participatory, outcome/impact-oriented and use-focused Monitoring and Evaluation (M & E) system should be put in place to obtain concurrent feedback and undertake mid-course improvements in the programme design and implementation systems. An Empowered National Committee on M & E, appointed by the national board and constituted for each major programme, should develop the strategy and lay down guidelines for selecting and funding independent, competent agencies to bring about continuous improvement of the programme. The lessons learnt should be available in a transparent manner, not only to the policy makers but also to the implementing agencies and to all those interested in improved performance of NRM programmes.

Declaration 6

For each major programme of natural resource management, an Empowered National Committee (ENC), appointed by the concerned National Board should develop strategies and lay down guidelines for effective capacity building through awareness creation, communication and training of key functionaries in the programme. The plan for capacity building should cover all stakeholders from policy makers, in the centre and in the states, to village level stakeholder's institutions and leading functionaries of relevant Panchayati Raj institutions. The strategy should be operationalised through national and state level institutions selected through objective criteria and funded according to the guidelines laid down by the ENC.

Declaration 7

Since the goal of NRM is raising incomes and creating wealth for all sections of rural community, it is essential that facilitating agencies should be mandated and supported to initiate productivity enhancement and value addition during the project period and for a few years beyond. The facilitating agencies can achieve this best by organising local groups and associations and federating them so that they can build strategic partnerships with larger private and public groups. The partnership in turn will provide access to knowledge and resources essential for sustaining the momentum of development.

Declaration 8

NRM programmes require relatively highly autonomous organisations at district, state and national level with performance accountability, accountability for service delivery to their stakeholders, and multi-disciplinary competencies, to enable them to design, modify, operationalize, and implement as appropriate the NRM programmes within their respective mandates.

ii) At the national level, this organisation will take the form of a Board for each major programme.

iii) To facilitate excellent contribution to their respective missions, each of them must have:

a) A charter that clearly spells out its mandate, mission, powers, responsibilities etc.

b) A CEO, who is competitively selected for a fixed term on a performance contract basis and is granted full autonomy to deliver results within the limits of the organization's charter:

c) A governance board with strong representation from stakeholders and relevant professionals.

d) An annual MoU between the organisation and its controlling/funding authority that sets out performance and support expectations on both sides.

e) A management information system (MIS) that provides periodic information on the organisation's performance against its MoU commitments to its controlling authority and its stakeholders.

f) A stakeholders' charter that sets out what services the stakeholders can expect from the organisation and the mechanism for redressing any grievances they may have.

g) Transparent HRM policies.

h) Performance-linked rewards.

i) 'Best value for money' market tests.

Source: Bopal Declarations (2005), ***Non-negotiable Principles of Development & Management of Natural Resources In Sustainable manner****, Ahmedabad: Development Support Centre, 16th January 2005.*

2. Ecological Variables Affecting Treatment Plan

Climate

The most important variable influencing treatment plan is climate because the total amount of precipitation depends on it. Although climatic zones are determined on the basis of a number of variables like rainfall, temperature and relative humidity, as a rule of thumb, climatic conditions can be classified on the basis of average annual rainfall. Rainfed areas in India can be classified into four broad climatic zones, shown in Table 1.

Table 1: Classification of Climate Based on Rainfall

Climate	Approximate Rainfall (mm)
Arid	<500
Semi-arid dry	501–700
Semi-arid wet	701–1100
Sub-humid dry	1101–1600

Source: Singh et. al. (2000) in Wani, Rockstrom and Oweis (2009).

The precipitation in a given area determines the *total run-off,* which is the most important factor in designing soil and water harvesting structures. The total run-off refers to the quantum of rainwater that flows over the surface of the land after precipitation occurs. When rain falls, some water enters the soil and flows as sub-surface run-off. In permeable soil strata, the proportion of sub-surface to surface run-off will be higher than in non-permeable strata. Most engineers consider only surface run-off in their calculations for designing water harvesting and storage structures and, therefore, the total run-off here refers to the total surface run-off. As we move from arid to semi-arid to sub-humid regions, the total run-off increases from low to high due to the increased levels of precipitation.

Slope

The topography of the land is another important source of variability. Landscapes may comprise rocky top slopes and isolated rock outcrops (slope > 45 per cent), to flat lands (0-5 per cent) and river channels. Although more detailed classifications are available, the classification shown in Table 2 is considered practical.

Slope affects the peak rate of run-off or the rate at which the water flows over the surface of the land. This is an equally important variable taken into account by engineers when designing water harvesting and storage structures. In general, as we move from undulating to flat lands, the *peak rate of run-off* slows from high to low.

Table 2: Classification of Land Based on Slope Percentage

Approximate Classification		Broad Classification
Category	Slope Percentage	
Steep (rocky outcrops)	> 45	Undulating
High	30–45	
Medium	10–30	
Low	5–10	Rolling
Negligible	0–5	Flat

Surface Resistance to Run-off

Resistance provided to run-off on the surface of the earth affects the velocity of the run-off. *Vegetative cover* and *soil texture* are among the key variables determining resistance.

In fact, scientists use these two variables besides slope percentage in the computation of the *run-off coefficient,* which is used while designing soil and water harvesting structures (Tideman, 2000).

Hydrogeology

Hydrogeology is a complex variable and depends on the type and positioning of rock strata in the project area. In general, soft rocks (for example, sandstone) are *permeable* and can store ground water whereas hard rocks (for example, basalt) are relatively *non-permeable* and do not offer scope for storing ground water. Sometimes a layer of soft rock lies on a deep layer of hard rock. Sometimes, the reverse is true. Often, these layers alternate, providing scope for the formation of aquifers, both in the sub-surface as well as deeper parts of the land. The nature and positioning of these rock layers define the sub-surface flow of run-off as well as the potential for ground water storage. Hence, the variable affects the objective of water harvesting and the resultant choice of structures. This variable also affects the volume of surface run-off. If the underlying stratum is mainly hard rock, the potential for ground water storage will be less and the surface run-off will be high. The reverse would be true if the underlying stratum comprises soft rock.

Shape of Watershed

The shape of the watershed also affects the peak rate of run-off. The shape could vary from *broad* to *narrow*. In the latter case, the peak rate of run-off will be slower because the surface run-off would have to cover a longer distance. The reverse is true for a broad watershed.

Natural Depressions in Topography

Sometimes, the surface of the land has natural depressions, which need to fill before the water can start flowing downstream. The presence or absence of such depressions will make a difference to the total run-off as well as the peak rate of run-off.

Salinity

The presence of salinity in the soil and groundwater poses additional complications for the design of water harvesting structures. Salinity could be of two types, a) *induced*, and b) *inherent.* The latter is generally found where the origin of land is marine like coastal Saurashtra and Kutch. Such lands are more difficult to tackle as compared to lands with induced salinity (for example, salinity induced by excessive use of irrigation water in the Mahi Canal System of Gujarat or the Indira Gandhi Canal System of Rajasthan). Saline lands are found mostly in flat/rolling topography. Whereas salinity as such does not affect either the total run-off or the peak rate of run-off, its presence in the ground water restricts the water-harvesting strategy to surface water. Salt-affected areas and highly arid (desert-like) regions are difficult to tackle and require specialized treatment.

3. Land Capability Classification

Land Capability Classification is a systematic classification of different kinds of land, according to properties that determine the ability of the land to produce common cultivated crops, pastures and plants. Land Capability Classification along with other soil- and water-related information and potential forms the basis for land use planning (Kakade, 2005). Given below are the schemes for classifying four variables (Tables 1 to 4), which contribute to the final Land Capability Classification shown in Table 5 (WOTR, n.d.)

- The basic principle of soil and water conservation is to use land according to its capability and treat land according to use.
- Land Capability Classification knowledge is an important prerequisite for planning and execution of the soil and water conservation programme.
- It is a systematic arrangement of different kinds of land, according to those properties that determine the ability of the land to reproduce on virtually permanent basis.

Table 1: Soil Properties

Soil Texture	Particle size
Sand (s)	0.05 to 2.00 mm
Silt (si)	0.05 to 0.02 mm
Loam (l)	0.02 to 0.002 mm
Clay (c)	less than 0.002 mm
(1 gm of clay has a surface area of up to 1,000 times that of 1 gm of sand)	

Table 2: Soil Depth Classes

Symbol	Name	Depth (cm)
d1	Very shallow	0–7.5
d2	Shallow	7.5–22.5
d3	Moderately steep	22.5–45
d4	Deep	45–90
d5	Very deep	> 90

Table 3: Slope Classes

Symbol	Slope class	Slope (%)	Abney's level
A	Nearly level	0 to 1	0 to 35'
B	Gently sloping	1 to 3	35 to 1°44'
C	Moderate sloping	3 to 5	1°44' to 2°52'
D	Strongly sloping	5 to 10	2°52' to 5°43'
E	Moderate steep	10 to 15	5°43' to 8°32'
F	Steep	15 to 25	8°32' to 14°03'
G	Very steep	25 to 33	14°03' to 18°16'
H	Very, very steep	> 33	18°16' to 26°34'

Table 4: Soil Erosion Phases

Symbol	Erosion Phase	Characteristics
e1	Sheet erosion	Up to ¼ of top soil lost
e2	Rill erosion	¼ to ¾ top soil lost
e3	Small gullies	¾ top soil and up to ¼ subsoil lost
e4	Gullied land (shallow gullies)	More than ¼ subsoil lost
e5	Very, very severe	Very severely gullied land/sand dunes

Table 5: Land Capability Classification Rating Table

Class	Texture	Soil Depth (cm) and Symbol	% slope of land and symbol					Erosion Class and Symbol		Permeability (mm/hr)	Conductivity (mmhos/cm at 250 C)	Climate
			Alluvial Soil	Black Soils	Red Soils	Deep Red Soil of the Eastern Ghats, Western Ghats and Nilgiris	Himalaya					
I	sicl, cl, l, sl, sil, scl	>90 (d5)	0–1 (A)	0–1 (A)	0–1 (A)	0–1 (A)	0–1 (A)	Up to ¼ of top soil lost sheet erosion (e1)	Very far away	Moderate (20–50)	0- 2	Humid climate, with well-distributed rainfall throughout the year
II	sicl, cl, sl, sil, scl	45–90 (d4)	1–3 (B)	1–3(B)	1–3 (B) 3 –5 (C)	1–3 (B) 3–5 (C)	1–3 (B)	Up to ¼ of top soil lost: sheet erosion (e1)	Minimum 60 m	Mod. slow (5–20); Mod. rapid (50–125)	2-4	Humid climate, with occasional dry spells: sub-humid crop yield frequently reduced by drought
III	Sc, sic, c, ls	22.5–45 (d3)	3–5 (C) 5–10 (C)	3–5 (C)	5–10 (D)	5–10 (D) 10–15(E)	3–5 (C) 5–10 (D)	Between ¼ and ¾ top soil lost: rill erosion (e2)	Between 6 and 60 m for 0–3% slope	Slow (1.25–5); Rapid (125–250)	4- 8	Sub-humid crop yield frequently reduced by drought semi-arid
IV	C, s	7.5–22 (d2)	10–15 (E)	5–10 (D)	10–15 (E) 15–25 (F)	15–25 (F) 25–33 (F)	10–15 (E) 15–25 (F)	Up to ¼ of subsoil and ¾ of top soil lost: small gullies (e3)	_	Very slow (> 1.25); Very rapid (> 250)	8-16	Semi- arid and arid
V	Same characteristics as class I land except for one or more limitation of wetness or stoniness or rockiness or adverse climatic conditions. It has no hazard of erosion like class I land.							Gullied land (e4) or sand dunes	Marginal land (6 m-wide strip near gully head)	_	> 16	_
VI		7.5 or less (d1)	15–25 (F)	10–15 (E)	25–33 (G)	33–50 (H)	25–33 (G) 33–50 (H)	Gullied land (e4) or sand dunes	Gully sides and beds	-	-	-
VII		7.5 or less (d1)	25–33 (G)	15–25 (F)	33–50 (H)	50–100 (I)	50–100 (I)	Bad lands	Gully sides and beds	-	-	-
VIII		Rock	> 33	> 25	> 50	> 100	> 100 (J)			-	-	-

Source (Table 1-5): WOTR (n.d.) Technical Notes. Ahmednagar: Watershed Organisation Trust.

4. Choice of Species for Developing Common Property Land Resources

Table 1: Popular Species for Tree Farming and Agroforestry

Botanical Name	Common Name	Fuel	Fodder	Tim-ber	Edible	Soil Stabilisation	Remarks
Arid Western Plains							
Acacia nilotica (L.) Del. Spp. cupressiformis	Babul	+	+	+		+	Quick growing, windbreak
Acacia Senegal willd.	Gum Arabic	+	+	+	+	+	Rocky and dune areas, dune situations
Acacia tortilis (Forks) Heyne	Israel Babul	+	+	+		+	Dune situations
Ailanthes excelsa Roxb.	Maharukh		+	+		+	Quick growing, canal bunds
Albizia lebbek Benth.	Siris		+			+	Windbreak on plains, avenue
Azadirachta indica	Neem	+					Quick growing, oil cake as manure
Carissa carandas L.	Karonda				+	+	Easy to establish, excellent hedge
Cassia siamea Lamk.	Kassod	+				+	Quick growing, avenue, windbreak
Cordia dichotoma Forst.	Lasoora	+	+		+		Easy to establish, gum from bark, backyards
Prosopis , chilensis Stuntz	Kabuli Kikar	+	+			+	Quick growing, windbreak for wastelands
Prosopis juliflora D.C.	Ganda Bawal	+	+			+	Quick growing, windbreak for wastelands

Continued...

Botanical Name	Common Name	Fuel	Fodder	Tim-ber	Edible	Soil Stab	Remarks
Salvadora persica Linn.	Kharajal	+	+		+	+	Quick growing, windbreak for wastelands
Tamarix troupii Hole	Shan	+				+	Quick growing, for sandy arid tracts
Tamarix aphylla Karst.	Shan	+				+	Quick growing, for sandy arid tracts
Zizyphus numularia Wt. and Arn.	Jharberi	+	+		+	+	Quick growing, drought-resistant
Semi-arid and Humid Western Ghats of Karnataka Plateau							
Acacia mearnsili de Willd.	Black Wattle	+				+	Along field bunds, over 1200 m, Nilgiris, wood for tannin
Acacia nilotica (L.) Del.	Babul	+	+	+		+	Quick growing, windbreak, var. *cupressiformis* planted along field bunds
Albizia falcataria (L.) Fosberg	Sanjon		+	+			Fast growing, green manure
Borassus flabellifer L.	Tar, Todipalm	+	+	+		+	Quick growing, material for handicrafts, fibre, neera
Cassia siamea Lamk.	Kassod tree	+				+	Quick growing, windbreak, green manure
Casuarina equisetifolia L.	She-oak	+	+	+			Quick growing, windbreak, rafters and poles, sandy coastal inlands
Eucalyptus citriodora Hook	Lemon-scented eucalyptus					+	Quick growing, aromatic oil; up to low hills
Eucalyptus globulus	Blue gum	+		+		+	Quick growing; above 1,500 m
Eucalyputus umbellata Domin	Mysore gum	+		+		+	Quick growing
Leucaena leucocephala, (Lamk.) de Wet	Koo-babul/ soo-babul	+	+			+	Quick growing, nutritive green manure/fodder
Orchlandra ebracteata Raiz Chat	Kolanji					+	Mats, baskets, newsprint

Continued...

Botanical Name	Common Name	Fuel	Fodder	Tim-ber	Edible	Soil Stab	Remarks
Pongamia pinnata (L.) Pierre and Glabra	Karanj	+				+	Fast growing, afforestation, Oil green manure cake as organic fertilizer
Santalum album L.	Sandalwood		+				Perfumery, handle art
Tamarindus indica L.	Imli, Tamarind	+	+	+			Avenue, medicinal, planted/ naturalized
Thespasia populena Soland ex Correa	Paras pipal	+	+			+	Quick growing, avenue, windbreak, poles, suitable for coastal plains-
Semi-arid Lava Plateau and Central Highlands							
Acacia nilotica (L.) Del.spp. indica	Babul	+	+	+		+	For day tracts, particularly windbreak, var. cuprassiformis field bunds
Ailanthus excelsa Roxb.	Maharukh		+			+	Shelterbelt along tanks, wood for industry, match splints
Azadirachta indica A. Juss.	Neem	+	+	+			Fast growing for afforestation of drier areas, seed oil medicinal, industrial use
Bambusa arundinacea.							
Willd.	Spiny bamboo		+	+	+	+	Rafters, poles, paper pulp; Deccan plateau and hill region up to 1,000 m
Cassia siamea Lamk.	Kassod	+				+	Quick growing, windbreak, excellent green manure
Casuarina equisetifolia L.	She Oak	+				+	Quick growing, windbreak, construction works, good particularly for sandy saline wastelands, coastal belts

Continued...

Botanical Name	Common Name	Fuel	Fodder	Tim-ber	Edible	Soil Stab	Remarks
Eucalyptus umbellata Domin	Mysore Gum	+		+		+	Very fast growing, pulpwood, eucalyptus oil from leaves, poles in construction works, in plains and low hills
Leucaena leucocephala (Lamk) de Wet	Koo Babul	+	+			+	Quick growing, windbreak, green manure plains and low hills
Pongamia pinnata (L.) Pierra	Karanj	+					Oilseed, green manure, ornamental
Santalum album L.	Sandal				+	+	Small-sized evergreen tree, wood in perfumery, handicraft
Sesbania grandiflora Pers.	Basna		+		+		Fast growing, green manure, flowers as vegetable
Zizyphus mauritiana Lamk.	Jujube	+	+		+		Fast growing, dry tracts mainly
Sub-humid Eastern-Southeastern Uplands							
Acacia auriculiformis A.Cunn.	Australian Babul	+	+			+	Fast growing, ornamental
Albizia lebbek Benth.	Siris						Fast growing, windbreak avenue/parks agricultural implements
Albizia chinensis (Osbeck). Merr	Siran		+			+	Fast growing, avenue/parks, shade tree for field crops
Agave sisalana Perr.	Ketaki				+		Fibre
Borassus flabelifer L.	Tar, Todipalm			+	+	+	Quick growing, windbreak for plains, fibre
Caryota urens L.	Fishtail palm				+	+	Quick growing

Continued...

Botanical Name	Common Name	Fuel	Fodder	Tim-ber	Edible	Soil Stab	Remarks
Carissa siamea Lamk.	Kassod					+	Quick growing, windbreak; excellent green manure
Eucalyptus (hybrid)	Nilgiri					+	Fast growing, poles for construction, pulpwood
Gliricidia sepium (Jacq.) Walp	Madre					+	Quick growing, windbreak, shade tree plantations, green manure
Gravillea robusta A. Cunn	Silver Oak					+	Quick growing, shade tree in tea/ coffee plantations
Leucaena leucocephala (Lamk.) de Wet	Koo-babul	+	+			+	Fast growing, highly nutritive fodder
Pongamia pinnata (L.) Pierre	Karanj	+			+	+	Green leaf manure, oil from seed, medicinal
Sub-humid Sutlej Alluvial Plains							
Acacia nilotica (L.) Delite spp. Indica	Babul	+	+	+		+	Gum, medicinal, for dry tracts windbreak
Ailanthus excelsa Roxb.	Maharukh		+	+		+	Shelterbelt, along tanks wood for industry, match splints
Albizia lebbek Benth.	Siris		+			+	Windbreak, fast growing avenue/parks; agricultural implements
Bauhinia variegata L.	Kachnar		+		+		Ornamental
Eucalyptus (hybrid)	Nilgiri	+				+	Fast growing, poles for construction work, pulpwood
Leucaena leucocephala (Lamk.) de Wet	Koo Babul	+	+			+	Fast growing, highly nutritive fodder

Source: Chundawat and Gautam, 1993.

Table 2: Species Suitable for Horticulture in Wastelands

Botanical Name	Common Name	Remarks
Arid Western Plains		
Commiphora wightii (Arnott) Bhandari	Gugul	Resin, medicinal, hedge, refractory sites
Moringa oleifera Lamk.	Sahaujna	Quick growing, fruit as vegetable, pickled, paper pulp
Prosopis cineraria Druce	Khejri	Quick growing, windbreak for wastelands in alluvial zone
Salvadora oleides Decne	Pilu	Quick growing, windbreak for wasteland, for arid areas, oil for industrial use
Zizyphus mauritiana Lamk.	Ber, Jujube	Quick growing, drought resistant, best fruit in arid zone
Semi-arid Lava Plateau and Central Highlands		
Anacardium occidentale L.	Cashew	Along coastal plains/uplands
Moringa oleifera Lamk.	Sahaujna	Fast growing, widely planted
Tamarindus indica L.	Tamarind	Windbreak, avenue, fruit used as seasoning in food
Semi-arid Western and Humid Ghats of the Karnataka Plateau		
Moringa oleifera Lamk.	Sahaujna	Fast growing, fruit as vegetable, pickled
Sesbania grandiflora Pers.	Basna	Fast growing, green manure, flowers as vegetables
Sub-humid Eastern-Southeastern Uplands		
Aegle marmelos Correa	Bel	Fruit, medicinal
Anacardium occidentale L.	Cashew	Sandy coastal plains/uplands
Artocarpus heterophyllus. Lamk.	Kathal	Avenue; wood in turnery, fruit as vegetable, pickled raw
Carissa carandus L.	Karonda	For backyards, hedges; fruit pickled, raw
Emblica officinalis Gaertn.	Arnla	Fruit pickled, preserved raw, rich in vitamin C
Moringa oleifera Lamk.	Sahaujna	Fast growing, fruit as vegetable, pickled
Morus alba L.	Mulberry	Fast growing, afforestation, edible fruit
Tamarindus indica L.	Imli, Tamarind	Avenue, medicinal, naturalized/planted
Sesbania grandiflora Pers.	Basha	Fast growing, green manure, flowers as vegetable
Zizyphus mauritiana Lamk.	Ber	Fast growing, drier tracts mainly
Sub-humid Sutlej Alluvial Plains		
Aegle marmelos Correa	Bael	Medicinal
Artocarpus heterophylus Lamk.	Kathal	Avenue, wood in turnery; raw fruit as vegetable
Carissa carandus L	Karonda	For drier slopes, backyards, hedges, eaten raw/pickled

Continued...

Botanical Name	Common Name	Remarks
Cordia dichotoma Forst	Lasoora	Food for drier locations
Emblica officinalis	Amla	Fruit pickled, preserves, rich in vitamin C
Madhuca indica Gmel.	Mahuva	Fast growing, fruit as vegetable, pickled
Moringa oleifera Lamk.	Sahaujna	Fast growing, fruit as vegetable, pickled
Syzygium cumini (L.) Skeels	Jamun	Avenue tree, moist areas, fruit edible
Tamarindus indica L.	Imli	Avenue, medicinal, naturalized and planted
Ziziphus mauritiana Lamk.	Ber	Quick growing, drier tracts mainly

Source: Chundawat and Gautam (1993)

Table 3: Pasture Land Species for Arid and Semi-arid Regions

Botanical Name	Naturally Preferred Terrain	Other Uses	Flowering Period
Aristida adscensionis	Sandy, rocky	Brooms	October–December
Visarpi ghas (Brachiana reptans)	Marshy	Food	October
Anjan (Cenchrus biflorus)	Sandy	Food, Soil Conservation	-
Safed Dhaman (Cenchrus cilvaris)	Sandy	Soil Conservation	Perennial
Kala Dhaman (Cenchrus setigerus)	Marshy	-	-
Duub (Cynadon doctylon)	Marshy	-	-
Motha (Cyperus rotundus)	Wasteland, Marshy	Agarbatti manufacturing	April–October
Dactyloctenuim sindicum	Sandy	-	April–September
Daab (Desmostachya bipinnata)	Sandy	Medicinal, soil conservation	July–September
Dicanthium annulatum	Marshy	Medicinal, soil conservation	September–February
Homa (Echinochloa colonum)	Sandy, marshy	Food, religious ceremonies	April–October
Echinochloa crusgalli	Marshy	Soil conservation	April–October
Underpuncha hotti (Eragrostis ciliaris)	Sandy, marshy	-	April–October
Eragrostis diarrhena	Sandy, marshy	-	July–September
Phoolan ghass (Eragrostis tremula)	Sandy, rocky	Soil conservation	April–October
Laab (Heteropogon contortus)	Sandy	Food, medicinal, soil conservation	October–November
Sewan (Lasiurus sindicus)	Sandy	Food, soil conservation	October–November

Continued...

Botanical Name	Naturally Preferred Terrain	Other Uses	Flowering Period
Murratghaas (Panicum antidotale)	Sandy	Food, soil conservation	September–November
Murtghas (Panicum turgidum)	Sandy, marshy	Food, soil conservation	-
Phalaris minor	Sandy	-	-
Baaru (Sorghum halapense)	Marshy	-	-
Sitaghas (Tragus biflorus)	Sandy	-	July–September
Tragus roxburghii	Rocky	-	October–November
Brachiara ramosa	Sandy	-	April–October
Moth (Cyperus elusinoides)	Marshy	Medicinal	Perennial
Echinochoa crusgalli	Marshy	Soil conservation	April–October
Eragrostic tenella	Sandy, rocky	-	August–October
Karaar (Lseilema prostratum)	Sandy, rocky	Soil Conservation	October
Sporobolus tremolus	Sandy	Soil conservation	-
Tetrapogon tenellus	Sandy	-	-
Gharaniaghass (chlons virgata)	-	-	July–September
Dinanath (Paspalidium flavidium)	Marshy	Food	July–October
Pennisetum pedicellatum	Wasteland	Soil conservation	-
Kanns (Saccharum spontaneum)		Fibre, medicinal	September–October
Anjan Grass, Buffel Grass *(Cenchrus ciliaris L.)*	Heavy, limestone, and sandy soils	Highly nutritious grass	Throughout the year, better chances in wet season
Australian blue stem *(Bothriochloa glabra (Roxb.)*	Black clay soils and loams and clay loams	Permanent pasture on lower fertility soil	End of March
Caribbean stylo *(Stylosanthes hamata)*	Alkaline soils	Good for cut and carry as green feed	End of dry season
Kusali Grass (Eulaliopsis binata)	Acid Lateritic soil	Broom making	
Buffel Grass *(Cenchrus ciliaris)*	Dry areas and sandy soil	Erosion control and livestock grazing	Perennials

Continued...

Botanical Name	Naturally Preferred Terrain	Other Uses	Flowering Period
Drought Grass (*Ischaemum muticum*)	Very poor soils	Animal fodder, erosion control (especially coastal sand dunes) and to make compost and mulch	Perennials
Finger Grass (*Chloris spp)*	Sandy loam and Sandy soil	Grass is extremely palatable to all types of stock as green feed, dry feed or hay.	September–April
Prairie Dropseed (*Sporobolus*)	Rocky soils	Looks good in front of the border or when woven in and out of taller flowering plants.	August to winter
Couch Grass, Bermuda Grass (*Cynodon dactylon*)	Almost in any type of soils	Conservation, erosion control and grazing	Perennials

Source: Rajora, 2002, and Dwivedi, 1992.

5. Glossary of Terms[1]

Soil and Water Conservation Measures

Anicut: A masonry water harvesting structure that provides a weir across a *nullah* or natural drainage line for holding the run-off. (Mahnot et. al., 2003)

Purpose: To intercept water coming from a local catchment and store it for optimum utilization. The water harvested can also be used for irrigation by LI or other means.

Bench terracing: The conversion of an original ground into a level step such as fields constructed by half cutting and half filling. This helps in reducing the degree of slope substantially.

Purpose: To make cultivation on hill slopes possible. It brings about uniform distribution of soil moisture, retention of soil and manure.

Brushwood check dam: A barrier constructed across the gully with the help of wooden poles and branches of trees/bushes.

Purpose: To control soil erosion, increase soil-moisture; protect farms on the downstream side from flood waters.

Check dam or overflow weir: A low weir with no canal taking off from it, providing for LI and firming up by means of percolation under the wells in the surrounding areas. (Kakade, 2005)

Purpose: To conserve surface water on the drainage line and facilitate the recharging of wells through percolation. The water can be used for irrigation either directly through lift or through the wells.

Chute spillway: An open channel with steep slopes, comprising an inlet, vertical curve section, steep sloped channel and an outlet. (MYRDA and IIRR, 1997)

Purpose: To carry run-off along the steep slopes and sudden drops (mainly in hilly terrain) without causing soil erosion.

Contour bund: Earthen bunds built along contours on gently sloping land to reduce surface run-off and erosion (Kakade, 2005). Contour bunding comprises constructing narrow-based trapezoidal embankments on a contour to impound the run-off water behind these embankments so that all the impounded water is absorbed gradually into the soil profile for crop use. (Tideman, 2000)

Purpose: To harvest the run-off coming from the small catchments, conserve moisture in soil, reduce soil erosion and reduce the velocity of run-off. Contour bunds help to break the slope into smaller compartments, thus allowing rainwater more time or opportunity to soak into the soil in each compartment.

Contour trench: An excavated trench along the contour or along a uniform level. (Mahnot et. al., 2003) Shallow trenches cut across the slope of land along the contour lines (Kakade, 2005).

Purpose: To conserve rainwater and to establish vegetative cover in arid and semi-arid areas; to convert surface water into sub-surface water and to act like a soak-pit. It also serves the purpose of breaking the slope length, reducing the velocity of the runoff, retarding its scouring action and conserving rainwater.

Dry boulder gabion: This is a gabion structure built with boulders (instead of stone) and without the use of cement or sand mortar for adhesion.

Purpose: To reduce velocity of run-off and to minimize soil erosion. (Kakade, 2005)

Earthen *nullah* bunding/ Earthen dam: Embankments across *nullahs*/streams to impound water and regulate excess flow through surplus weirs/channels. Can be adopted in low to medium rainfall areas.

Purpose: Usually constructed across a rivulet to hold up the water for a period of time and to allow it to gradually percolate into the soil, thereby raising the subsoil water level in the surrounding area.

Farm pond: An indigenous technique that fulfills multiple purposes of rainwater harvesting on the farm.

Purpose: For irrigation, water for livestock, recharging groundwater and conserving soil moisture, etc.

Farm pond network: A series of ponds (between 5 and 15 in number) constructed along the contour lines and connected to one another, allowing easy access to water and a better soil moisture regime. A unique model of networking farm ponds has been developed by BAIF in Karnataka. (Reddy, et. al. in Agarwar, Narayan and Khurana, 2001)

Purpose: To improve overall water availability within the watersheds, leading to better irrigation, improved water availability for drinking and agriculture, and establishment of orchards and agroforestry in farmlands. It helps satisfy the water demand of individual farmers located in different reaches of the watershed.

Field outlet: A structure made of stones for draining surplus run-off from the farm.

(Kakade, 2005)

Purpose: To let out surplus water without any damage to the bunds.

Gabion structure: A dam made of a wire-woven basket filled with stones constructed across non-arable land to control silt erosion in steep slopes. (MYRADA & IIRR, 1997) A stone bund bounded by galvanized iron chain link. (Kakade, 2005)

Purpose: To control erosion in steep slopes; reduce the velocity of run-off and recharge water in the ground. The treatment leads to soil conservation and develops a source of irrigation for agriculture/horticulture.

Graded bunds: Earthen bunds built across land slopes, with minimal deviation from the contours for allowing the run-off to flow with a non-erosive velocity.

Purpose: To conserve soil, allow run-off to flow from the fields with non-erosive velocities.

Gradonies: Narrow trenches with bunds on the downstream side, built along contours in the upper reaches of the catchments to collect the run-off and to conserve moisture for trees or crops. (Kakade, 2005)

Purpose: To break the velocity of the run-off, conserve water, control soil erosion and protect bunds on the lower reaches from the run-off. Gradonies help to harvest the run-off coming from small catchments, ranging from a fraction of a hectare to 5-10 hectares, and to conserve moisture in soil.

Gully plug: A bund constructed out of stones/local earth across the stream channel in order to conserve soil and water.

Purpose: To control soil erosion, prevent further deepening of gullies, reduce velocity and runoff, and increase infiltration of water in the soil.

Impermeable gabion with core wall: A gabion structure with three components as described below:

1. *Core wall:* Impervious layer (made of ferro-cement or plastered brickwork from both sides), provided in the core of the structure. This ensures that the gabion is leak-proof.
2. *Concrete raft*: The layer of concrete provided at ground level in which the chain link is embedded.
3. *Stone embankment:* A section of stones wrapped in a chain link. It gives stability to the gabion. (Kakade, 2005)

Purpose: To store surface run-off, in areas where masonry dams, which require deep foundations, are uneconomical.

Infiltration pit: A pit dug to a permeable depth of soil for infiltration of harvested rainwater into the sub-surface soil. (Kakade, 2005) It has the effect of reducing surface run-off but increasing sub-surface flow.

Purpose: To increase soil moisture levels and ground water availability in the lower reaches. The top layer of the soil remains uninterrupted for farming.

***Jal kund*:** A small dug-out with silpholin plastic lining. (Kakade, 2005)

Purpose: To store rainwater.

Khadin: A very popular form of inundation farming or rainwater conservation practised in western Rajasthan. '*Khadin*' is a local term for a submergence tank. (Mahnot et. al., 2003)

Purpose: To conserve water during the kharif season for irrigation and other purposes. Once the stored water is used, the residual moisture in the land is utilized to raise an agricultural crop, usually in the rabi season.

Kuin: An age-old rainwater conservation and storage system prevalent in areas where water is scarce. It is a system that collects sweet water for drinking only from the rainwater or moisture conserved in the deep sand strata. A *kuin* is a very narrow, shallow, vertical and cylindrical structure, which helps to transform the moisture that is hidden in the sand into precious drops of drinking water. (Mahnot et. al., 2003)

Purpose: To conserve moisture and use it as drinking water in places of acute drinking water shortage such as the arid and saline regions of Rajasthan, where the practice has evolved.

***Kunds* or *tankas*:** Older communities in desert cities use the roofs of their houses and courtyards to collect rainwater and store it in covered underground tanks that prevent loss due to evaporation. A *tanka* is a small circular or rectangular underground tank with lime mortar or cement plaster, constructed normally on shallow ground. (Mahnot et. al., 2003)

Purpose: To store rainwater for drinking water and domestic use in arid and desert climates. Small *tankas* can meet the needs of individual families whereas larger *tankas*, built as common property, meet the requirements of groups or communities.

Land levelling and grading: The process of preparing or modifying (that is, reshaping) the land surface to a planned grade, to provide a suitable surface for cultivation.

Purpose: To prepare a suitable field surface, control the flow of water, check soil erosion and provide better surface drainage.

Live hedge: A barrier created by planting grass, shrubs and/or trees across rills to stop soil erosion. Such a barrier is created where the gully/rill originates. (Kakade, 2005)

Purpose: To conserve soil and water on non-arable lands. Vegetative hedges break the run-off, allowing water to pass through them slowly by trapping the silt. This enhances the filtration rate and conservation of soil, and checks the deepening of gullies.

Micro-catchment farming/planting: It is a method of rainwater harvesting that allows plants to be grown in regions with desert like conditions. A micro-catchment is prepared to harvest the water requirements for each single plant. The only disadvantage of the method is that it needs a large area for the creation of micro-catchments. Hence relatively few plants/ trees can be grown as compared to other regions with less harsh environment.

Purpose: To harvest rainwater that is just enough for the growth of every individual plant/tree that is being cultivated in highly water-scarce and arid regions.

Nadi: Small excavated or embanked village ponds that harness the meagre precipitation, to mitigate the scarcity of drinking water in the Indian desert region. (Mahnot et. al., 2003)

Purpose: To harvest rainwater and create a system of domestic water supply at the village level for human beings and livestock.

Percolation tank: An embankment constructed across natural depressions/valleys in arable, non-arable and community lands, to store run-off for percolation so as to recharge groundwater and make water available for domestic and agricultural use at the surface level. (Mahnot et. al., 2003)

Purpose: To conserve water for drinking, domestic and irrigation purposes.

Spring development: A method of enhancing the spring flow and utilizing it for both consumptive and productive purposes (Kakade, 2005)

Purpose: To improve water quantity and quality for human consumption in regions that have natural springs but which are not utilized optimally.

Stone wall terracing: A stonewall terrace is a stone barrier placed across a small gully or in a cultivated valley.

Purpose: To conserve soil and water in hilly tracts and to bring new land under cultivation.

Terracing: The conversion of sloppy lands, especially in hilly terrains, into flat lands by cutting the up-slope area and filling the down-slope area.

Purpose: To reduce run-off and minimize soil erosion, conserve soil moisture and fertility, and facilitate modern cropping operations.

Underground *bandhara* (UGB): A structure that intercepts or obstructs the natural flow of groundwater and provides storage for water under the ground. (Kakade, 2005)

Purpose: To conserve shallow surface water and/or to check salinity ingress.

Vegetative filter strips: Similar to live hedges, these are strips of suitable plant species planted across the water course/*nullah.*

Purpose: To check the velocity of water flow, arresting the silt

Water spreading: A system of diverting or retarding run-off from natural channels or gullies with ditches, dikes, dams and ponds and spreading it over relatively flat areas to grow crops. (Mahnot et. al., 2003)

Purpose: To provide moisture for plants in areas that can make effective use of additional moisture to supplement natural precipitation and to recharge groundwater for future use.

Weir: A pucca (masonry) structure designed to drain out excess water from a field or a pond.

Purpose: To let excess water drain out from ponds or fields without damaging the structure.

Irrigation Methods

Drip Irrigation: An irrigation method that allows water to drip slowly to the roots of plants, either on to the soil surface or directly on to the root zone, through a network of valves, pipes, tubing and emitters. Also known as trickle irrigation.

Purpose: To minimize the use of water and fertilizer and achieve high, water distribution efficiency.

Lift irrigation scheme (LIS): A system with a water source, pumping unit, piped supply and delivery unit. (Kakade, 2005)

Purpose: To provide assured water supply for irrigation, ensure food security and increase in income levels for farmers by encouraging them to take up cultivation of cash crops and horticulture. Frequently an LIS helps to improve access to water for farmers in the upper catchments.

Micro-irrigation systems: Low-pressure irrigation systems that spray, mist, sprinkle or drip water thereby improving resource-use efficiency.

Purpose: To conserve water in arid and semi-arid regions, improve resource-use efficiency and raise productivity of corps.

Pepsee drip system: A low-cost alternative to the drip irrigation system (DIS). It does not require micro tubes or emitters to direct water to the root zone; instead, a lateral, called pepsee (a lightweight plastic pipe used for making ice candy, locally called 'pepsee'), is placed directly to the root zone of the plants. (From www.cgiar.org/iwmi, accessed in 2008)

Purpose: To make drip irrigation affordable for small farmers.

Span pump: A modified hand pump that delivers water to a distant place and at a higher elevation from the source point. (Kakade, 2005)

Purpose: To reduce the drudgery for women collecting water for domestic purposes and for use in small irrigation plots such as a kitchen garden.

Sprinkler Irrigation Systems: A method, similar to natural rainfall, of applying water for irrigation. (Kakade, 2005)

Purpose: To conserve water, avoid soil erosion and improve productivity of crops. It is particularly useful for sandy (permeable) soils.

Agronomic Practices

Broad bed and furrow system: A system of farming comprising broad beds about 100 cm wide separated by sunken furrows about 50 cm wide. (Tideman, 2000)

Purpose: To store moisture in the soil profile, safely dispose off surplus surface run-off without causing erosion and provide better-drained and more easily cultivated soils in the beds.

Contour farming: A system of farming on sloping land by which ploughing, preparing land, planting/sowing and intercultural operations are performed on the contours or across the slope. It is a method of cultivation designed to enhance the rate of infiltration and control soil erosion. (Kakade, 2005)

Purpose: To check soil losses while catching and holding the water, making it available to the crop, encouraging infiltration of water and conserving soil fertility. It helps conserve rainwater in low rainfall areas and reduce soil loss in humid areas.

Crop rotation: Crop rotation refers to the recurrent succession of crops (usually different) on the same piece of land, either in a year or over a longer period of time. (Kakade, 2005)

Purpose: To maintain and improve soil fertility; prevent build-up of pests, weeds and soil-borne diseases; control soil erosion and conserve moisture from one season to the next.

Inter-cropping: The growing of two or more crops, with a definite row pattern, simultaneously on a plot of land (MYRADA and IIRR, 1997).

Purpose: To secure higher income per unit land as compared to sole cropping. It serves as an insurance against failure of crops in abnormal years. When crops with synergistic relationships are selected for intercropping, it brings about resource efficiency and increases significantly productivity.

Mulching and crop residue management: A process of covering the soil between crop rows with a layer of crop residues. Mulches are ground covers that prevent the soil from blowing or being washed away, reduce evaporation, increase infiltration and control the growth of unwanted weeds (Kakade, 2005).

Purpose: To reduce the impact of raindrops on the soil, hinder flow of run-off and check erosion. It reduces evaporation by its physical presence on the soil, increases moisture retention in the soil, reduces wind velocity and traps the soil, which is otherwise susceptible to erosion. It prevents formation of hard crust after each rain, adding plant nutrient to soil upon decomposition.

Multistoried cropping: The growing of plants of different heights in the same field at the same time. (Kakade, 2005)

Purpose: To achieve maximum use of solar energy under high planting density systems, especially in orchards and plantation crops.

Strip cropping: A practice of growing strips of major crops with poor potential for erosion control, or erosion permitting crops, alternated with strips of crops with good potential for erosion control, or erosion resisting crops, in the same field. (Mahnot et. al., 2003)

Purpose: To control water erosion, reduce velocity of run-off, improve water infiltration and check eroded soil from being washed away.

Tal farming: Practised where rainwater run-off flows into low-lying valleys, forming stagnant pools. During the monsoon, water is sometimes lifted and used in adjacent fields. After the monsoon, a crop is grown in the residual moisture in the tal bed when the water has evaporated and percolated. (MYRADA and IIRR, 1997)

Purpose: To use stagnant water pools for irrigation in arid areas. (See also khadins of Rajasthan)

Biomass

Afforestation: The raising of a forest crop on lands that are not covered with forests. (Tideman, 2000)

Purpose**:** Afforestation meets various purposes, as follows.

(a) *Protective purposes*: To conserve the soil and moisture in denuded bare lands, sand dunes, ravines, land slips, etc.

(b) *Productive purposes:* To raise forests to meet local or national demands for economic utilization of land.

(c) *Bio-aesthetic purposes*: To give an aesthetic effect to the landscape, provide for recreation and conservation of wild life, etc.

Agroforestry: The production of crops (including trees) and forest plants or animals or both, simultaneously or sequentially, on the same unit of land, which applies management practices of the local population. (Tideman, 2000)

Purpose: To create a system of sustainable land management that increases the productivity of land.

Ecological/Natural farming: A system of farming wherein it is possible to accumulate nutrients against the forces of erosion, fire, leaching or volatization. (Kakade, 2005) It involves farming without the use of external inputs and relies on recycling of nutrients on the farm itself.

Purpose: To carry out farming without polluting the environment and using natural processes to maintain the productivity of the farm.

Reforestation: The raising of trees for the production of wood and other forest produce on lands that were originally covered with forests or were reduced to scrub due to biotic interference. (Tideman, 2000)

Purpose: To supplement natural stands with artificial regeneration for stocking the area completely in different systems of forest management. It involves replacing the natural regeneration when it cannot be achieved in a limited time and/or changing the composition of the forest by increasing the proportion of more valuable species.

End-notes

1. The definitions given here have been taken from standard textbooks and handbooks written by eminent authors. More than one definition is given in case these bring out somewhat different dimensions of the term in use. Wherever no references are given, the authors have, in consultation with experts, provided their own definitions of the term. In addition, the authors have tried to explain the purpose of each structure or method so as to provide a better understanding of its use.

6. Resource Guide

Agriculture

1. **Dryland Agriculture**

   S C Panda (2004)

   369 pages; Rs 969

   Agrobios: Jodhpur

   A reference/guide book for students of agriculture, veterinary and soil conservation, and for field practitioners. The book is an up-to-date comprehensive text on dry-land agriculture under varying situations. It has information on the basic principles and applied aspects of dry-land farming for students, teachers, scientists, extension workers and professionals engaged in agricultural development.

2. **Handbook of Agriculture**

   Indian Council for Agriculture Research—ICAR (2008)

   1,346 pages; Rs 700

   Publication and Information Division, ICAR: New Delhi

   Presenting scientific developments in Indian agriculture, ongoing research efforts at the national level and ideas on the shape of future agriculture, the handbook covers the following themes: soil and water, land utilization, field and forage crops, environment, agro biodiversity, resource conservation technologies, IPM, pesticide residues, seed production technologies, energy in agriculture, informatics, biotechnology, intellectual property rights, agricultural marketing and trading and indigenous technical knowledge. The Handbook of Agriculture is one of the most popular publications of the ICAR.

3. **Forage Grasses and Legumes**

   L N Singh, A Singh and J Singh (1998), 1st edition

   133 pages; Rs 450

   Scientific Publishers: Jodhpur

   Providess basic information about the important species of grass and legume of tropical and temperate regions. The book has details related to the origin, morphological description, reproduction, chromosome number, seed characteristics, adaptability, herbage production and herbage quality. The information helps us know forage grasses and legumes better, for efficient utilization particularly of waste, barren, rangelands and mountainous areas through an increase in herbage production with a resultant increase in livestock production. There are large number of grasses and legumes of annual growth habit that are under cultivation on arable land for fodder purpose. These have not been covered in this book. However, a sowing guide for common grasses and legumes is included.

4. Introduction to Crops of India

N R Das (2007), 1st edition

334 pages; Rs 199

Scientific Publishers: Jodhpur

Covering nearly 550 crops, the book has 12 chapters, that is, four chapters cover fields crops (cereals, pulses, oilseeds, fibre crops, tubers, sugar crops, vegetables, fodders, green manure, medicinal plants, spices, fruits, flowers including succulents and ornamentals, beverage crops, narcotics and weeds) and eight chapters deal with plantation crops (fruits, medicinal plants, tree fodders, beverages and narcotics, timbers and other furniture plants, spices, industrial crops and fuel crops). The details of the climatic, soil and land requirements, importance of the crop, fertilizer management, water management, duration of the crop, parts used, habitat, export possibility, economic yields, economic values, byproducts, use of byproducts are given for each crop species.

5. Nutrient Management Practices in Crops and Cropping Systems

C.P. Ghonsikar and V S Shinde (1997), 1st edition

285 pages; Rs 650

Scientific Publishers: Jodhpur

A useful guide to nutrient management practices for attaining optimum yield of a particular crop. Different technologies that are being practised for nutrient management in a crop specific cropping system are described, supported by research data, perceptions and practices related to plant nutrient use. Crop specialists, leading research workers, project directors/coordinators and heads of research centres and national institutes have contributed in different chapters of the book.

6. Sustainable Development of Dryland Agriculture in India

R P Singh (2005), 1st edition

544 pages; Rs 264

Scientific Publishers, Jodhpur

Dealing with the principles and practices of dry-land agriculture with details of rich Indian experiences gained over the years by Indian scientists, the book covers almost all the topics in the curriculum on dry-land agriculture, prescribed by Indian agricultural universities. The book brings together a vast array of information on all aspects related to the improvement of the productivity, profitability, stability and sustainability of dry-land farming systems. There are 34 chapters written by eminent scientists on varied topics, covering the entire gamut of dry-land agriculture. The book is a good resource and ready reference for researchers and development workers.

Horticulture

1. Commercial Production of Horticultural Crops

Kunal Mitra (2008)
316 pages; Rs 975
Oxford Book Company, Jaipur

Delineating the principles and practices of producing commercial horticultural crops along with the potential and scope in rainfed areas, the book also takes into account current trends and developments in the field, incorporating critical perspectives, which also touch upon the dilemmas involved in raising commercial horticultural crops. It covers the production of fruits and vegetables, floriculture, and ornamental plants in arid, semi arid sub-tropical climate. Some of the important themes covered include quality management, horticulture harvesting, handling and transportation of produce and storage of fruits and vegetables.

2. Handbook of Horticulture

ICAR (2008)
1031 Pages; Rs 400
Publication and Information Division, ICAR, New Delhi

Providing information on standardized cultural practices for cultivating various species of fruit, vegetables, spices, plantation, ornamental, medicinal, aromatic, potato and tuber crops, the general principles of horticulture, disease and pest management, and post-harvest management have been discussed in detail. The book is ideal reading for the amateur horticulturist, farmer, student and extension worker.

Agro-forestry

1. Agro-forestry Principles and Practices

A P Dwivedi (1992) (Reprint 1997)

365 pages; Rs 450

Oxford & IHB Publishing Co. Pvt. Ltd., New Delhi

Discussing various agroforestry systems of India, including aspects of crop composition and crop interaction, the book explains the selection criteria for different species, interaction of trees with agricultural crops, their effect on the total yield, the income of farmers, management considerations, economics and ecological aspects. It outlines the silvi-cultural practices for about 150 tree species, commonly grown in different regions of India.

2. Handbook of Agroforestry

S.P. Singh (1993)

208 pages; Rs 400

Agrotech Publishing Academy: Udaipur

The book is an introduction to agroforestry and is designed for use by undergraduate and postgraduate students of agricultural sciences as well as professionals, teachers and farmers interested in a practical approach to the subject. The information given is with particular reference to India and the topics. The topics covered include the benefits of agroforestry; land-use systems related to agroforestry; desirable characteristics of tree species; multipurpose trees and shrubs (MPTS); nursery management; propagation; management techniques in agroforestry systems; climatic and edaphic factors in agroforestry; agro-ecological regions of India; and energy plantation. Also included are a glossary of terms and a list of scientific names of common woody agroforestry species.

3. Practical Nursery Production

N R Kaushik, A Kaushik, R S Saini, and N R Godara (2006), 1st edition

128 pages; Rs 484

Agrobios, Jodhpur

Attempting to present all aspects related to nursery production at a single place, in a systematic manner and in layman's language, the book will prove to be useful to nursery growers, foresters, students, environmentalists and horticulturists. Nursery raising is a highly remunerative commercial venture. The problem of unemployment in the country can be tackled to some extent by the adoption of nursery raising as an occupation. People need comprehensive training on this subject. The literature available on practical nursery production is scanty and scattered. This book fills the gap.

4. Textbook of Agro-forestry

B.S. Chundawat and S K Gautam (1993, 1996)

188 pages; Rs 65

Oxford & IBH Publishing Co. Pvt., Ltd, New Delhi

Detailing the agro-ecological zones, classification of agro-forestry systems, agro-forestry systems for small holding, arid and wetland agro-forestry, biomass production and agro-forestry management, the book provides a checklist of tree species, a list of references and definitions of terminologies. Valuable information on the suitability of various tree species for different agro-climatic zones, techniques of sowing, planting, the uses of trees, and the characteristics of multipurpose trees and shrubs is provided in tabular forms.

Watershed Management

1. Grasses and Legumes for Forage and Soil Conservation

K A Shankarnarayan and Vinod Shankar (1984)

155 pages; Rs 20.50

Publication and Information Division, ICAR, New Delhi

Outlining the efforts made by the government to address the problem of forage and soil conservation in India, the book explains in detail the selection process and the establishment techniques of grasses and legumes for soil conservation. It provides ready reference lists for various needs, including forage for livestock, grass vegetation according to forest type and plants used for stabilization of bunds, slopes, etc. The book also lays out the research agenda for natural grasslands and forage conservation.

2. Pasture Development in Arid Wasteland

M S Yadav, N L Vyas and N D Yadav 1997

246 pages; Rs 475

Yash Publishing House, Bikaner

A compendium of authentic information on pasture/grassland development in arid and semiarid wastelands. It comprises 30 articles contributed by different experts. The book covers aspects of NRM, crops and species identification, perennial grasses and legumes suitable for arid wastelands, different advanced agro-techniques for pasture development, seed production technologies for grasses and fodder legumes, livestock production management, grazing methodology and different extension approaches for dissemination of technology. The herbage/fodder production in different situations has also been highlighted.

3. Soil Water Conservation and Dry Farming

Panda S C (2007), 1st edition
490 pages; Rs 784
Agrobios: India,Jodhpur

A very comprehensive textbook, covering all the basic principles of agronomy and soil science in soil and water conservation, and dry farming. Although it is primarily written to serve as a text book/reference for the students in the undergraduate and postgraduate levels of agronomy, soil science and engineering students, professionals in soil conservation, Krishi Vigyan Kendras, Agri extension institutions, etc., will also it useful. Even farmers may benefit from it because considerable emphasis is placed on obtaining maximum yield and making dry farming profitable.

4. Watershed Management

Archana Mishra (2001)
309 pages; Rs 589
Authorspress, New Delhi

Illustrating how to achieve success in this field, using technological skills together with public cooperation, the book also presents the basic concepts of water science and ecology to aid management tasks. This comprehensive study will be of interest to managers, scientists, planners, policy makers and engineers, who work in the field of watershed management.

5. Watershed Management

Y V R Reddy, B M K Reddy, Y S Ramakrishna,
B Narsimlu and LL Somani (2008)
200 pages; Rs 650
Agrotech Publishing Academy, Udaipur

Covering different aspects of watershed management, the book observes and judges the effectiveness and efficiency of various approaches to watershed development. Based on the experience gained during 1983–90, the Watershed Development Programme has been expanded further to cover larger areas. The Government of India through its ministries of Agriculture, Rural Development, Forestry, etc., managed the Watershed Development Programme in India. There are a number of books covering watershed development programmes.

6. Watershed Management: Guidelines for Indian Conditions

E.M. Tideman (2000)

372 pages; Rs 600

Omega Scientific Publishers, New Delhi

Bringing together the technical and some of the socio-economic knowledge available for successfully implementing watershed management, the book details different soils and their properties, land capability classification for watershed management, rainfall and the methods of measurement, estimating run-off, methods of topographic surveying, engineering measures for erosion control in agriculture land, water conservation and harvesting techniques, agronomic measures in soil and water conservation, erosion control measures for non-agricultural lands and key points for watershed management.

7. Watershed Management: Principles, Parameters and Programmes

N.D. Mani (2005)

176 pages; Rs 384

Dominant Publishers and Distributors, New Delhi

Furnishing details about watershed approach, area development programmes and salient features of and guidelines for watersheds, the book also explains the indicators of watershed development and the various qualitative and quantitative methodologies for various qualitative and quantitative monitoring and evaluation of watershed development projects.

8. Watershed Manual: A Practical Guide for Watershed Development Practitioners and Trainers

B K Kakade (2005)

310 pages; Rs 400

BAIF Development Research Foundation, Pune ; and Leadership in Environment and Development, New Delhi

The manual is a ready reference material for field practitioners and trainers. It explains in detail the basket of treatment measures suitable for various locations and site conditions. The manual also provides valuable tips on construction methodology of various structures in watershed.

9. Watershed Planning and Management

Raj Vir Singh (2003)

624 pages, Rs 1,000

Yash Publication, Bikaner

Presenting an integrated approach to watershed planning and management, the book discusses the basic principles and practices systematically. Various aspects of watershed planning and management are discussed in detail in the 26 chapters. In the Foreword, Professor, Vijay P. Singh, of Louisiana State University, Baton Rouge, USA, observes that the book deals not only with the technical aspects of watershed management but also with environmental, socio-economic and policy issues so vitally needed for sustainable development. The book will serve as a textbook to the students of agricultural engineering and sciences, civil engineering, environmental engineering and sciences, ecology, earth sciences, and social and economic sciences. The book could be useful to researchers, administrators, planners, policy makers, NGOs and others involved in watershed planning and management.

Poultry Management

1. Livelihood Opportunities in Broiler Farming: A Livelihood Resource Book

Anish Kumar, H K Deka, Pankaj Das and Pawan Ojha (2007)

118 pages; Price: not priced

Professional Assistance for Development Action— PRADAN, New Delhi

Focusing on the essential elements of a small holder poultry (broiler farming) model, the book elaborates on processes like training, intensive production support and veterinary services. It lays emphasis on promoting producers' collectives and developing market linkages in poultry. This book is in an easy-to-understand format and includes checklists and formats for small enterprise management.

Participatory Tools and Methods

1. A Handbook on Using Participatory Monitoring and Learning Tools (Series—1. Action for Social Advancement)

G Jayanthi, Janet Geddes, Utpal Moitra, and Ashis Mondal (2007)

66 pages; Rs 595

Academic Foundation, New Delhi

Addressing the concepts behind participatory monitoring and learning (PM&L) like collaborative review and problem solving through the generation and use of information on a regular basis, this reference focuses on how this system leads to corrective action and improvement within a project, based on shared decision-making from a number of stakeholders. Offering field-tested techniques from an initiative that experimented with PM&L within three World

Bank-assisted rural development areas, this resource provides facilitators with practical information on how to prepare and apply these tools, as well as how to present the results.

2. **Rural Appraisal—Rapid, Relaxed and Participatory**
Robert Chambers (1997)
125 pages; Rs 60
PRAXIS, Patna and ACTIONAID, Bangalore

Providing introductory material on the origins, principles and approaches of both Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), the book uses examples from Asia, Africa and Latin America.

Organic Farming

1. **Organic Farming: Theory and Practice**
S.P. Palaniappan and K. Annadurai (2008)
258 pages. Rs 135
Scientific Publishers (India), Jodhpur

Presenting the available information on organic agriculture in a cogent and easily understandable manner, the book, though not exhaustive, provides an overview on the subject. The viewpoint on organic agriculture in the book is based on the experience of the authors. It includes chapters on organic manure (including green manure), recycling of organic wastes, vermiculture, biofertilizers, organic methods of pest and weed management, integrated nutrient management, farming systems and case studies of organic farming. Selected literature is presented for further reading. The book will serve as a good reference source for those interested in organic agriculture.

2. **Organic Farming and Sustainable Agriculture**
Hari Mohan Gupta (2005)
224 pages, Rs 564
ABD Publishers, Jaipur

A compilation of research and review articles on various facets of organic farming and sustainable agriculture, the book includes the economics of organic agriculture, the scope of organic farming in India and the government initiatives for promoting organic farming. It also focuses on the eco-technological aspects of organic farming and gives detailed information on registered tests and certification agencies for organic farming and its exports.

Bio-fertilizer/Organic Fertilizer

1. **Biofertiliser: Technology, Marketing and Usage**

   M.R. Motsara, P. Bhattacharyya and Beena Srivastava (2001)

   184 pages; Rs 350

   Fertiliser Development and Consultation Organisation, New Delhi

   A resource on various aspects of biofertilizer technology, marketing and usage, the book discusses all types of major biofertilizers. The chapters include subjects on characteristics of biofertilizers, demand and production, evaluation and specifications, selection criteria, production technology, standards of quality control and the financial aspects of commercial production. The book has a detailed glossary, with simple explanations of terms used in biofertilizer work.

2. **Organic Fertilisers and Biofertilisers: A Techno-commercial Sourcebook**

   H.L.S. Tandon (2003)

   191 pages; Rs 300

   Fertiliser Development and Consultation Organisation, New Delhi.

   A resource on the production of various organic fertilizers and biofertilizers, the book provides a catalogue of products along with related technological information and details of producers/manufacturers. It also has notes on research and development on organic fertilizers, biofertilizers, bio-control agents, compost accelerators and plant growth accelerating rhizobacteria.

Animal Husbandry

1. **Handbook of Animal Husbandry**

   ICAR (2002), Revised edition

   1234 pages, Rs 125

   Publication and Information Division, Indian Council for Agriculture Research (ICAR), New Delhi

   Providing information on important aspects of modern animal husbandry, the book is wide in its scope, covering cattle, buffalo, sheep, goats, and pigs, fish, poultry and beekeeping. The topics covered in the handbook include important aspects of animal husbandry such as breeding, animal management, housing and hygiene, animal nutrition, and the control of bacterial viral, fungal and parasitic diseases.

Websites and Portals

AgricultureInformation.com

An online community comprising buyers, sellers and technical experts in agriculture. Some of the attractive features of the site include a directory of experts, online agri-magazines, email newsletters, classified ads, online stores and two-way communication with members.

Indiaagronet.com

A premier website on Indian agriculture. The portal was started with the vision of improving Indian agriculture practices thereby impacting the quality of life of the Indian farmer. It aims at making Indian agriculture a viable activity by making available the latest information for improved decision-making. Indiaagronet.com provides latest updates on events, markets, weather, products, technology and services. It also provides various newslinks related to agriculture, information on exhibitions, export-import, directory, etc.

IndiaWaterPortal.com

An open, inclusive, web-based platform for sharing water management knowledge among practitioners and general people. It aims at drawing on the rich experience of water-sector experts, packaging their knowledge and adding value to it through technology and then disseminating it to a larger audience through the Internet. It shares best practices, advocates sustainable approaches to water management, brings transparency by bringing vital data on the sector in public domain, and thereby spreads awareness. The portal is a voluntary effort being coordinated by Arghyam, a non-profit trust that works in the area of water (See www.arghyam.org for more on the organization). The water portal is created in a spirit of sharing and openness by a wide range of partners, including technical water experts, research institutes, NGOs, government departments, historians and hydro-geologists, IT specialists and educators.

7. Resource Institutions

1. People's Science Institute (PSI)

252, Vasant Vihar, Phase-I
Dehradun 248006, Uttarakhand, India
Tel: +91 135-2773849/2763649
Fax: +91 135-2763186
E-mail: psiddoon@gmail.com
Website: http://www.peoplesscienceinstitute.com

A group of IIT-educated professionals, with two decades of experience in the field of development, and their friends, established a PSI in 1988. It is a non-profit research and development organization. Its stated mission is: "To help eradicate poverty through the empowerment of the poor, and the productive, sustainable and equitable use of available human and natural resources." Operationally, it provides technical and managerial support to communities and organizations that work with them, implements development programmes and undertakes public interest research.

The Institute is known in India's voluntary sector for its pioneering work in the fields of community-led, watershed-based livelihoods development, environmental quality monitoring, disaster-safe housing and dissemination of appropriate technologies.

2. Aga Khan Rural Support Programme – India (AKRSP-I)

9th and 10th Floor, Corporate House, Opp. Dinesh Hall,
Off Ashram Road, Ahmedabad- 380009, Gujarat, India
Tel: 079-66312451/66312461
E-mail:apoorva@akrspi.org
Website: www.akdn.org

The Aga Khan Rural Support Programme (India) founded in 1983 by His Highness the Aga Khan, the spiritual leader of the Shia Ismaili community, is a non-denominational, non-government development organisation. AKRSP (India) works as a catalyst for the betterment of rural communities by providing direct support to local communities to promote activities and develop models for sustainable natural resource use and development of human resources. AKRSP (India) is active in tribal districts of Bharuch – Narmada – Surat- Tapi, coastal salinity-affected Junagadh and the drought-prone Surendranagar of Gujarat. Since 2005, it has also initiated work in Khandwa, Khargone and Burhanpur of Madhya Pradesh and Samastipur and Muzaffarpur districts of Bihar.

AKRSP (India) has set up two training centres in the rural areas of Gujarat, which train more than 3500 villagers and government staff annually. It also partners with other NGOs and research agencies to influence policies and programmes of the Government and market players to improve the quality of life of the rural poor. It is a member of many state and national committees on natural resource management.

3. N M Sadguru Water & Development Foundation

Near R.T.O. Naka
Dahod 389 151, Gujarat, India
Tel: +91 2673-238601/238602
E-mail: nmsadguru@yahoo.com
Website: http://www.nmsadguru.org/

Established in 1974, by Mr. and Mrs. Jagawat, Sadguru Foundation is a non-profit organization promoting rural and tribal development through community-based NRM in the tribal, rain-fed districts of Dahod and Panchmahal (Gujarat), Jhabua (Madhya Pradesh), and Jhalawar, Banswara and Dungarpur (Rajasthan). Sadguru's NRM programme includes water resource management, forestry and micro-watershed development. These are integrated with biogas, agricultural diversification, off-farm income generation and other related programmes. The Foundation has established a training complex in Chausala near Dahod with modern training facilities, where it conducts various training programmes for its personnel, government officials, and other NGOs.

4. BAIF Development Research Foundation

BAIF Bhavan, Dr Manibhai Desai Nagar
Warje, Pune 411029, Maharashtra, India
Tel: +91 20-5231661/5231662
E-mail: baif@vsnl.com
Website: www.baif.com

BAIF is a public charitable trust and a recognized research organization founded by the late Gandhian, Dr Manibhai Desai. Based in Pune, Maharashtra, BAIF's mission is to create opportunities of gainful self-employment for rural families, especially disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life and good human values. BAIF is a non-political, secular and professionally managed organization. BAIF is much sought after for its expertise in the fields of animal husbandry and horticulture (*wadi* programme) as well as participatory NRM and watershed development. It is one of the few NGOs involved in participatory technology development.

5. Seva Mandir

Old Fatehpura, Udaipur 313004
Rajasthan, India
Tel: +91 294-2451041/2450960
E-mail: info@sevamandir.org, Website: http://www.sevamandir.org/

Seva Mandir is a well-known NGO working for the development of the rural and tribal population in the Udaipur and Rajsamand Districts of southern Rajasthan. The work area encompasses 626 villages and 56 urban settlements. The organization reaches out to around 70,000 households, influencing the lives of approximately 360,000 persons.

Seva Mandir's residential training centre located in Kaya is used to host workshops and training for the Seva Mandir staff, the communities with which Seva Mandir works and external organizations. The centre is located in a tranquil and beautiful area just 30 km outside Udaipur.

6. Samaj Pragati Sahayog (SPS)

Jatashankar Village, Bagli Tehsil,
Dewas District, Madhya Pradesh 455227, India
Tel: +91 7271-275757/275550
E-mail: core@samprag.org
Website: http://samprag.org/

Over the last two decades, SPS has grown to be one of India's largest grass-roots initiatives for water and livelihood security, working with its partners on a million acres of land, across 72 of India's most backward districts, mainly in the central Indian adivasi belt. SPS is inspired by the life and work of Baba Amte, who rejected charity and successfully empowered even the most challenged. SPS is headquartered in a drought-prone, tribal area in the Dewas District of Madhya Pradesh, which typifies the most difficult problems of the country. SPS concentrated all its interventions in about 220 villages and towns of this area. This work is not so much a model as a living laboratory of learning for others to adapt to their own areas. To facilitate this mutual learning, in 1998, SPS set up the Baba Amte Centre for People's Empowerment in the tribal village Neemkheda, where its watershed development work began in the early 90s.

7. Society for Promotion of Wastelands Development (SPWD)

14-A, Rouse Avenue Lane, Vishnu Digamber Marg
New Delhi 110002, India
Tel: 011-3236440, 3236387
E-mail: spwd@vsnl.com
Website: http://www.spwdindia.org

Set up in 1982 by a team of like-minded and dedicated individuals, SPWD has been actively involved in documenting and analyzing the causes of degradation of natural resources in India, and creating a world of possibilities. The analysis and documentation is matched by a consistent and diversified search for solutions within the technical and socio-institutional domain. SPWD banks on its partner NGOs to create competence at local levels in various agro-ecological regions of India. It engages with an extensive network of grassroots organizations, enabled to implement strategic alternatives and achieve a better quality of life for the underprivileged rural population. SPWD's work makes it an ideal forum for sharing experiences and taking up policy level issues.

8. Watershed Organisation Trust (WOTR)

63/2B, Padmawati Corner, 2nd Floor, "The Forum",
Pune-Satara Road, Parvati, Pune 411009, Maharashtra, India
Tel.: +91 20-24226211
E-mail.: info@wotr.org
Website: http://www.wotr.org

WOTR, India, is an NGO established in 1993 to undertake holistic and integrated developmental activities for poverty reduction in resource-fragile and rainfed areas in India. WOTR's initial mandate was to develop the capacities of various stakeholders for the Indo-German Watershed Development Program. Since then, it has come to be known as among the best watershed development agencies in the country.

9. TATA-DHAN Academy

Boys Town Campus, Pulloothu
Madurai 625016, Tamil Nadu, India
Tel: +91 452-2475318/2475219
E-mail: tatadhanacademy@satyam.net.in
Website: http://www.dhan.org

The Tata-Dhan Academy nurtures, grooms and educates young graduates, both boys and girls, as Development Professionals. These professionals are provided multi-disciplinary knowledge, including applied technologies relevant to the 'context'. Equally high is the Academy's emphasis on 'learning' and 'building knowledge' through action-reflection-action. Simultaneously, the focus is on building high quality techno-managerial competencies supported by appropriate motivations, values and attitudes to work with people, the disadvantaged in particular, with a view to 'building people's organisations to build people'.

10. National Remote Sensing Centre (NRSC)

ISRO (Dept. of Space, Govt. of India), Balanagar
Hyderabad 500625, Andhra Pradesh, India
Tel: +91 40-23879572-76
Fax: +91 40-23878648
E- mail: sales@nrsa.gov.in, training@nrsa.gov.in,
Website: http://www.nrsc.gov.in

NRSC is one of the centres of Indian Space Research Organisation under the Department of Space, Government of India, engaged in operational remote sensing activities. The operational use of remote sensing data spans a wide spectrum of themes, which include water resources, agriculture, soil and land degradation, mineral exploration, groundwater targeting, geomorphologic mapping, coastal and ocean resources monitoring, environment, ecology and forest mapping, land use and land-cover mapping and urban area studies and large-scale mapping. The chief activities of NRSC are satellite data and aerial data reception, data processing, data dissemination, applications for providing value-added services and training and distribution of data from foreign satellites RADARSAT, IKONOS, QUICKBIRD and ORBVIEW.

11. Action for Food Production (AFPRO)

25/1-A Pankha Road, D-Block, Janakpuri,
New Delhi 110058, India
Tel: +91 11-28525452/28522575/28525412
E-mail: afprodel@afpro.org, ed@afpro.org
Website: http://www.afpro.org

AFPRO is an Indian socio-technical NGO, with Christian inspiration, working for the development of the rural poor through effective natural resource management solutions. It provides technical guidance and back-up support for grassroots level NGOs to implement environmentally friendly projects for water, food security, livelihoods and allied capacity building. AFPRO reaches out to the country through nine field units located strategically all over India. It has a team of hydrologists, geologists, geophysicists, civil engineers, sociologists and specialists in agriculture, fisheries, forestry and livestock.

12. Society for Research and Initiatives for Sustainable Technologies (SRISTI)

AES Boys Hostel Campus, Nr. University Library, Navrangapura
Ahmedabad 380009, Gujarat, India
Tel: +91 79-27912792/27913293
E-mail: info@sristi.org, Website: http://www.sristi.org

SRISTI, which means ‘creation’, was born in 1993 essentially to support the activities of the Honey Bee Network and to respect, recognize and reward creativity at the grassroots. Based in Ahmedabad, Gujarat, SRISTI is a registered charitable organization that is devoted to empowering knowledge-rich, economically poor people by adding value to their creativity. SRISTI has been focusing, of late, on more concerted ways of exploring hitherto neglected domains like women’s knowledge systems, value addition through a natural product laboratory, and innovations in education.

The success of the Honey Bee network and SRISTI has led to the scaling up of its activities at the national level, in the form of the National Innovation Foundation (NIF). NIF is supported by the Department of Science and Technology and organizes national-level competitions for scouting grassroots innovations on a bi-annual basis. The SRISTI-NIF database can be accessed on its website and comprises over a lakh entries of innovative solutions in diverse fields of crop improvement, crop protection, livestock management, farm equipment, etc.

13. Gujarat Grassroots Innovations Augmentation Network (GIAN)

Bungalow No: 1, Satellite Complex, Nr. Satellite Tower, Mansi Cross Road
Premchand Nagar Road, Satellite, Ahmedabad 380015, Gujarat, India
Tel: +91 79-26769686
Fax: +91 79-26760398
E-mail: gian@gian.org
Website: http://www.gian.org/

GIAN is India’s first technology business incubator focused on incubating and commercialising grassroots innovations. Grassroots innovations are essentially solutions generated by people at the grassroots level, to tide over persistent problems—solutions that are either not available or not affordable by a large section of the consumer masses in developing countries like India.

These innovations, therefore, capture an unmet need of a large section of the population. Building a value chain around these innovations to take them to the market holds the potential of wealth creation in a truly sustainable and equitable manner. GIAN’s mission is to build value chains around these innovations with the end-objective of making them available to the masses through the market mechanism or otherwise. GIAN was established in Gujarat in 1997 with support from the state government. Since then, similar organizations have been established in the north, east and south to cover different parts of the country.

NRM Networks

1. PRAVAH – The Network

Secretariat:

Dada Saheb Pagala flat
Ground floor D-3
Nr.Dada sahib Pagala
Opp. Rasranjan Restaurant
Vijay Cross Road, Navrangpura Ahmedabad.
Tel: 079- 26407870/26404709
Email: pravah@gmail.com

The **"**Platform for Mobilizing Action on Drinking water and Sanitation**"**, known by the acronym PRAVAH emerged as a network initiative of NGOs in 1994 with an initial membership of 60 organistations in Gujarat. The formation of the network was the result of collective concerns raised and interest expressed by several individuals and institutions for addressing complex challenges in the area of drinking water and related developmental issues. It worked as a networking and policy advocacy body and was registered under Charitable Trust and Societies Registration Act in November 1996 with a secretariat functioning from Ahmedabad. The larger goal of PRAVAH is to initiate a movement in Gujarat for ensuring safe, adequate, sustainable and self reliant water supply for drinking and other domestic purposes to all, round the year, from a gender perspective. It also works towards developing common perspective amongst all the partners about the need for decentralisation of water systems, through this effort of building a platform to evolve and act on a common action plan.

2. Sajjata Sangh

Secretariat:

Development Support Centre (DSC)
Marutinandanvilla, Near Govt. Tube well,
Bopal, Ahmedabad- 380058.
Gujarat
Tel+91-235994/95/98
Email: sajjatasangh@gmail.com

Initiated by Anil C Shah, Founder Chairman, Development Support Centre, in 1996, Sajjata Sangh, is a network of NGOs implementing participatory NRM programmes in different parts of Gujarat. The Sangh was formally registered on June 29, 2000 as a society and trust. The founding mandate of the Sangh is to create a platform for mutual learning among NGOs to strengthen their capacity building efforts and enhance their access to external resources of knowledge. The primary goal is to increase the productivity of natural resources, which in turn would contribute towards uplift of farmers, especially small and marginal farmers. The Sangh also undertakes action research and policy advocacy for participatory NRM and livelihood programmes.

The promoters of the Sangh are organizations with long-term involvement in rural development in general and natural resource management in particular. These include the Aga Khan Rural Support Programme- India (AKRSP-I), Bhartiya Agro Industries Foundation (BAIF), Development Support Centre (DSC), N M Sadguru Water Foundation, Vivekanand Research and Training Institute (VRTI) and others. At present 34 NGOs are members of the Sangh.

End-notes

The institutinos included in this list are based on our knowledge of the contribution they have made to this field. The authors are aware that there may be several other institutiuns doing equally valuable work and therefore this should not be taken as an exhaustive list.

8. About the Contributors

Contributing Institutions

AKRSP(I)

9th and 10th Floor, Corporate House
Opp. Dinesh Hall, Off Ashram Road,
Ahmedabad
Ph: 079-66312451, 66312461
Email:apoorva@akrspi.org

The Aga Khan Rural Support Programme (India) founded in 1983 by His Highness the Aga Khan, the spiritual leader of the Shia Ismaili community, is a non-denominational, non-government development organisation. AKRSP (India) works as a catalyst for the betterment of rural communities by providing direct support to local communities to promote activities and develop models for sustainable natural resource use and development of human resources. AKRSP (India) is active in tribal districts of Bharuch – Narmada – Surat- Tapi, coastal salinity-affected Junagadh and the drought-prone Surendranagar of Gujarat. Since 2005, it has also initiated work in Khandwa, Khargone and Burhanpur of Madhya Pradesh and Samastipur and Muzaffarpur districts of Bihar.

AKRSP (India) has set up two training centres in the rural areas of Gujarat, which train more than 3500 villagers and government staff annually. It also partners with other NGOs and research agencies to influence policies and programmes of the Government and market players to improve the quality of life of the rural poor. It is a member of many state and national committees on natural resource management.

Action for Social Advancement

E-5/A, Girish Kunj
Above State Bank of Indore (Shahpura Branch)
Bhopal 462 016 Madhya Pradesh
Ph: +91-755-405 7925, 242 7369
Email: asa@asabhopal.org
Website: www.asaindia.org/

Based in Bhopal, Madhya Pradesh, ASA has been working since 1996 for the uplift of tribal and other socio-economically marginalized communities through the augmentation of natural resources and local livelihoods. Its various projects, including watershed and WRD, PIM, micro-finance, PVSP, agriculture research and extension, and training and consultancy are operational in about 800 villages spread across Gujarat, Jharkhand and Madhya Pradesh

BAIF

BAIF Bhavan
Dr Manibhai Desai Nagar
Warje
Pune 411 029 Maharashtra
Ph: 020-5231661, 020-5231662
Email: baif@vsnl.com
Website: www.baif.org.in

A public charitable trust and a recognized research organization founded by the late Gandhian leader, Dr. Manibhai Desai. Based in Pune, Maharashtra, BAIF's mission is to create opportunities of gainful self employment for rural families, especially disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life and good human values. BAIF is a non-political, secular and professionally managed organization.

Jal Bhagirathi Foundation

Jal Darshan Marg, Bijolai,
Near Kaylana Lake
Jodhpur, Rajasthan, India
Ph: +91 291 2751556
Email: programs@jalbhagirathi.org
Website: www.jalbhagirathi.org/

In 2003, the erstwhile Maharaja of Marwar, Mr. Gaj Singh decided to create a separate institution called Jal Bhagirathi Foundation (JBF) to take up developmental work in the Marwar region. Marwar is the most densely populated arid zone in the world. Lack of adequate drinking water for humans and livestock was the key factor that limited the development of the region. JBF's direct intervention in 200 villages of Pali, Barmer and Jodhpur Districts covers two main activities: (a) Reviving traditional water conservation systems, and (b) Mobilizing communities and establishing decentralized systems of governance. In addition, JBF has created a network of developmental agencies, working in the Marwar region through which, it plans to reach all the villages of the region, taking up common issues and building the capacities of partner institutions.

N.M. Sadguru Water & Development Foundation

Near R.T.O. Naka
Dahod 389 151
Ph: 02673-238601/238602

Email: nmsadguru@yahoo.com
Website: www.nmsadguru.org

Established in 1974, by Mr. and Mrs. Jagawat, Sadguru is a non-profit organization promoting rural and tribal development through community-based NRM in the tribal, rain-fed districts of Dahod and Panchmahal (Gujarat), Jhabua (Madhya Pradesh) and Jhalawar Banswara and Dungarpur (Rajasthan). Sadguru's NRM programme includes water resource management, forestry and micro-watershed development. These are integrated with biogas, agricultural diversification, off-farm income generation and other related programmes.

Seva Mandir

Old Fatehpura,
Udaipur 313004, Rajasthan
Ph: 0294-2451041, 2450960
info@sevamandir.org
Website: www.sevamandir.org/

An NGO working for the development of the rural and tribal population in the Udaipur and Rajsamand districts of southern Rajasthan. The work area encompasses 626 villages and 56 urban settlements. In total, the organization reaches around 70,000 households, influencing the lives of approximately 360,000 persons.

Society to Uplift Rural Economy

P.O. Box 29, Gurudwara Road Barmer
Rajasthan
Ph: 02982-230865, 230801
Email: surebmr@rediffmail.com
Website: www.surebarmer.org

The outcome of the vision of Padma Shri Magraj Jain—a vision that has matured over six decades of work with the poor and the destitute in Barmer District. In the beginning, SURE started work with the women folk of the refugees from Pakistan after the Indo-Pak war of 1971. In 1992, SURE started working in the field of education with the Shiksha Karmi programme of the Rajasthan government of Rajasthan SURE has been active in providing relief in the face of the prolonged drought that the region has been facing since 1999.

Timbaktu Collective

Chennekothapalli Village
Anantapur District
Andhra Pradesh 515 101
Ph: 91 (0)8559 202149,202335,202339
Ph: 91 (0)8559 202337,202020

Email: info@timbaktu.org
Website: www.timbaktu.org

A registered voluntary organization, Timbaktu Cooperative was initiated in 1990, to work for sustainable development in the drought prone Anantapur District of Andhra Pradesh, India. As of March 2006, the Collective had a team of 63 members and worked in about 112 villages of Chennekothapalli, Roddam and Ramagiri mandals of Anantapur district, serving about 33,000 marginalized people.

Authors

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Based in Ahmedabad, Pastakia works as a freelance consultant and academic in the fields of rural livelihood augmentation and natural resource management. His career spans a decade of grassroots experience followed by two decades of developmental academics. Pastakia who has done his Fellow Programme in Management from the Indian Institute of Management, Ahmedabad (IIMA), has a basic education in agricultural sciences. Prior to this, he has edited two books: *Locked Horns: Conflicts and their Resolution in Community Based Natural Resource Management* (2008) and *Farmer-led Participatory Research: Cases from Western India* (2002) with two others; both published by Books for Change, Bangalore. His research interests include innovations and entrepreneurship for sustainable development, ecopreneurship, common property resource management, sustainability of people's institutions and participatory natural resource management. He has published over a dozen papers in the international and national journals. His paper "Grassroots ecopreneurs: Change agents for a sustainable society" in the *Journal of Organisational Change Management* (1989) received the Outstanding Paper of the Year Award from MCB University Press, London.

Sachin Oza

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Sachin Oza, is the Executive Director of Development Support Centre and has a Masters degree in Social Work. He has been with the voluntary sector for 20 years and has wide experience in the capacity building of functionaries of NGOs as well as government departments. He is a member of several policy making bodies at the state and national levels like the Expert Group for Formulation of the National policy on Voluntary Sector 2007, Expert Group for formulation of the Integrated Watershed Management Programme Guidelines 2008 and Expert Group for Implementation of MGNREGA on a Watershed Platform 2010. His main contribution has been in the area of promoting people's participation in natural resource management and institution development. He is also a consultant for World Bank and GTZ for projects related to NRM.

Project Coordinator

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Virendra Vaghani has done his Bachelor of Technology with specialization in Agricultural Engineering and is presently the Technical Expert in Watershed Management at Development Support Centre. He has eight years experience in the field of rural livelihoods and natural resource management and is involved in providing technical training to various stakeholders. He is responsible for curriculum development for various stakeholders. He also looks after project planning, coordination implementation and monitoring of DSC's initiatives in rainfed areas. He was part of the team for evaluation of various watershed development projects in Gujarat and Madhya Pradesh and involved in various assignments related to natural resource management.

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A Strategy Handbook for the Practitioner

In India, close to 400 million poor reside in rural areas, most of them in rainfed areas. Scientific research has revealed a vast untapped potential in rainfed agriclulture where crop yields are lower than their potential by two to five folds. A large number of innovative projects and ideas have been tried to address this issue, although documentation has been uneven and fragmented. Drawing upon such experiences, the present handbook points towards new vistas and untapped opportunities in meeting the challenge of enhancing food security with limited water resources and improving the carrying capacities of rainfed areas to match the rapidly increasing population in these regions and elsewhere.

The handbook is presented in four volumes under a common framework. Each volume presents a selection of best practices, articulation of basic principles, and description of strategies that are known to work on the ground.

Volume I describes natural resource based strategies such as watershed development, community forestry, lift irrigation, animal husbandry, wasteland development etc.

Volume II deals with market-led interventions, such as addressing market imperfections, creating market opportunities, and building pro-poor value chains.

Volume III focuses on ICT enabled strategies such as plot specific farm advisories, market intelligence services, inclusive finance, and opportunities like rural BPO in the emerging ICT led service sector.

Volume IV dwells upon the difficult task of building the capacity of rural communities to implement livelihood projects and maintain productive assets. Social capital building is a crosscutting theme for all developmental interventions because it helps empower the people to take charge of their own developmental trajectories.

About DSC

Established in 1994, Development Support Centre provides knowledge based support to community based organizations, non-government organizations and government functionaries. DSC helps in capacity building of key functionaries in rural development, performs hand holding operations in the field, takes initiatives for policy changes, and carries out field studies and research projects related to issues in policy and practice. It directly implements key projects in more than 200 villages in rainfed and irrigated areas across two states i.e. Gujarat and Madhya Pradesh.

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