Overcoming Poverty in Rural India:

Focus on Rainfed Semi-Arid Tropics

International Crops Research Institute for the Semi-Arid Tropics

Citation: Rao KPC, Bantilan MCS, Singh K, Subrahmanyam S, Deshingkar P, Rao P Parthasarathy and Shiferaw B. 2005. Overcoming Poverty in Rural India: Focus on Rainfed Semi-Arid Tropics. Patancheru 502 324 Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 96 pp. ISBN 92-9066-474-6. Order code BOE 035.

Abstract

This study is a comprehensive analysis of the nature, the dynamics and the determinants of poverty in the semi-arid tropics (SAT). It uses the sustainable livelihood framework to identify the underlying determinants of poverty and the pathways in moving out of poverty. Quantitative analysis based on the most recent National Sample Surveys (NSS) of India (1999-2000 round) generated classifications of relevant typologies including agroecological zones, occupational groups, irrigation access and social groups. It shows that poverty in India is concentrated most in the SAT and humid areas. It identifies caste and occupational groups facing highest incidence of poverty. The typologies systematized the establishment of linkages between rural poverty and the semi-arid tropics.

The study presents a synthesis of evidence and lessons learnt from the village level studies (VLS) by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and other household level case studies - income and expenditure levels, incidence of poverty and under-nutrition and coping strategies when faced with droughts and other income shocks. The empirical analysis uses both the quantitative and the qualitative data to document the existing and emerging evidences on the spatial and the social dimensions of poverty. The poverty diagnostics and strategic assessment of the issues confronting SAT generated a comprehensive perspective from both the micro and the macro levels, thus deepening our understanding of the multi-dimensional nature of SAT poverty.

The study reviews the existing poverty alleviation programs (their merits and demerits and successes and failures) and concludes with a set of recommendations on strategies to increase the contribution of SAT agriculture to poverty reduction.

Résumé

La présente étude fait une analyse détaillée de la nature, de la dynamique et des déterminants de la pauvreté dans les zones tropicales semi-arides (SAT). Elle se s'appuie sur le cadre de moyens de subsistance durables pour identifier les facteurs qui déterminent la pauvreté et explorer les pistes qui permettent d'en sortir. Une analyse quantitative, basée sur les enquêtes les plus récentes faites en Inde (1999-2000), à partir d'échantillons nationaux (*National Sample Surveys – NSS*), s'est traduite par des classifications pertinentes - zones agro-écologiques, groupes professionnels, accès à l'irrigation et groupes sociaux. Cette analyse montre, qu'en Inde, la pauvreté se concentre surtout dans les SAT et les zones humides. Elle permet d'identifier les castes et les groupes professionnels qui subissent le plus les conséquences de la pauvreté. Les typologies ont systématisé l'établissement de liens entre la pauvreté en milieu rural et les zones tropicales semi-arides.

L'article résume les preuves et les enseignements issus des études menées au niveau villageois (VLS) par l'Institut international de recherche sur les cultures des zones tropicales semi-arides (ICRISAT) et d'autres études de cas réalisées au niveau des ménages – niveaux des revenus et des dépenses; incidence de la pauvreté, et sous-alimentation et stratégies d'adaptation en cas de sécheresse et autres contrecoups liés au revenu. L'analyse empirique s'appuie à la fois sur les données quantitatives et qualitatives en vue d'étayer les preuves existantes et émergentes, relatives aux dimensions spatiales et sociales de la pauvreté. Le diagnostic de la pauvreté et l'évaluation stratégique des problèmes que connaissent les zones tropicales semi-arides, ont permis d'avoir une perspective générale, d'un point de vue à la fois micro et macro, renforçant ainsi notre compréhension de la nature multidimensionnelle de la pauvreté dans les SAT.

L'article examine les programmes qui existent en matière d'atténuation de la pauvreté (avantages/inconvénients; succès et échecs) et se termine par une série de recommandations sur les stratégies qui permettent d'améliorer la contribution de l'agriculture dans les SAT à la réduction de la pauvreté

Overcoming Poverty in Rural India:

Focus on Rainfed Semi-Arid Tropics

KPC Rao, MCS Bantilan, Katar Singh, S Subrahmanyam,
Priya Deshingkar, P Parthasarathy Rao and Bekele Shiferaw

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

Patancheru 502 324, Andhra Pradesh, India

IFAD

International Fund for Agricultural Development

Via del Serafico, 107, 00142 Rome, Italy

2005

About the authors

KPC Rao Principal Scientist (Village Level Studies), Global Theme on SAT Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India.

MCS Bantilan Global Theme Leader - SAT Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India.

Katar Singh Former Director, Institute of Rural Management, Anand 388 001, Gujarat, India.

S Subrahmanyam Senior Fellow, Centre for Economic and Social Studies, Hyderabad, Andhra Pradesh, India.

Priya Deshingkar Research Director, Andhra Pradesh Livelihood Options Project, Overseas Development Institute, UK.

P Parthasarathy Rao Senior Scientist (Economics), Global Theme on SAT Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India.

Bekele Shiferaw Scientist-Resource Economics, Global Theme on SAT Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics.

Acknowledgments

We express our thanks to the International Fund for Agricultural Development (IFAD) for inviting ICRISAT to contribute a background paper for developing its Country Strategic Opportunities Paper (COSOP). We would like to express special thanks to CH Hanumantha Rao and MV Nadkarni for their valuable comments to further articulate the message of this paper. We also wish to express thanks to Pravesh Sharma, Shyam Khadka and Julian Hamilton-Peach for their useful comments. We acknowledge the assistance of the Ministry of Human Resource Development, Government of India, for providing the NSS data in time for the analysis.

We would also like to thank the members of the working team - PK Mehta, R Padmaja, GV Anupama, Dharmendra Kar, Gloria Christina and B Ravindra - for their valuable assistance.

Our thanks to N V N Chari, H Padmini and VN Krishnan for their administrative and secretarial assistance.

Contents

Executive Summary

This report is a strategic assessment of rural poverty in the semi-arid tropics (SAT) involving a comprehensive analysis of the dynamics and determinants of poverty, and the major issues of the SAT agriculture in India. The objectives of the strategic assessment are to

- establish a linkage between the SAT agriculture and rural poverty;
- understand the critical issues of SAT agriculture in India;
- recommend strategies to increase the contributions of SAT agriculture in reducing poverty; and
- recommend priority interventions and research directions.

Ultimately, the analyses of major issues confronting the SAT agriculture and the alternative strategies and recommendations are intended to serve as a basis for identifying priority areas for future investments that would increase the contribution of SAT agriculture in reducing poverty in a sustainable manner.

An assumption underlying this strategic study is that the current interventions in the SAT agriculture are inadequate and have to be enhanced and intensified. In fact, the SAT agriculture explicitly bore unfavorable policy and institutional neglect, leading to inadequate investments. It is expected that the livelihoods of the rural poor in the SAT can be enhanced by addressing the key constraints of the rural sector and the major issues confronting the SAT agriculture. It is also expected that the strategy prepared as an output of this study will result in changes in the priorities of the government and donors to hasten the contribution of SAT agriculture in reducing poverty in a sustainable manner.

The SAT region is a vital and important sector on which a large number of poor in India depend on. An overview of the state of SAT agriculture in India gives a perspective on the nature of poverty and the dynamics of the external environment surrounding it. This overview presents a background of the SAT in terms of coverage, population, major crops and its importance to India's economy. The major issues affecting the SAT agriculture involve several dimensions: social, technical, structural, policy, institutional, human resources, and biotic and abiotic constraints. The developments in SAT reflects the pervasiveness of poverty (predominantly a rural phenomenon), growing constraints on water, continuing concerns about malnutrition, changes in production and consumption patterns, and effects of government policies and further economic liberalization on the competitiveness of dryland crops.

Understanding the underlying determinants of poverty and the pathways to its alleviation is a major challenge. To start with, the Sustainable Livelihoods Approach (SLA) emphasizes on the rural poor sector, particularly in marginalized areas, to empower, value and work on what matters to them. This 'pro-poor people centered' perspective is essential for the development of an impact-driven policy and investment strategy. In line with this perspective, the research team appeals to the principles of sustainable livelihoods in developing an overarching framework for the entire study. The SLA was updated and expanded to capture the essential determinants and dynamics of poverty in the process of identifying primary constraints and opportunities in SAT. In particular, it added emphasis on the aspects of market access, agricultural research and technology and power relations as important determinants of poverty and drivers of change in SAT It recognizes the multi-dimensional nature of poverty, encompassing economic, social and governance perspectives.

The empirical analysis used both quantitative and qualitative data to document the existing and emerging evidences on the spatial and social dimensions of poverty. Quantitative analysis was based on the most recent National Sample Surveys (NSSs) of India (1999-2000 round) which has generated various measures of poverty. Classifications by relevant typologies including agro-ecological regions, occupational groups, access to irrigation, social groups, among others, systematized the establishment of the linkages between rural poverty and SAT in the context of India. District, state and national level estimates based on India's NSS of 70,000 sample households were generated to compare the incidence of poverty across regions. The results underlined the economic dimensions of poverty based on income, consumption expenditures, wages, productivity and other measurable parameters. Interesting trends showed the varying levels of incidence of poverty among occupational sectors as well as agro-ecological zones and other relevant groupings. It also brought out implications regarding the dependence of the poor on agriculture in the SAT region.

The major findings generated from the quantitative assessments are as follows:

- The total number of poor in rural India is estimated at 147.5 million during 1999-2000, out of which 81.0% or 119.9 million poor are concentrated in the humid and the SAT regions.

- The humid and the SAT regions have roughly the same size of India's rural population and they together account for 72% of the rural population. The semi-arid temperate zone accounts for 21% and the arid zone accounts for about 2% of the rural population.
- The SAT and humid zones have high incidence of poverty (about 24%) and the arid and semi-arid temperate zones have low incidence of poverty (12.6% and 14.6%). By and large, all areas with low irrigation have the highest incidence of poverty in all the zones.
- The incidence of poverty is found to be the highest among the Scheduled Tribes (ST) at 39.6% followed by the Scheduled Castes (SC) at 28.56% in contrast to 16.4% among general population. Scheduled Tribes are concentrated in the humid and SAT zones, which partly is the reason for high incidence in these two regions. The low irrigated areas in the humid and SAT zones have a high concentration of these social groups. The correlation coefficient between poverty incidence and Scheduled Tribes is found to be high at 0.47 for rural India.
- Among five occupational groups, the incidence of poverty is the highest among agricultural laborers (wage workers) at 35.5% and the lowest among the cultivators at 13.9%. The non-agricultural laborers have significantly lower poverty levels than the agricultural laborers.
- Incidence of poverty among agricultural laborers is uniformly high in all the zones and it is distinctly higher in the low irrigated areas.
- The correlation between poverty and the proportion of agricultural laborers is positive and very high in all the zones except in the high-irrigated areas of the SAT.
- The correlation between poverty incidence and the proportion of non-agricultural laborers is negative and statistically significant indicating that the development of non-farm activities is an important policy intervention to reduce rural poverty.
- Agricultural wages and cereal prices are important determinants of rural poverty. High agricultural wages tend to decrease the incidence of poverty while high cereal prices tend to increase the incidence of poverty.
- Semi-arid temperate and humid zones are agriculturally developed but have high population pressure on land. On the other hand, the SAT zone is backward in agriculture but has moderate pressure on land. Only the arid zone has very low pressure on land and in spite of low agricultural productivity, productivity per capita is quite high. Hence, poverty levels tend to be low.
- Except in the semi-arid temperate zone, considerable sections of non-poor were also found to be purchasing rice and wheat from the Public Distribution System (PDS). This implies a leakage in the system that needs to be rectified.
- The rural poor from the humid zones had a higher coverage under the anti-poverty programs than those in other zones. Relatively low utilization of the anti-poverty programs by the rural poor in the SAT and arid zones highlights the critical issue of constrained access by these bypassed groups.
- Arid and semi-arid temperate zones have markedly higher levels of standard of living whereas the humid and SAT zones are having relatively low levels of standard of living.
- Agricultural development, higher wages and employment opportunities contribute to poverty reduction. The effect of wages is much stronger than that of productivity growth mainly because many of the rural poor are net buyers.
- The semi-arid temperate zone has well developed markets whereas the SAT zone is lagging in market infrastructure.

The qualitative analysis substantiated other equally important dimensions not covered in the quantitative analysis above. The report presents a synthesis of evidences and lessons learned from the ICRISAT's Village Level Studies (VLS) and other household level case studies. In particular, it provided empirical evidence about the vulnerability of the poor to various sources of risks and shocks as well as the capacity to access physical, financial and social resources and networks in the risky environments of SAT. The analysis captured welfare indicators involving the level of human development and the extent of vulnerability and insecurity among individuals or households. The major livelihood strategies adopted by the population in the SAT region are elucidated with particular emphasis on the livelihood portfolios of the rural poor. It is on this basis that the list of major issues that need to be addressed to strengthen livelihoods in the SAT regions are identified.

Qualitative evidences drawn from the VLS, case studies and other micro-level data highlight the following:

- There have been many changes in the patterns and sources of livelihood in the SAT region over the last 25 years or so in response to changes in technology, infrastructure, markets, urbanization and commercialization of agriculture. Diversification of sources of income and shifts in cropping patterns

and food habits are occurring in most of the SAT areas in India.

- Real incomes of the VLS sample households more than doubled over the last 25 years, 1975-78 to 2001-02. And the structure of income underwent remarkable changes.
- The share of income from crops declined in the SAT villages except in villages in the more reliable rainfall regions and those which had access to supplemental irrigation. The share of income from livestock showed a marginal decline. The share of earnings from agricultural wages also declined considerably, while that of earnings from non-farm activities increased sharply.
- Diversification of income sources has increased including new high value commodities and migration.
- About one-third of the sample households were below the poverty line (with less than Rs 20,000 net annual household incomes) and the proportion of the poor estimated from micro-level studies was even higher than what was reported by the National Sample Surveys Organization (NSSO) for the relevant districts.
- The consumption expenditure data pointed to a considerable undernutrition among the SAT households relative to other regions.
- Besides low incomes, the SAT households face a high probability of drought-occurrence and consequent shortfalls in incomes. Nearly one half of the sample households adopted coping strategies such as borrowing, reduced consumption, participation in labor market, sale of assets and migration to survive the droughts.

On the whole, at micro and macro levels, the poverty diagnostics and strategic assessment of the issues confronting the SAT generated a comprehensive perspective, which enhanced our understanding of the multi-dimensional nature and dynamics of poverty, including the linkages between rural poverty and its determinants and the opportunities for future priority investments. This understanding is vital in (1) identifying and designing appropriate interventions to help the poor achieve preferred livelihood outcomes, (2) improving the poor's access to productive natural resources and technology, and (3) evolving strategies from an investment angle and enhance the standards of living of the poor.

The report concludes with a set of recommendations on strategies to increase the contribution of the SAT agriculture resulting in the reduction of poverty. Major questions such as what is the future of agriculture in less favorable regions such as SAT; what kind of agriculture would be sustainable; what kind of policy, research and extension support is needed to make agriculture financially viable for the majority of farmers; what priority areas for future investments would increase the contribution of SAT agriculture in reducing poverty in a sustainable manner; have contributed to the development of a strategy for the SAT agriculture. Future research strategy in agriculture should be responsive to the felt needs of the poor farmers in spite of the complex relationship between agricultural research and poverty reduction; and aim at generating yield-increasing, drought-resistant and labor-intensive technologies suitable for agro-climatic conditions.

The priority thematic areas for possible development intervention in the SAT region are

- improved access to supplementary irrigation along with complementary inputs (techniques for harvesting and storage of rain water, recharging of groundwater aquifers and regulation of groundwater extraction, adoption of watershed management approach, rationalization of pricing of water and power reflecting their opportunity costs, improving water use efficiency of irrigated agriculture, specification and enforcement of property rights in water);
- wider diffusion of new dryland technologies adapted to local conditions;
- reclamation and productive use of wastelands, fallow lands and common pool lands;
- diversification of agriculture with a higher priority to livestock development;
- marketing and commercial orientation of agriculture;
- revamped and targeted public distribution system;
- strengthening of support systems and basic infrastructure;
- better-targeted wage employment schemes to address transient poverty;
- institutional innovations (securing women's participation, demand-driven agricultural extension system; using mass media to create awareness about the problems of SAT agriculture); and
- re-orienting public policies (protecting the interests of migrant labor, ensuring food security through provision of wage-paid employment, and rationalizing subsidies on agricultural inputs).

The low irrigated SAT areas covering Maharashtra, Madhya Pradesh, Gujarat, Karnataka, Andhra Pradesh, Bihar and Rajasthan; the medium irrigated areas covering parts of Rajasthan, Madhya Pradesh, Gujarat, Karnataka, Andhra Pradesh and Bihar; and the high irrigated areas of SAT spanning over Tamil Nadu, Andhra Pradesh, Bihar, and Gujarat are the priority geographical areas for intervention.

In setting priorities for research, the involvement of target users in the process is important. Participatory priority setting can lead to different diagnoses and recommendations for future agricultural research and project implementation. A synthesis of participatory surveys cited in this report has shown how farmers' own perceptions and priorities regarding constraints to production and the quality of agricultural services went beyond just resource endowments and allocation (climatic and environmental factors, access to land, labor, skills, and draft power) to the quality of public and private agricultural services. This process helped to identify the livelihood diversification strategies including changing farming practices, more reliance on non-farm sources of income, and modified patterns of exchange and consumption. Consequently, the study recommends the following priorities for research:

- developing cost-effective methods and techniques of integrated watershed development and management;
- techno-economic assessment of water saving micro irrigation technologies and determinants of their adoption in SAT;
- breeding of water-efficient drought-tolerant varieties of rainfed crops; shift in focus from crop improvement of sorghum and millets as food grains to their improvement as feed grains;
- markets and policy; and alternative options for making the typical farm family financially viable through optimum mix of farm and non-farm enterprises;
- value addition and better utilization of dryland crops;
- mainstreaming of gender in the SAT agricultural development strategies;
- role of power relations and social exclusion in designing and implementing effective intervention strategies;
- economics of postharvest technologies in SAT;
- institutional innovations for reducing the high transaction costs and marketing costs; and
- harnessing modern information and communication technologies for outreach and technology dissemination as well as interfacing with farmers, policy makers, Non-Governmental Organizations (NGOs) and research agencies.

The report begins with an overview of the state of SAT agriculture in India and an analytical framework for the study based on essential principles of sustainable livelihood. Linkages between rural poverty and the SAT agriculture are identified and major livelihood strategies and current interventions in the SAT agriculture are presented in subsequent units of the report. The major issues affecting the SAT agriculture in India, including biophysical, technical, economic and institutional issues are discussed. The report concludes with a set of recommendations on strategies to increase the contribution of SAT agriculture in reducing rural poverty in a sustainable manner.

1. Introduction and Background

The last four decades have registered impressive gains in food production, food security and rural poverty reduction in India. Increased intensification of agriculture through intensive use of irrigation, fertilizers, and pesticides along with High Yielding Varieties (HYVs) in more-favored high-potential zones was the major driving force for this success. However, many regions in less-favored rainfed areas like much of the semi-arid tropics (SAT) have not benefited from this process of agricultural transformation. Along with low productivity of rainfed agriculture and widespread poverty, the changing globalized environment, scarcity of water, and degradation of productive resources (land and biodiversity) are threatening to further marginalize agriculture and livelihoods in the Indian SAT. Stimulating productivity growth in the SAT agriculture is the key for improving the well being of 41% of the India's poor now inhabiting the less-favored areas.

As opportunities for further growth in the more-favored regions are exhausted, food security and productivity growth in agriculture in India are increasingly depending on improved utilization of natural, human, financial, and material resources and productivity growth in the less-favored regions. The emerging evidence of higher impacts on poverty as well as higher marginal productivity gains from public investments in the less-favored regions suggests the need to prioritize these hitherto overlooked areas in terms of technology development and diffusion.

If future agricultural growth is to benefit the poor and contribute towards equitable economic growth, it is important to recognize the untapped potential of SAT, and design suitable strategies and policies for stimulating sustainable productivity growth in these regions. Adverse biophysical conditions and scarcity of water, which characterize much of SAT, and the wide diversity and fragility of ecosystems in these regions, are likely to require approaches that differ from the Green Revolution strategy. But simply introducing blanket policies targeted at increasing yields is not sufficient as past experience has shown. Understanding who gains from interventions and who loses and why, is now known to be more important in addressing persistent poverty in the SAT areas. This calls for an interdisciplinary and crosscutting approach that is long-term and sustained. The Sustainable Livelihoods Approach (SLA) offers a good starting point for the analysis and understanding of poverty and designing of interventions in the SAT agriculture.

1.1 Genesis and background

The strategy of the International Fund for Agricultural Development (IFAD) for Asia and the Pacific envisages a focus on the less-favored areas. In focusing on this niche area, the strategy intends to ensure complementarity with the poverty-reduction initiatives of governments, particularly for the landless, and with those of the World Bank and other donors in areas such as health, education and infrastructure. The following are fundamental to the regional strategy to reduce rural poverty:

- the changing of unequal gender relations to increase women's ownership and control of assets, and their effective participation in community management affairs;
- enhancing the productivity of staple food in less-favored areas;
- reforming property and tenurial rights of various marginalized communities and indigenous people; and
- enhancing the capabilities of the poor and the vulnerable through greater access to self-help, local accumulation, new skills and technologies.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has 30 years' experience of service to the poor residing in the SAT regions, which are one of the less-favored areas. The broad understanding and the village level data from these regions have equipped ICRISAT to better address the problems and constraints prevalent in these regions. Reflecting the ICRISAT's philosophy of "Science with a Human Face", its research strategy focuses on the poor in the marginal areas of the SAT to empower, value and work on what matters to people; and to learn from them. This "people centred" approach led to the development of a people-oriented and impact-driven ICRISAT research strategy.

Understanding the underlying determinants of poverty in the SAT and the pathways to its alleviation is a major challenge. In this regard, ICRISAT conducted a series of brainstorming workshops commencing in 2000 as a component of its SAT Futures initiative. It discussed the future of agriculture in the SAT and shared ideas about ICRISAT's future

role in both Asia and Sub-Saharan Africa (SSA). Discussions were organized around the SLA in the process of identifying primary constraints and opportunities in SAT. This served as a basis for the series of follow-up discussions with stakeholders and release of a book on "Future challenges and opportunities for agricultural R&D in the semi-arid tropics" published by ICRISAT in 2001. This was adapted and expanded to capture the essential dynamics of poverty for the design of its village level studies and measurement of research impacts and development of the ICRISAT's vision and strategy to 2010.

A poverty diagnostics and strategic assessment of the issues confronting the SAT is intended to further deepen our understanding of the linkage between rural poverty and SAT, and the nature and dynamics of poverty. This would help design appropriate interventions to help the poor achieve preferred livelihood outcomes. Besides, this would also contribute significantly to IFAD's understanding of the opportunities for the SAT agriculture to identify key interventions and priority investments.

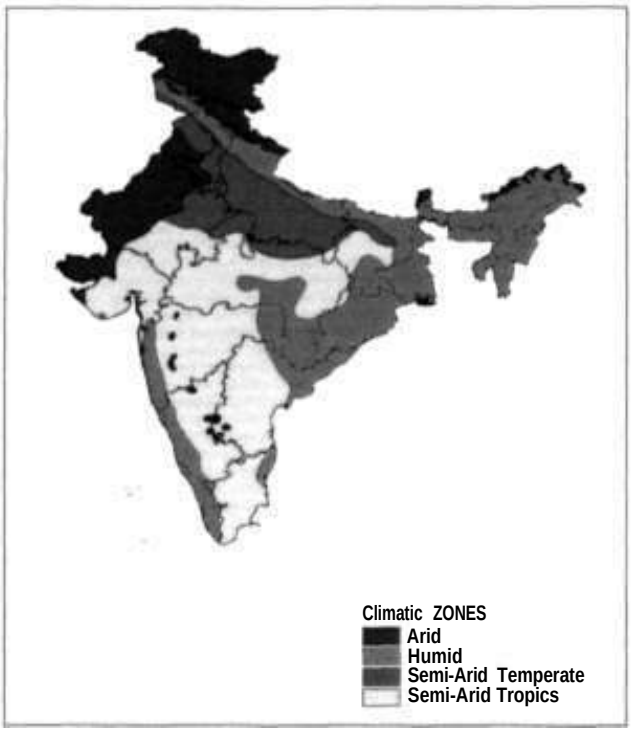

Figure 1.1. Agro-ecological zones of India.

1.2 Importance of SAT and SAT agriculture in India's economy

The semi-arid tropics (SAT) cover parts of 55 developing countries. There are many definitions of the SAT (see Appendix 1.1). In this report, the SAT is defined using two parameters, ie, length of growing period (75-180 days) and mean monthly temperature (more than 18°C). Thus defined, the SAT extends over a total geographical area of nearly 1.2 million sq km, which constitutes 37.2% of the total geographical area of India (Figure 1.1 and Table 1.1). It is home to nearly 37% of India's total population. In 1997-98, the SAP areas accounted for 46.2% of India's total net cultivated area and 31.9% of gross irrigated area, 58.7% of the area under coarse cereals, 59.7% of the area under oilseeds, 52.6% of the area under pulses and 60% of the area under commercial crops such as

Table 1.1. Relative importance of SAT vis-a-vis other climatic zones of India: 1997-98.

	Share to All India (%)*			
Importance/region	Arid	Humid	Semi-arid temperate	Semi-arid tropics
Geographical area	10.3	22.3	12.0	37.2
Population	4.3	32.3	21.5	36.9
Net cultivated area	11.4	21.1	19.0	46.2
Gross cropped area	11.3	22.6	21.1	42.9
Gross irrigated area	12.4	16.4	35.1	31.9
Coarse cereals area	16.9	8.0	16.5	58.7
Pulses area	12.9	17.4	17.1	52.6
Oilseeds area	11.9	10.7	14.6	59.7
Commercial crops area	15.5	8.2	16.3	60.0
Fruits and vegetables area	23	49.9	19.2	28.6
Production of coarse grains	10.0	10.3	19.2	60.5
Production of pulses	7.7	16.0	24.8	51.5
Production of oilseeds	10.0	10.1	13.5	62.8
VOP agriculture	8.7	27.8	26.6	36.9

*Figures do not add to 100 because of unavailability of data from a few states.
Source: ICRISAT database

cotton and sugarcane. Similarly, it made a significant contribution to the food grains basket of the country. For example, in 1997-98, it contributed 60.5% of total coarse grains production, 51.5% of total production of pulses, and 62.8% of total oilseeds production in the country.

Several areas that are classified under the SAT in India are likely to be similar to what Scoones and Thompson (1994) describe as the "Third Agriculture", which is complex, diverse and risk prone, and yet supports 1.9-2.2 billion people globally. The South Asian SAT, home to nearly 300 million people, cover mainly southern interior areas of India and small parts of Pakistan and Sri Lanka (Kerr 2000). Poverty levels are high and literacy rates are low. With productivity greatly limited by low and variable rainfall, lack of irrigation, and poor soils, the SAT agriculture contrasts sharply with irrigated Green Revolution areas. Appendix 1.2 provides a list of predominantly the SAT districts in India. The relative importance of the four regions is detailed in Appendix 1.3 for two periods, 1970-71 and 1997-98.

1.3 Important interventions in SAT agriculture and their impacts

In India, rainfed farming has been practised since times immemorial. India has a long history, perhaps the longest in the world, of government intervention in dryland agriculture with a view to increase and stabilize crop yields. A few of those interventions are listed below:

- Establishment of dryland research stations in the 1930s;
- Establishment of the Central Soil and Water Conservation Research and Training Institute at Dehradun in 1954 and its regional centers;
- Establishment of the Central Arid Zone Research Institute (CAZRI) at Jodhpur in 1959;
- Launching of an All-India Coordinated Research Project for Dryland Agriculture in 1970;
- Launching of five Operational Research Projects in 1975 and another four in 1984;
- Establishment of the Central Research Institute for Dryland Agriculture (CRIDA) in Hyderabad (AP) in 1984;
- Development of 47 model watersheds in the 1980s and 1990s; and
- Launching of the National Watershed Development Programme for Rainfed Areas in 1990s.

In addition, several national level programs such as the Drought-prone Area Programme (DPAP), Desert Development Programme (DDP) and poverty alleviation and employment generation programs were also launched by the Government of India with the main objective of development of dryland agriculture and reduction in poverty and unemployment. The establishment of ICRISAT at Patancheru in 1972 significantly complemented the national efforts and initiatives.

However, despite all these interventions, the SAT agriculture did not register as much progress as agriculture in the irrigated areas elsewhere in the country and incidence of rural poverty remained high. The crop yields continued to be lower than in irrigated areas and so also the farm incomes. Some of the major changes in the SAT agriculture, which could be attributed to the interventions made, are briefly summed up below:

Increase in land productivity: Over the period, 1970-73 to 1992-95, there had been several changes in the area and productivity of major dryland crops. For example, the average yield of coarse cereals had increased by 65.4% and that of oilseeds by 57% (Kanwar 1999). Most of the growth occurred in the 1970s in the irrigated areas and in the 1980s in the rainfed areas. The total factor productivity actually declined in both the areas in the 1990s. The average value of crop and livestock outputs was Rs 21,985 ha^{-1} in the SAT during 1997-98 while it was Rs 31,563 ha^{-1} in the non-SAT regions (Table 1.2).

Change in cropping pattern: Gulati and Kelley (1999) in their study found that there had been a distinct shift in the cropping pattern in the SAT over the period, 1968-70 to 1992-94, away from coarse grains in favor of wheat, paddy, and oilseeds. Using more recent data, we find that the share of oilseeds in the gross cropped area of SAT had gone up from 11% in 1970 to 19% in 1997-98. In contrast, the area under pulses declined from 21 to 16%, and the area under coarse cereals from 31 to 21%. With the expansion of irrigation, wheat has emerged as the favored crop.

Increase in area under irrigation: There has been a marked increase in the Gross Irrigated Area (GLA) in the SAT from 12.5 million ha to 23 million ha over the period, 1968-70 to 1997-98. Much of the expansion in irrigation has occurred in the northern regions, facilitating shifts to high value crops such as wheat, paddy, sugarcane and rapeseed/mustard. Irrigation has also led to an increase in the intensity of cropping in the SAT from 1.10 to 1.25. Yet, 70% of the gross cropped area remains rainfed.

1.4 Objectives of the study and research questions

The main objective of the study is to provide significant inputs for development of a Strategic

Table. 1.2. Selected indicators of SAT and Non-SAT districts of India: 1997-98.

Indicators	SAT	Non-SAT	All India
Population density (No/sq km of geog. area)[1]	300	393	324
literate rural female (%)[1]	39	38	39
Urban population (%)[1]	30	22	28
Average size of land holdings (ha)	1.9	1.4	1.6
Proportion, of small land holders (%)	69	81	78
Net area sown per capita	0.18	0.14	0.15
Livestock units (units/ha cropped area)	1.7	2.2	2
Livestock units per capita	0.33	0.29	0.31
Gross value of agricultural produce (Rs/capita)	3919	4030	3989
Gross value of agricultural produce (Rs ha^{-1})	21,985	31,563	27,209
Tractor density (No./OOO ha)	4.5	11.7	8.3
Diesel and electric pump sets density (No. / '000 ha)	74.2	75.5	74.9
Cropping intensity (%)	124.2	142.9	139.2
Area under HYVs (%)	31.7	41.6	40.7
Gross Irrigated area (%)	28.9	41.7	38.3
Fertilizer consumption (kg ha^1 of NCA)	97	117	101
Fertilizer consumption (kg ha^{-1} of GCA)	78	83	85
Mean annual rainfall (mm)	965	1364	1212
Market density (No/10,000 km^2)	21.3	22.9	22.1
Road density (km/sq. km)	0.5	0.5	0.75

1. Based on 2001 Census data
Source: ICRISAT database
NCA: Net cropped area
GCA: Gross cropped area

Opportunities Report for India by IFAD. In particular, the study is designed to (1) establish a linkage between the SAT agriculture and rural poverty; (2) understand the critical issues of SAT agriculture in India; (3) recommend strategies to increase the contributions of SAT agriculture in reducing poverty; and (4) recommend priority development interventions and research directions. The detailed terms of reference *of* the study are given in Appendix 7. More specifically, the study seeks to find answers to five questions: (1) Who are the rural poor? (2) Where are they concentrated in the SAT, or elsewhere? (3) Why are they poor? (4) What has been done to reduce rural poverty? (5) What should be done to further reduce rural poverty?

1.5 The sample and sources of data

The study is based on a review of the relevant literature readily accessible to the study team and the following sources of data:

(a) 55th Round of the National Sample Survey (NSS) conducted during the period 1 June 1999 to 31 July 2000, covering 537 districts of India and a sample of nearly 70,000 rural households;
(b) Population Census 2001;
(c) ICRISAT database for 1970 to 1997 covering 483 districts;
(d) CMIE (Centre for Monitoring Indian Economy) database; and
(e) Longitudinal Village Level Studies of ICRISAT in selected villages in Andhra Pradesh and Maharashtra.

1.6 Structure of report

The study is structured to include the following components: Chapter 1 provides an overview of the state of SAT agriculture in India and Chapter 2 presents an analytical framework for the study based on essential principles of sustainable livelihood. Chapter 3 identifies linkages between rural poverty and the SAT agriculture. Chapter 4 presents major livelihood strategies and current interventions in the SAT agriculture. Chapter 5 addresses the major issues affecting the SAT agriculture in India, including biophysical, technical, economic and institutional issues. The report concludes in Chapter 6 with a set of recommendations on strategies to increase the contribution of SAT agriculture in reducing rural poverty in a sustainable manner. This also identifies and highlights priority thematic and geographical areas for possible interventions as well as priority research directions for future.

2. Sustainable Livelihoods Approach and Analytical Framework

2.1 Introduction

This chapter provides a conceptual and analytical framework that underpins the analysis and synthesis of results that are presented in subsequent chapters of this report. This study uses the principles of sustainable livelihood in developing its overarching framework. First, we expound on the genesis, evolution and current thinking about Sustainable Livelihoods Approach (SLA). Adaptation of the principles of SLA is intended to guide the understanding and analyses of poverty and livelihood strategies in SAT. The SLA is adapted and expanded to capture the essential dynamics of poverty in the process of identifying primary constraints and opportunities in SAT. In particular, the expanded framework added emphasis on the aspects of markets, access, agricultural research and technology, and power. It recognizes the multi-dimensional nature of poverty, encompassing economic, social, and governance perspectives. This chapter also presents the basic concepts and measures of poverty, including a specification of determinants of income poverty.

The context of vulnerability in the SAT agriculture is based on a relatively risk-prone environment characterized by low and erratic rainfall, and poor soils. In this way, several groups of people who live within the SAT areas are poorer and more vulnerable than people in better-endowed regions. Understanding how rural households within the SAT manage *risk, covariant* risk or risk that affects everybody such as the risks imposed by drought, as well as *idiosyncratic* risks, which affect particular household alone through coping, adaptation and diversification strategies is important. A key feature of the SAT livelihood strategies is the *substitution* between different kinds of assets (human, political, natural etc.) and activities in response to the context at a particular point that allows them to deal effectively with risks imposed by a highly variable environment. In fact this goes a long way in explaining why many SAT areas have demonstrated *resilience* in the face of adverse environmental conditions that defy doomsday prophesies and orthodox predictions about the finiteness of resources.

2.2 Sustainable livelihoods approach and framework

The SLA grew out of a number of analytical streams, from diverse disciplines including economics, sociology, anthropology and the new institutional economics. Amartya Sen's theory of ***entitlements*** (Sen 1981) highlighted the importance of access to resources and challenged the notion that resource deprivation occurred as a result of production failure alone. Sen's theory showed, for example, why a rich farmer with land, animals and other assets would be able to command more resources compared to a landless laborer for whom the only endowment or tradable asset is often labor. Sen later developed this work further with the idea of *capabilities* (Sen 1990), which arose from the recognition that increased access to a resource can improve the welfare of the users only if they are capable of utilizing it effectively. Swift (1989) broadened the definition of assets owned by an individual to include a wide range of tangible and intangible stores of value or *claims* to assistance which can be mobilized in a crisis.

Davies (1996) distinguishes between *ex-ante* and *ex-post coping strategies.* She likens ex-ante coping strategies to insurance strategies because they are undertaken in anticipation of the shock. Ex-post strategies are undertaken in response to the event or shock. In the long term, people may engage in more ***adaptive*** strategies.

Robert Chambers' theory of ***vulnerability*** continues to be a core influence in livelihoods thinking. Vulnerability occurs as a result of external risks, shocks and trends'. It is also because of defencelessness, which stems from discrimination on the basis of class, age, gender, ethnicity, and disability. Vulnerability is not the same as poverty, although the terms have been used interchangeably by some, and it is crucial to understand the meaning because this helps us in understanding the circumstances of marginalized groups.

Studies on gender have highlighted entrenched inequalities in control over assets, gender discrimination in labor markets, and lack of voice in

1. **Although the theory allows for a broad interpretation, the vulnerability context is usually interpreted in such a way that it underplays the importance of liberalisation and conflict [Chronic Poverty Programme Website].**

the power struggles controlling resource allocation as the main reason for women's vulnerability. Gender research has also created awareness of the feminization of poverty (Jackson 1995; Kabeer 1995; Lockwood 1995) and the often vulnerable situation of female-headed or female-maintained households (Buvinic and Gupta 1994).

The New Institutional Economics (NIE) highlights the importance of formal and informal *institutions* as well as transaction costs involved in the access to assets. Institutions are the rules of the game and are separate from organizations and individuals who are players in the game.

2.3 A new sustainable livelihoods framework for SAT agriculture

We propose some additions (Figure 2.1) to the classic livelihoods framework based on emerging concerns, especially those that relate to the SAT agriculture. Three areas need to be mainstreamed in livelihoods analyses, namely, markets, agricultural research and technology, and power.

Markets: In its classical form, the SLA is weak on market analysis, although as Dorward et al (2003) point out, this is a strange omission considering that one of the main influences was Sen's theory of entitlements. Inadequate attention to markets can lead to failure in identifying and acting on a wide range of market, institutional and technological opportunities and constraints (Dorward et al. 2003). A more explicit analysis of the interactions between institutions, technology and assets in livelihoods analysis is required because the poor are already engaged in a range of markets. In fact, some of the main constraints to livelihoods may arise from missing markets or imperfect markets, although as we will see later, some have argued that the latter should be viewed as vital institutions that fulfill an important economic function. Markets are more likely to be imperfect in remote areas, which often lie within the SAT boundaries.

Understanding the functioning of markets for labor, primary commodities, agricultural inputs and cheap consumer goods is therefore crucial. Interventions could then be formulated to ensure that new arrangements for trade and exchange do not create anti-poor markets and institutions and that the pro-

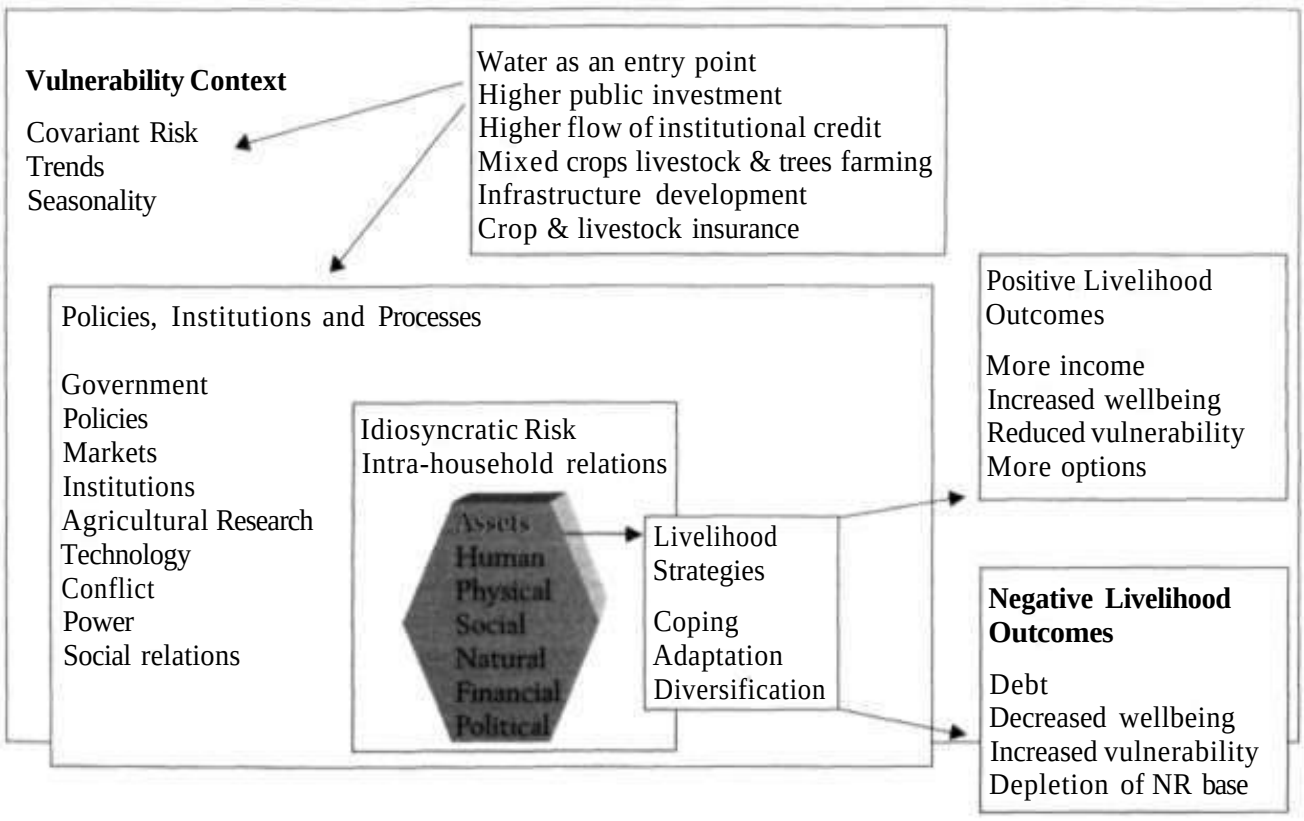

Figure 2.1. A sustainable livelihoods framework for SAT agriculture.

poor elements of existing markets/institutions are enhanced.

Agricultural research and technology: Linked to the under-recognition of markets is an under-recognition of the role of technology in promoting livelihoods[2]. Although the record of technology development for the SAT is impressive, uptake has been poor. India in particular has developed a vast and diverse bank of (station-) proven technologies for dryland farming and conservation over several decades. This has been achieved through massive investment in research, with the strategic objective of doing for the drylands what the Green Revolution did for the irrigated areas (CRIDA 1997, quoted in gatekeeper series). As explained throughout the remainder of this report, this is due to the various constraints faced by households in the SAT areas. An SLA can help us to understand how agricultural research and technology intersect with livelihoods and why they are adopted successfully in some cases and why not in others.

We draw on the work of Adato and Meinzen-Dick (2002) here and incorporate agricultural research and technologies in the policy and the institutions. Both research and technology are strongly linked to the asset base as well as the vulnerability context. Technology, for example, irrigation, pest management and livestock vaccinations can reduce vulnerability and the vulnerability context can influence the choice of technology. Negative impacts of research and technology are also possible, especially if farmers adopt (for whatever reason) cultivars that are not suited to their conditions as was seen in the case of cotton in Andhra Pradesh, India. Certain kinds of assets may be required to adopt new technologies effectively as seen in the case of Green Revolution technologies which were more suited to larger parcels of land (natural capital) or those with access to credit (financial capital) and infrastructure (physical capital). Human capital, in the form of knowledge and skills, is necessary to make proper use of many kinds of technologies.

Power: Recent feedback from applying livelihoods approaches highlights the inadequacy of SLA in addressing power, politics and conflict both within local communities and between groups of people and the elite or formal institutions (Farrington 2001). In fact corrupt or rent-seeking officials and politicians as well as upper caste people and the local elite may present the main obstructions to the poor in improving their livelihoods. This realization has led certain agencies such as the World Bank and the Department for International Development (DFID) to start taking a greater interest in corruption and strengthening of poor people's capacity and *voice* to demand their entitlements, for example, to fair wages and services. This aspect of livelihoods attains great importance in the SAT areas which are often remote and where people are more prone to exploitation through interlocked markets and less access to democratic institutions. Empowering them to fight for their entitlements and rights presents special challenges which may be beyond the mandate of organizations concerned mainly with technology development. But we include it in our framework because it needs to be recognized as an important prerequisite for ensuring success in the dissemination and uptake of several kinds of technologies and improved agricultural practices.

An important dimension of vulnerability in remote SAT areas is lack of power, voice, and social networks, which can help the poor to access resources, institutions, technology and markets. We therefore stress the significance of social capital and add a sixth type of asset, which is "political" capital. This has been suggested before in the literature (Bauman 2001) and makes sense in the SAT context because this is where (a lack of) power is most likely to have an impact on livelihood outcomes.

This report addresses in particular seven issues: identification of the poor, their livelihood strategies, access, trade offs, trends, technology and markets. In facilitating the analysis, the analytical framework shown in Figure 2.2 addresses the five key questions: (1) Who are the rural poor? (2) Where are they concentrated? (3) Why are they poor? (4) What has been done to reduce poverty? and (5) What should be done to further alleviate poverty?

2.4 Multi-dimensional view of poverty

There are many quantitative measures of poverty that are commonly used. Underlying most of these is the view that poverty connotes a state of affairs in which a person or a household, or a community does not have access to basic (minimum) necessities of life such as adequate food, clothing, shelter, healthcare, and education. One perspective is that a person is

2. Although the United Nations Development Programme (UNDP) approach does identify technology as one of the drivers of change.

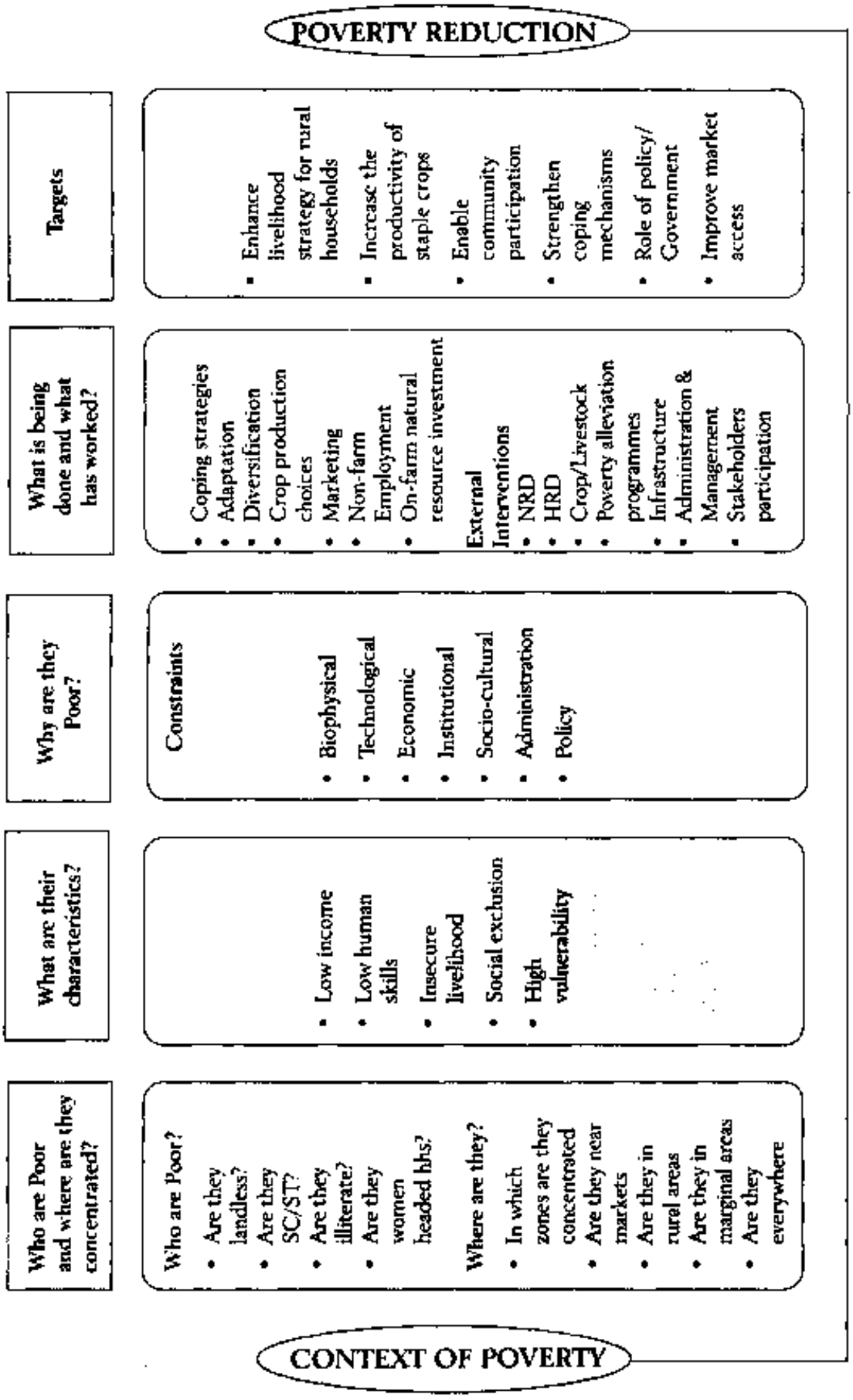

Figure 2.2. A conceptual framework for understanding the poor, the poverty and the poverty reduction.

considered poor if his/her consumption expenditure or income is below some minimum level necessary to meet the basic needs of life. This minimum level is usually called the "poverty line".

Depending upon the extent of gap between his/her actual consumption expenditure, or income and the poverty line, a person may be classified as marginally or moderately poor and severely poor. Similarly, we may also differentiate between chronic poverty and transient poverty depending on whether the person has been poor for a relatively long period of time or only for a relatively short period of time. Four quantitative measures of poverty, namely, (1) headcount ratio, (2) poverty gap, (3) squared poverty gap, and (4) mean per capita expenditure, were used in this study. They arc elaborated in Appendixes 4 and 5.

Poverty goes beyond lack of income. It is multi-dimensional, encompassing economic, social, and governance perspectives. Fxonomically, the poor are not only deprived of income and resources, but also of opportunities. Markets and jobs are often difficult to access, because of low capabilities and geographical and social exclusion. Limited education affects their ability to get jobs and to access information that could improve the quality of their lives. Poor health, because of inadequate nutrition and health services, further limits their prospects for work and from realizing their mental and physical potential. This fragile position is exacerbated by insecurity. Living in marginal conditions with no resources to fall back on, shocks become hard or impossible to offset. The situation is made worse by the structure of societies and institutions that tends to exclude the poor from participating in decision-making over the direction of social and economic development. Evidences from the literature suggest that the concepts and indicators used to measure poverty do matter **a lot** in identifying the poor.

2.5 Complementary framework for identifying determinants of poverty

For conceptualizing the relationship between poverty and factors affecting it, we complement **the** sustainable livelihoods framework with principles from the neoclassical economic theory of production that help determine the optimum level of use of a resource and optimal allocation of resources, **which** states that a rational producer tries to maximize his/her private profit subject to the constraints of underlying production function and other economic, institutional, and social considerations. The theory is put into practice through a set of principles including the principles of diminishing marginal returns and equi-marginal returns.

As we have seen above, poverty is a multi-dimensional concept and accordingly there are several concepts and measures of poverty. Of all the concepts of poverty, income or consumption poverty is the simplest to understand and measure. Appendix 3 provides an elaboration on the measurements of income poverty and its determinants. Appealing to the expanded conceptual framework based on principles of sustainable livelihood (Figure 2.1), the context of poverty, causal factors and suitable interventions **are** identified to underpin the subsequent analysis of poverty and livelihood strategies in SAT.

3. Levels and Determinants of Rural Poverty in the Semi-Arid Tropics of India

3.1 Introduction

The previous chapter highlights the importance of a holistic approach, which considers the multi-dimensional perspective of poverty. Poverty being a multi-dimensional concept is influenced by several factors. To understand the nature and dynamics of poverty and therefore find the ways for effective intervention, policymakers first need to understand how it is distributed across geographic and socio-economic groups, what are its characteristics, and what factors determine it.

The literature is replete with the evidence that rural poverty is strongly related to the structure and performance of agriculture, especially in India. Time series analysis clearly shows positive association between poverty decline and agricultural growth. But the relation between agricultural growth, rural poverty and agro-climatic conditions is not very clear. This chapter establishes the association between rural poverty, agricultural development, and agro-climatic factors using the National Sample Survey (NSS) data of the 55th Round (1999-2000). The analysis focuses on three aspects: (1) Who are the poor? (2) Where do they live? (3) Why are they poor? It also attempts to answer the question: what has to be done to bring the poor out of poverty. Starting with the concept of income poverty, the analysis is extended to other indicators, correlates, and determinants of poverty. The concentration of the poor in various agro-climatic zones is discussed. Caste, occupation and gender are also considered in the analysis.

3.2 Sources of data and methodology

Studies on patterns of poverty in India generally consider state as the unit of analysis. Since, states are not homogeneous in terms of agro-ecological characteristics, analysis at that level cannot capture and explain the effects of agro-climatic differences. What we need are relatively homogenous systems/ zones with a distinction on the basis of irrigation levels that will provide a better understanding of the incidence, correlates and determinants of poverty. Fan et al. (2000) have analyzed the problem by classifying dry areas (irrigation ratio less than 40%) into 13 zones on the basis of the importance of crop and livestock production. They have not considered agro-ecological zones. Furthermore, irrigation level of 40% as the cut-off point in consideration of an area as dryland is too high. Initially, we started with 12 zones, which comprised four broad zones - Humid, Arid, Semi-Arid Temperate and Semi-Arid Tropics (SAT). Each zone was further divided into three classes based on three irrigation levels, viz, less than 25% (low), 25 to 40% (medium) and above 40% (high). The analysis focuses on rural poverty, so that purely urban districts and a few districts where data were not available were not included. The number of zones were reduced from 12 to 10. The arid and semi-arid temperate zones, with low and medium irrigation comprising only of a few districts, were clubbed together. Our analysis of ten agro-climatic zones considering both pictures provides a better understanding of the structure and determinants of poverty.

The analysis is based on ungrouped household data of the 55th Round (1999-2000) of the National Sample Surveys (NSSs) on Consumer Expenditure and Employment and Unemployment. The household data is aggregated for ten agro-climatic zones as illustrated in Figure 3.1. The classification considers length of growing period and levels of irrigation, and takes into account the household level multipliers supplied by the National Sample Surveys Organization (NSSO). In addition to the NSS database, district-wise data on agricultural statistics from the Ministry of Agriculture and Cooperation and decennial population census data, are also used. The study adapted the estimates of rural poverty lines developed by Deaton and Dreze (2002). These are based on the prices implicit in the NSS data. It is noted that the use of these poverty lines results in a lower estimate of rural poverty than the official estimates of India. Correlation coefficients between rural poverty and socio-economic factors are calculated using the district level estimates of poverty derived from the NSS data. The district level estimates of poverty are likely to suffer from high standard errors because of the small sample size at that level. However, their use as dependent variable in regression analysis will not create a serious problem because even if the dependent variable contains errors, the estimates will be unbiased, although variances will be high (Gujarati 1987).

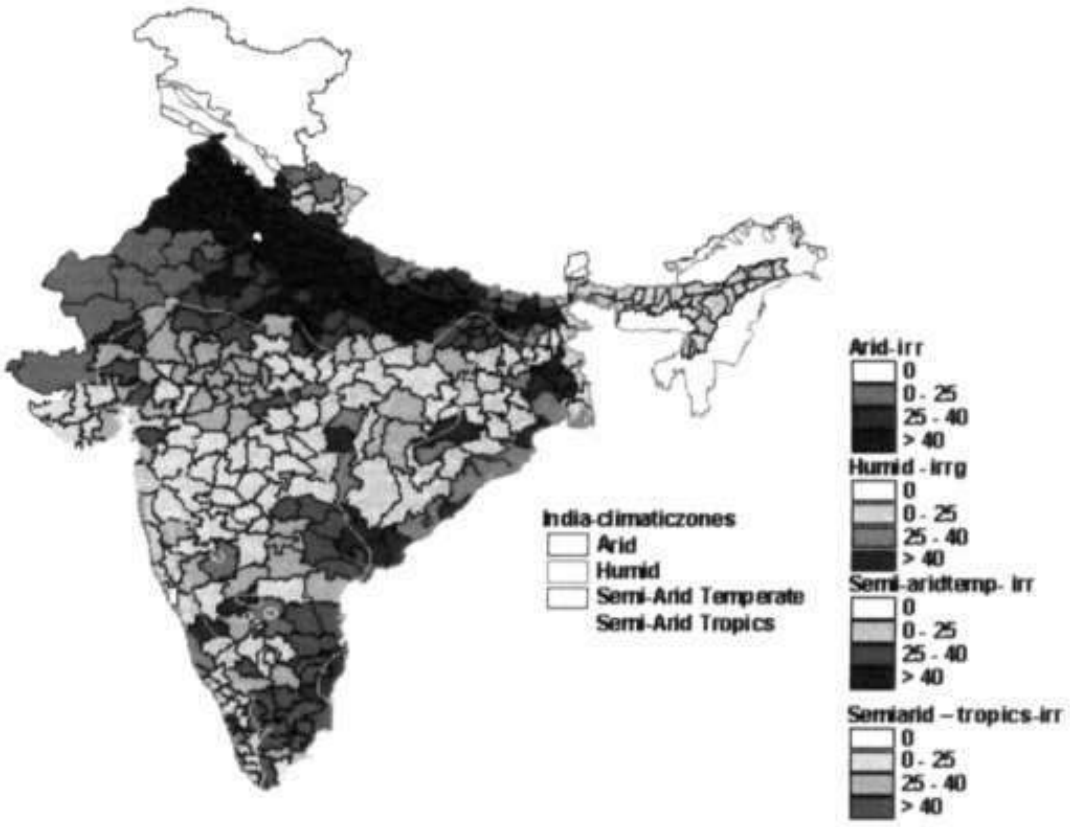

Figure 3.7. Agro-ecological zones and levels of irrigation, India.

Since poverty is a multi-dimensional concept, the study extends the analysis to examine other aspects of deprivation where quantitative measures (such as education and health) are available. Using the indicators of standard of living, knowledge and health, an index of human development (HDI) is constructed adopting the methodology of United Nations Development Programme (UNDP). Appendix 5 provides a detailed description of the methodology used for computing the measures of poverty.

3.3 Where are the poor concentrated?

The head count measure of poverty shows that 21.3% of the India's rural population is poor in 1999-2000 with levels of poverty incidence varying across zones (Figures 3.2 and 3.3). The estimates shown are actually lower than the official or the Deaton's estimate as we have used Deaton's poverty lines without correcting for overestimation as he did. The poor are concentrated in the humid and SAT zones. The incidence in each of these zones is about 24.0% and each accounts for 40.5% of the country's rural poor. Thus, the humid and SAT regions account for 81% of the rural poor, though their share in total population is 72% (as illustrated in Figure 3.4). The semi-arid temperate zone at 14.6% and the arid zone at 12.6%) have a lower incidence than the other two zones. The semi-arid temperate zone accounts for 14.5% of the rural poor in India, while its share in rural population is 21.1% (Table 3.1)*. The arid zone accounts for 2.2% of the rural population and 1.2% of the rural poor. The remaining 3.2% of the poor are in

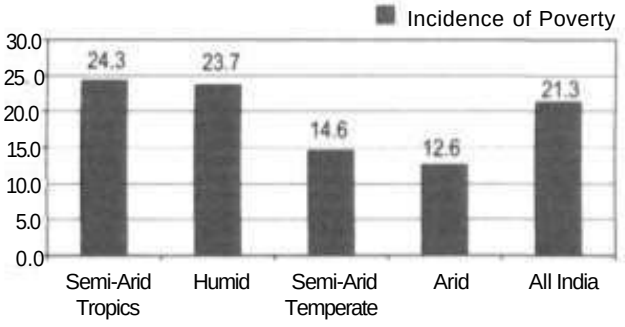

Figure 3.2. Incidence of head count poverty across zones.

* All the tables referred in this chapter are given in Appendix 3.

the unclassified areas. It is important to note that areas with low irrigation have the highest incidence in all the zones. The reason for low incidence of poverty in the semi-arid temperate zone is that this region, especially major parts of Punjab and Haryana, have benefited much from the Green Revolution. Less population pressure, more non-farm activities and less employment in the agriculture sector in the arid region appears to explain the relatively low incidence of poverty in arid region.

Variations in the incidence of poverty within the broad zones reveal that areas of medium level of irrigation have lower incidence of poverty than areas of high irrigation in humid and tropical zones. In the other two zones, poverty is significantly lower in the areas of high irrigation as compared to the areas of medium irrigation. Further, the arid zone has exceptionally low incidence of poverty even in the less irrigated areas. The low poverty in temperate zone is because of its high average irrigation ratio. For instance, the irrigation level in the semi-arid temperate zone is 62.1 %, as against 31 % and 28.4% in the humid and SAT zones, respectively. Even in the high irrigation category, the irrigation ratio in the semi-arid temperate zone is significantly higher than in the other two zones. Further, there is an inverse relation between irrigation level and rainfall in the humid and SAT zones as a result of which the differences across irrigated levels are narrowed down. Because of the high rainfall, areas of moderate irrigation are showing better performance than areas of high irrigation.

In the semi-arid temperate zone, rainfall is lower in the less irrigated areas and difference in irrigation level is very high. As a result, difference in poverty incidence is also quite high. The high-irrigation arid zone has exceptionally low poverty because of its very high irrigation ratio at 79.3%. The areas of low and medium irrigation in the arid zone have higher irrigation ratio than their counterparts in the humid and SAT.

The other measures of poverty, viz, poverty gap, squared poverty gap, Sen's Index and monthly per capita consumer expenditure yielded almost the same ranking of the regions as the head count ratio. These measures further confirm that the difference between the humid and SAT zones is not significant (Table 3.3).

Because of higher share in rural population and higher incidence of rural poverty, the SAT and humid zones have high concentration of the poor. Out of 147.5 million rural poor in the country in 1999-2000, 119.9 million are concentrated in the humid and SAT zones and another 16.8 million arc concentrated in the semi-arid temperate zone with high irrigation.

3.4 Who are the rural poor?

The aim of this section is to examine who are the rural poor among various classes across social groups, occupational groups and gender groups.

3.4.1 Rural poverty and social groups

It is generally believed that poverty is higher among the Scheduled Tribes (ST) and the Scheduled Castes (SC) as a result of which the concentration of these groups in certain agro-ecological zones results in a higher incidence of poverty. The incidence of poverty is found to be the highest among the ST at 39.6% followed by the SC at 28.56% in contrast to 16.4% among general population (Table 3.6). The ST are

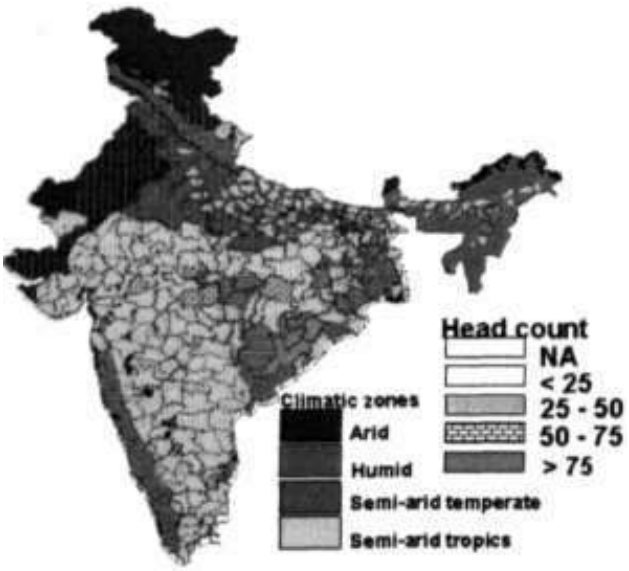

Figure 3.3. Poverty levels in India by climatic zone.

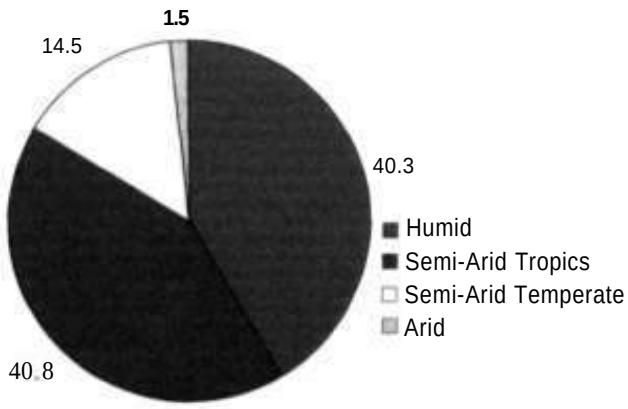

Figure 3.4. Distribution of poor across zones.

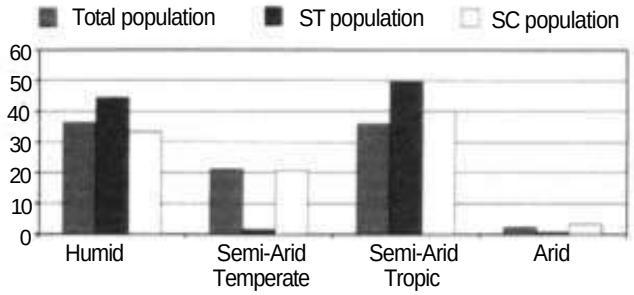

Figure 3.5. Distribution of SC, ST and total population.

mainly concentrated in the humid and SAT zones which partly is the reason for high incidence of poverty in these two zones (Figure 3.5). These two zones together account for 93.8% of the ST whereas they contain only 72.0% of the rural population. Even within these two zones, the distribution of the ST population is quite uneven. The less irrigated areas in the humid and SAT zones have a high concentration of this social group. In these areas, the ST account for 61.9% of the total population while the share of these areas in the total population is about 30%. Thus, the concentration of the ST and the high incidence of poverty in the humid and SAT zones, especially in the less irrigated areas require special attention in the policymaking. The SC are evenly spread across all the zones with a slightly high concentration in SAT. It is observed that the ST (who are mostly farmers) are concentrated in less irrigated areas, whereas the SC (who are mostly laborers) are concentrated in high-irrigated areas. The correlation coefficient between poverty incidence and the ST population is found to be high at 0.47 for rural India (Table 3.25). The correlation is significant especially in medium and low irrigated areas of the humid region and less irrigated areas of SAT. As these are the concentrations of the ST, the results clearly indicate a positive association between poverty and the proportion of ST population. In the case of SC, the correlations are positive and statistically significant in high irrigated areas of all the four zones. From the above observations, we find that there is a higher incidence of poverty among ST and SC communities than in the general population. Moreover, the ST and SC communities are mainly concentrated in low irrigated zones of the humid and SAT

3.4.2 Rural poverty and occupational groups

Incidence of rural poverty is calculated separately for five occupational groups, viz, agricultural laborers, non-agricultural manual laborers, other non-agricultural hired workers (non-manual), self-employed in agriculture, and self-employed in non-agriculture. Among these five groups, poverty is the highest among agricultural laborers at 35.5% and the lowest among the cultivators at 13.9% (Table 3.7). The laborers engaged in rural non-agricultural activities have significantly lower poverty than the agricultural laborers. The people engaged in self-employed activities in non-agricultural sector also have a low incidence, but they stand next to cultivators. Thus, the agricultural laborers in rural areas face the highest incidence of poverty. It is significant to note that the incidence of poverty among agricultural laborers is high uniformly in all the zones and it is distinctly higher in the less irrigated areas. The correlation coefficients between poverty and the proportion of the agricultural labor population are positive and statistically significant in all the zones except the high-irrigated areas in the SAT zone (Table 3.25). Similarly, the correlations between poverty incidence and the proportion of non-agricultural laborer populations are negative and statistically significant indicating that development of rural non-farm activities is an important policy intervention to reduce rural poverty.

Cultivators as a class are highly heterogeneous as the size of operated land varies significantly across households. Incidence of poverty declines as farm size increases in the semi-arid temperate and SAT zones (Table 3.8). In the humid and arid zones, poverty incidence is higher among small farmers as compared to marginal farmers.

3.4.3 Rural poverty and gender groups

Another socio-economic group that is likely to be vulnerable to poverty is female-headed households. It is observed that in areas of low irrigation in the humid zone, incidence of poverty among female-headed households is 20.1 % while the incidence among male-headed households is 26.3%. Similar result is observed in the areas of low irrigation in the arid and SAT also. On the other hand, in the areas of high irrigation in the semi-arid temperate and arid zones, incidence of poverty is significantly higher among female-headed households as compared to male-headed households. While the incidence is 21.0% among female-headed households, it is only 13.0%) among male-headed households in the semi-arid temperate zone with high irrigation. These results show that at the aggregate level, for all the zones taken together, there is no

difference between the male- and female-headed households in the incidence of poverty. But in the two high poverty zones, incidence of poverty is lower among female-headed households as compared to male-headed households.

3.5 Why are they poor?

The previous sections of this chapter reveal that rural poor are mainly concentrated in the humid and SAT zones and they are mainly agricultural laborers, small farmers and ST. This section deals with the question: why are they poor? Since most of the Indian population is dependent on agriculture sector, agricultural development promises a strong positive influence on rural poverty. Crop output, wages, cereal prices and other factors relating to agriculture along with assessment of the impact of anti-poverty programs, and human development index (HDI) are important to account for while studying rural poverty.

3.5.1 Agricultural development and rural poverty

Crop output is computed for the major crops for the year 1997-98 (Table 3.18). The value of livestock output is also computed for the same year. Crop output per hectare is found to be Rs 20,350 at the national level. The low poverty semi-arid temperate zone has the highest value of output at Rs 28,284 ha^{-1} and the SAT zone has the lowest value of output at Rs 16,417 ha^{-1}. The humid zone has significantly higher productivity of land than the SAT zone with per hectare output of Rs 23,999. It is found that areas with high irrigation have distinctly high value of crop output in all the zones. The medium and low irrigation parts in the semi-arid temperate, SAT and arid zones have significantly low value of output as compared to their counterparts in the humid zone. The results indicate that medium and low irrigation areas in the semi-arid temperate, SAT and arid zones deserve attention for accelerating agricultural development.

When the value of crop output per capita is considered, the ranking of the zones is completely altered. The high poverty in the humid zone despite agricultural development is due to high pressure of population on cultivated land. While the density of population per hectare of cultivated land is four in the tropical zone, it is more than seven in the humid and temperate zones. Thus, poverty is same in both humid and temperate zones, despite significant difference in the level of agricultural development. While per hectare output is at a moderate level, per capita output is the lowest in the humid zone at about Rs 3100, as against Rs 4100 in the temperate and tropical zones. The correlation coefficient between poverty incidence and agricultural output per hectare has negative sign as expected and is statistically significant in all the zones (Table 3.25). Livestock output per capita also has a strong negative association with poverty. But the correlation between poverty and per capita crop output is not very strong. Fertilizer use per hectare is highest in the semi-arid temperate zone followed by the SAT and humid zones. It is found that in highly irrigated areas in all regions, especially in the humid and SAT zones, the use of fertilizer is very high. The SAT zone has a very high level of fertilizer use in relation to its crop output per hectare.

The correlation coefficients of poverty indices with crop output per hectare have expected negative signs and are statistically significant in all the zones and for different irrigation levels within a zone (Table 3.25). Crop output per capita has negative association with poverty indices in all the zones, but the correlation coefficients are significant only in a few agro-ecological zones. For instance, in the humid zone all the correlations are statistically insignificant. Livestock output per capita also has the expected negative sign in all the zones, indicating that livestock output is an important factor influencing poverty incidence. The correlations are as strong as in the case of crop output per hectare. Market density has a negative correlation with poverty indices in humid and semi-arid temperate zones. The other two zones do not indicate any significant association between poverty and density of markets. The density of roads has the weakest association with the incidence of poverty. Combining all the infrastructure components, an index of infrastructure is developed and it is found to have a significant negative association with poverty only in a few zones.

3.5.2 Agricultural wages, cereal prices and rural poverty

Agricultural wages and cereal prices exert strong influence on the incidence of rural poverty. The price of cereals is the highest in the humid zone and within the zone the low irrigated areas have a distinctly higher price (Table 3.11). The high and medium irrigation parts of the SAT zone also exhibit high price of cereals. Thus, cereal price is higher in the entire humid zone and parts of the SAT zone. Though agricultural wage rates are high in the humid zone, cereal price is also the highest in this zone. The SAT zone has low wage rate and high cereal price. Thus, high cereal price

combined with low agricultural wage rates are contributing to high poverty in the humid and SAT zones. The price of cereals is relatively low in the semi-arid temperate zone, but agricultural wages are the highest in this zone. Thus, the low incidence of poverty in the semi-arid temperate zone appears to have been contributed by high agricultural wages (Green Revolution zone, high surplus, low prices, and higher rural employment) and low prices of cereals (Table 3.11). Most of the correlations with cereal price are not significant and have no expected sign (Table 3.25). On the other hand, the correlations with agricultural wages have the expected negative sign and most of them are also statistically significant.

3.5.3 Poverty and food composition

Calorie intake levels are very low in the SAT zones followed by the humid zones (Table 3.10). The share of cereals in the total calories intake is the highest in the humid zone followed by the SAT zone. Conversely, the proportion of calories obtained from non-cereals is relatively high in the arid and semi-arid temperate zones. In a relative sense, pulse consumption is high in the SAT and semi-arid temperate zones, while milk consumption is higher in arid and semi-arid temperate zones. Humid and semi-arid temperate zones report a relatively high consumption of vegetables. It is significant to note that non-vegetarian sources such as meat, fish and egg provide only 0.8% of the total calories. The consumption of these items is relatively high in the humid zone as compared to all other zones. Monthly per capita food expenditure is the highest in arid zone followed by the humid zone. The proportion of monthly per capita food expenditure to the total monthly per capita expenditure exceeds 60% in these two zones (Table 3.11). Interestingly, the unit price of cereals is also relatively high in these two zones. Equality in consumer expenditure as measured by the ratio of the expenditure of the bottom quintile to that of the top quintile is better in arid zone when compared to the other three zones.

3.5.4 Poverty and work participation rates

Work participation rates have been computed for children and adults separately. Child participation rates are computed for the 6-14 age group (Table 3.13). While work participation rates vary significantly across the zones, their association with the incidence of poverty is weak. The SAT zone with the highest incidence of poverty has the highest work participation rate and the arid zone with the lowest incidence also has high participation rate. On the other hand, the humid zone has low participation rate despite its high incidence of poverty. Female participation rates vary significantly across the zones (Table 3.14). The SAT zone has the highest female participation rate at 61.1% and the humid zone has moderate female participation rate at 41.9%. Thus, one of the high poverty zones has high participation rate and one of the low poverty zones also has high participation rate. Similar is the case with child participation rates. It is striking to find that the arid zone has the highest incidence of child labor at 17.6% and girls are contributing for this high incidence. While the participation rate for boys is 14.3%, the corresponding rate for girls is 21.4%. The SAT zone also has a very high incidence of child labor at 12.9%. On the other hand, the semi-arid temperate zone has the lowest incidence at 5.7%. These differences in the child work participation rates are clearly reflected in their participation in education. The proportion of children attending educational institutions is the lowest in the arid zone followed by the SAT zone (Table 3.15). For instance, only 46.2% of the girls in the 6-14 age group are attending school while 61.6% are attending school in the semi-arid temperate zone. These differences are also reflected in the primary and secondary education completion rates (Table 3.16). Only 37.2% of girls in the 12-14 age group completed primary education in the arid zone as compared to 55.3% in the semi-arid temperate zone. The completion rates of secondary education are abysmally low in all the zones and the differences across zones are narrowed down at this level. Unemployment rates computed on the basis of daily status in a week are the highest in the humid zone followed by the SAT zone (Table 3.14). Semi-arid temperate zone has the lowest incidence of only 4.3%. Thus, unemployment is higher in high poverty areas as compared to the other areas. The dependency ratios are highest in the semi-arid temperate zone and lowest in the SAT zone (Table 3.17). Humid and arid zones have intermediate position with respect to the dependency ratios.

3.5.5 Poverty and Public Distribution System (PDS)

The Public Distribution System (PDS) is expected to supply food grains and other commodities to the poorer consumers at a subsidized price. Our analysis revealed that only 12.4% of rice and wheat, 34.8% of sugar and 76.5% of kerosene purchased by the rural

people are drawn from the PDS (Table 3.19). Purchases from the PDS are the lowest in the semi-arid temperate zone because the differences between PDS and open market prices are the lowest in this zone in the case of rice, wheat and sugar (Table 3.20). This zone also has low incidence of poverty. In the remaining three zones, the share of PDS is about 15%. Though poverty is low in the arid zone, the demand for commodities supplied through PDS is high because of the low production of rice and wheat. To get the proper indication of coverage, the participation of the poor and the leakage through supply to the non-poor have to be examined. The gap between the PDS price and the open market price determines the demand for the PDS commodities. Accessibility to the PDS is reflected in the purchases of the poor and the non-poor. The low purchase in the semi-arid temperate zone is due to lack of demand. This is partly because of small gap between the PDS price and the open market price. The PDS price is lower than the market price by only 30% (Table 3.20). Nearly two-thirds of the rural poor in the semi-arid temperate zone are not purchasing from the PDS. There is also not much leakage in the supply of grains through PDS in this zone as less than 5% of the non-poor are getting cereals under the PDS. On the other hand, about one-half of the rural poor in the humid zone are not buying rice and wheat from the PDS. In contrast, two-thirds of the rural poor in the SAT and arid zones are purchasing rice and wheat from the PDS (Table 3.21). Except in the semi-arid temperate zone, considerable sections of non-poor were also found to be purchasing rice and wheat from the PDS.

3.5.6 Coverage of anti-poverty programs

Only 5.3% of the sample households were found to have taken advantage of Integrated Rural Development Programmes sponsored by the government during a period of five years (Table 3.22). The participation in employment programs of the government was even lower at 2.8% . These statistics indicate that only 25% and 13% of the rural poor have access to self-employment and wage-employment programs of the government, respectively. The rural poor from the humid zones had a higher coverage under the anti-poverty programs than those in other zones. The rural poor from the SAT and arid zones have relatively low utilization of the anti-poverty programs.

3.5.7 Human Development Index (HDI)

Since poverty is multidimensional in nature, one has to go beyond the measure of poverty estimated based on the household consumption expenditures. Indices are constructed for standard of living, knowledge, and health for each zone. An index of human development is computed as a simple average of the three indices. In the foregoing discussion, we observed that the humid and SAT zones have relatively high levels of poverty when compared to the other two zones. The same results are reflected in the standard of living indices. Arid and semi-arid temperate zones have markedly high levels of standard of living, but the results pertaining to knowledge and health indices do not reflect the same trends (Table 3.24). Knowledge index seems to be correlated more with the level of irrigation than with the agro-climatic zones. But, in general, knowledge indices are higher for humid and semi-arid temperate zones and are lower for arid zones, with the SAT zones occupying a middle position. Among the humid sub-zones, both the high and low irrigated areas have much higher knowledge indices than the medium irrigated zones. The same trend was also noted in case of the SAT sub-zones. These results suggest that knowledge indices are not necessarily correlated with the standard of living indices. Arid zone, which had the lowest levels of poverty, also had very low levels of knowledge indices. Health indices are showing much more diverse results. In the case of the semi-arid temperate and arid zones, high-irrigated areas had better health indices and low and medium irrigated areas had relatively lower levels. But in the case of the SAT and humid zones, health indices had the highest values for low-irrigated areas. High-irrigated areas of these two zones occupied the middle positions with respect to health indices and medium irrigated areas reported much lower values for health indices. While the low-irrigated areas of SAT reported highest level of poverty, they showed highest measure of health index. There is no correspondence between standard of living, on one hand, and other social indicators such as knowledge and health on the other.

The HDI results show no clear trend or pattern that can be correlated with either the agroclimatic zone or the irrigation level. Arid high-irrigation zone has the highest level of human development index and the humid medium irrigation zone has the lowest measure. Medium irrigation zone areas seem to be reporting lowest levels of HDI in case of all agro-climatic zones. High irrigation areas in all the zones

and low irrigation areas of the humid and SAT zones reported relatively high levels of HDI.

3.6 Key factors influencing poverty and crop productivity

3.6.1 Determinants of Poverty

Though incidence of poverty is relatively the same in the humid and SAT zones, causes are likely to be different and so also the policy interventions required for reduction of poverty. In order to find the causes of poverty an econometric model was estimated for each zone using the cross-section data for the districts. This analysis is confined to 410 districts because of data limitations in the case of the other districts. Estimates of poverty, unemployment rates, work participation rates, wages rates, cereal prices and literacy rate are derived from the 55th round NSS data on consumer expenditure and employment and unemployment. Data for the remaining variables are drawn from the district level database of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) which is based on the Ministry of Agriculture statistics and 2001 Population Census. The value of crop output is estimated for 25 major crops and livestock output including the value of milk, meat, eggs and wool. The specification of the model for each zone is made on the basis of the expected relationships between poverty and hypothesized casual factors including agricultural and livestock output, wage rates, cereal prices, and infrastructure index. The econometric specification used is in the logarithmic functional form. The results of the estimated equations are shown in Table 3.26.

The model for all India contains all the important determinants of poverty, viz, agricultural output per hectare, livestock output per hectare, agricultural and nonagricultural wage rates and unemployment rate. As we could see from the results of the regression analysis presented in Table 3.26, growth of crop output, reduction of unemployment and growth of wages contribute independently to poverty reduction. The reduction of poverty with agricultural growth in West Bengal, Rajasthan and Madhya Pradesh and reduction of poverty in Orissa without much agricultural growth between 1973-74 and 1993-94 has led to a controversy regarding the association between agricultural growth and rural poverty (Mehta and Shah 2003). Gaiha (1989) argues that growth alone is not sufficient for poverty reduction. Employment generation, effective PDS and better government are also needed to alleviate poverty. The effect of wage increase is much stronger than that of productivity increase. An increase in the agricultural wage rate by 10% reduces rural poverty by 1.19 percentage points and a similar increase in non-agricultural wage rate reduces rural poverty by only 0.59 percentage points. On the other hand, a 10% improvement in the crop productivity reduces the incidence of poverty by 0.29 percentage points only. Within agriculture, livestock production has a stronger effect on poverty than crop production. An increase in the per capita livestock output by 10% reduces rural poverty by 0.66 percentage points. Though reduction in unemployment reduces poverty, the effect is not very high. The effect of literacy is relatively low indicating that its direct effect on poverty reduction may be weak, although its indirect effect through occupational mobility can be considerable.

The determinants of poverty differ significantly across zones. Livestock production turned out to be important only in low irrigated areas in the humid zone. These areas may be better suited to livestock production than others. However, if livestock production is further disaggregated into small ruminant and dairy production, the former may turn out to be important in SAT. Between per capita output and per hectare output, the latter is found to be important only in the arid zone. This result should be interpreted carefully. Output *per* capita rises only when land productivity rises, given the constraints for area expansion and the growth in rural population. Because of the favorable land-man ratio in the arid zone, growth in output per hectare is enough to reduce poverty.

The share of agricultural labor in total workers has a strong impact on poverty in all the zones. For any level of agricultural development, a higher proportion of agricultural labor leads to a higher incidence of poverty. But the semi-arid temperate and arid zones with low incidence of poverty are more sensitive to the share of agricultural labor than other zones. Any intervention in poverty alleviation should have this group as the clearly identified target group. Increase in the share of non-agricultural labor has a significant effect on poverty in the semi-arid temperate and SAT zones. The impact is stronger in the SAT with medium irrigation than in the SAT with low irrigation. It appears that agricultural development is a necessary condition for the development of non-farm activity.

3.6.2 Determinants of Crop Productivity

Improvement in the value of crop output per hectare depends on improvement in crop yields, increase in the price of output, and shift in the crop pattern towards high value crops. Assuming that the cropping pattern is the result of constrained optimization by the farmers, the scope for improvement in the value of output per hectare is only through improvement of yield. Yield levels are influenced by several factors among which irrigation ratio, fertilizer use, market density and literacy rate are important. Except irrigation ratio and literacy rate, all other variables and the dependent variable are introduced in logarithmic form. The equations are estimated for the four broad zones and all India.

The elasticity of output with respect to fertilizer use is 0.12 at the national level and it is the highest in the semi-arid temperate and SAT zones (Table 3.27). The elasticity for the semi-arid temperate zone is thrice and the elasticity in SAT is twice that of the all India average. The humid zone has very low fertilizer elasticity at 0.08. Irrigation ratio has significant impact in all the zones, but the effect is again negligible in the humid zone. Market density has a positive impact on the value of agricultural output only in the SAT zone. Density of markets is so high in the semi-arid temperate zone that the coefficient turned out to be negative. The SAT zone requires policy interventions through irrigation development, increase in the fertilizer use and development of markets. The humid zone has a greater potential for the development of livestock sector than agriculture.

3.7 Major findings related to SAT

Having analyzed the problems of rural poverty across the four broad agro-ecological zones in a comparative perspective, we focus on the structure and development of SAT. Poverty is more concentrated in this zone as compared to others. While its share in rural population is 36%, its share in rural poor is 41.0%. The region has a high concentration of the weaker sections - 50% of the ST and 40% of the SC population of rural India belong to this region. It is found that the SAT regions have a high incidence of poverty (24.3%) and the highest incidence of poverty was noted in the low irrigation areas of SAT. The low irrigated areas in the SAT have a high concentration of ST among whom the incidence of poverty is found to be the highest.

It is observed that the SAT zone is agriculturally backward and has moderate pressure on land, which results in relatively low value of crop output per hectare. Also, high cereal price combined with low agricultural wage rates are contributing to high poverty in the SAT zones. Calorie intake levels are very low and the share of cereals in the total calorie intake is very high in the SAT zone. In a relative sense, pulse consumption is high in the SAT and semi-arid temperate zones, while milk consumption is higher in arid and semi-arid temperate zones.

SAT has a high incidence of work participation along with a high incidence of female participation and child labor. The proportion of children attending educational institutions is the lowest in the arid zone followed by the SAT zone. Unemployment rates computed on the basis of daily status in a week are the highest in the humid zone followed by the SAT zone. The utilization of the anti-poverty programs by the rural poor is less in the SAT and arid zones than in the other zones.

The results of regression show that while poverty is caused by several reasons, low agricultural wages, high price of cereals, high landlessness and high unemployment stand out as important. The low-irrigated areas in the SAT and arid zones may be suitable for small ruminant production than dairying. The SAT zone requires development of markets also. It should be noted that the semi-arid temperate zone has excessive development of markets whereas the SAT zone is lagging in market infrastructure.

3.8 Synthesis of results and policy implications

The analysis throws light on three important questions: (1) Who are the poor and where are they concentrated? (2) Why are they poor? (3) What strategies are needed to lift them from poverty? Our analyses revealed that the humid and SAT zones have the highest number of rural population and together account for 72% of India's rural population. Incidence of poverty is high among the ST, the SC and the agricultural laborers. While the ST are concentrated in the low-irrigated areas of the humid and SAT, the SC and agricultural laborers are evenly spread across all the four zones. However, high-irrigated areas have higher concentrations of the SC as well as agricultural laborers. While poverty is caused by several reasons, low agricultural wages, high price of cereals, high landlessness and high unemployment stand out as important. Their importance differs across zones. In

the high poverty humid zone, agricultural wage rates are high, but the cereal price is the highest among all the zones, nullifying the advantage of high agricultural wage. In the high poverty SAT zone, agricultural wage rates are low and cereal prices are high. The leakage in the PDS is also high in these two high poverty zones. While 40 to 50% of the poor are unable to buy rice and wheat from the PDS, more than 35% of the non-poor people buy cereals from the PDS.

The two high poverty zones, ie, humid and SAT, differ in the level of agricultural development. The humid zone is agriculturally prosperous with a high value of crop output per hectare. But the pressure of population on land is very high. The SAT zone is agriculturally backward with a very low value of crop output per hectare. Because of the moderate pressure of population on land, value of crop output per capita is relatively low as compared to the other zones. Agriculture in the medium and low-irrigated areas in the semi-arid temperate as well as the SAT zones has to be strengthened. Improvement in agricultural wages has a significant impact on rural poverty in the SAT and humid zones. For every 10% increase in rural wage rate, poverty is likely to decline by 1.17 points in the former and 0.77 percentage points in the latter. A reduction in the proportion of agricultural labor and increase in the proportion of non-agricultural labor is also expected to have a significant impact on poverty in these two zones. The low and medium-irrigated SAT zone will gain in poverty reduction if per capita crop output increases. The response of the low-irrigated humid areas to agricultural growth in terms of poverty reduction is not significant. But the response to livestock development is quite high. The agro-ecological conditions of this zone are quite suitable for livestock production. The low-irrigated areas in the SAT and arid zones may be suitable for small ruminant production than dairying. The semi-arid temperate zone requires rural diversification and planned migration to reduce the pressure of population on land. The elasticity of crop output for fertilizer use is higher in SAT than in the other two zones. The SAT zone requires development of markets also. It should be noted that the semi-arid temperate zone has excessive development of markets whereas the SAT zone is lagging in market infrastructure.

4. Major Livelihood Strategies and Current Interventions in SAT Agriculture

4.1 Introduction

Given the Sustainable Livelihoods Approach (SLA) and framework presented in Chapter 2 and the high incidence and severity of poverty in SAT and its determinants as presented and analyzed in Chapter 3, we first examine in this chapter the major livelihood strategies of the SAT dwellers, and their strategies for coping with natural or man-made shocks and threats to their livelihoods. Thereafter, we critically evaluate the effectiveness of current public interventions aimed at directly or indirectly reducing rural poverty and improving the livelihoods of the SAT dwellers and the lessons of their experience that might be useful for designing future development and research strategies for SAT

4.2 Livelihood portfolios and changes over time

Our analysis in chapter 3 has established that the proportion of rural poor is higher in the Semi-Arid Tropics (SAT) region of India when compared with the same in the arid, semi-arid temperate and humid regions. We have micro-level evidence from the Village Level Studies (VLS) to substantiate the macro-level findings. Six villages, two from Mahaboobnagar district in Andhra Pradesh and two each from Akola and Solapur districts in Maharashtra, were intensively studied by the Social Science group of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) during the period, 1975-76 to 1984-85. The VLS were revived in 2002 and survey method was used to collect data from the original sample households in these six villages. Four more watershed villages in Andhra Pradesh were covered by VLS surveys in 2002. Analysis of income sources in these ten villages helped identify important sources of livelihood in the SAT villages. The estimates of average annual net household incomes from 10 SAT villages are presented in Table 4.1, which also contains information on the percentage of households with less than Rs 20,000 annual net household income (poverty line) along with the comparisons with the National Sample Survey (NSS) estimates of the poverty in the relevant districts.

There is a considerable variation in the average annual net household income between the villages, with Kanzara reporting highest income of Rs 60,687 and Isthalapuram reporting lowest income of Rs 23,864. Same is the case with the percentage of poor households with annual income less than

Table 4.1. Net household income levels and percentage of the poor in the SAT villages and relevant districts

S.No	Name of the village (District)	Average annual household income (Rs)	% of households with annual income <Rs 20,000	Average percentage of the poor in the districts	
				VLS estimate	NSS estimate
1	Kanzara (Akola)	60687	6.00	17.00	21.80
2	Kinkheda (Akola)	36606	28.00		
3	Shirapur (Solapur)	51522	23.00	26.50	11.40
4	Kalman (Solapur)	43943	30.00		
5	Aurepalle (Mahaboobnagar)	31561	33.00		
6	Dokur (Mahaboobnagar)	36757	28.00	32.00	37.00
7	Sripuram (Mahaboobnagar)	36084	35.00		
8	Karivemula (Kurnool)	26081	55.00	55.00	31.70
9	Nemmikkal (Nalgonda)	31796	45.00	50.50	17.80
10	Isthlapuram (Nalgonda)	23864	56.00		
	Average (SAT)	37890	33.90	36.2	23.94

Source: ICRISAT VLS survey, 2001-2002

Rs 20,000, which ranged between 6% in Kanzara and 56% in Isthalapuram. The average annual net household income in the 10 SAT villages was Rs 37,890 and the average percentage of poor households worked out to be 33.90. In the last two columns, the average percentage of poor households in the five study districts were compared with the corresponding NSS estimates. The percentage of poor was found to be even higher in VLS sample (36.20%) than in NSS sample (23.94%). Part of the difference could be due to the fact that whereas the VLS estimates are based on income, the NSS estimates are based on consumption expenditure. The major sources of average annual net household income in the SAT villages are furnished in Table 4.2.

Farm income accounted for 53.28% of the average annual net household income in the VLS villages. But the variation between villages was considerable. In the Akola villages with assured rainfall, farm income contributed more than 70% of the income, while in the Dokur village, which was experiencing a persistent drought for nearly a decade, it contributed a mere 25%. On an average, non-farm income contributed 27% of the total income. But its share was greater than one-third in the villages located nearer to urban centers, while its share was lower in the remotely located villages. Caste occupations and migration were more important sources of income in villages of Andhra Pradesh than in villages of Maharashtra. Migration and remittances contributed a significant share of income in the villages where farm incomes were lower.

Table 4.3 presents the changes in the structure of incomes between 1975-78 (average) and 2001-2002 in the six VLS villages. The share of crop income fell from 40 to 27% over the 25-year period. The share of labor income also dropped from 41 to 21%. There was a marginal drop in the share of livestock income from 11 to 10%. Non-farm income registered a growth virtually in all the villages, registering, on an average, an increase in its share from 4 to 23%. Caste occupations and migration are contributing substantial amounts to income in the Mahaboobnagar villages.

Due to water scarcity and land degradation, the productivity and profitability of crops in the SAT villages are showing a decline. The Akola villages are an exception to this. The share of crops in the total net household income has either remained constant or has improved. Income shares of labor and livestock declined in these villages, while that of non-farm income increased. In the Mahaboobnagar villages, there was a drop in the share of crops in the total net household income. This drop is quite sharp in the case of Dokur village. The share of livestock in net household income fell in Aurepalle, while it increased sharply in Dokur. In both these villages, the share of labor income decreased. In Solapur villages also, the share of crops in the total net household income declined. Same was the case with the labor income. The share of livestock in the net household income remained unchanged in Shirapur village, while it increased substantially in Kalman village. In both the villages, the share of non-farm income increased substantially. Caste occupations and outmigration did not contribute much to the net incomes of households in Maharashtra villages. The total net income of the households did increase in all the villages. The lowest increase was noticed in Dokur, where it increased by 1.92 times (or a 92% increase) over the income level in 1975-78 converted to present value using consumer

Table 4.2. Sources of annual household income in SAT villages (in Rs).

S.No	Name of village	Sources of income					
		Farm	Non-farm	Caste occupation	Migration	Other sources	Total
1	Kanzara	44737 (73.72)	8584 (14.15)	2364 (3.90)	942 (1.55)	4057 (6.69)	60686(100)
2	Kinkheda	26322(71.91)	7418 (20.27)	656 (1.79)	562 (1.54)	1646 (4.50)	36606 (100)
3	Shirapur	27314(53.02)	18026 (34.99)	739 (1.44)	461 (0.90)	4980 (9.67)	51591 (100)
4	Kalman	19832(45.13)	18795 (42.77)	1168 (2.66)	100 (0.23)	4045 (9.21)	43942 (100)
5	Aurepalle	12783(41.00)	5983 (19.00)	9023 (29.00)	2396 (8.00)	1376 (4.00)	31561 (100)
6	Dokur	9019(25.00)	10156 (28.00)	4793(13.00)	7491 (20.00)	5298(14.00)	36757 (100)
7	Sripuram	16663(46.00)	11275 (31.00)	1181 (3.00)	2703 (7.00)	4262(12.00)	36084(100)
8	Karivemula	14659(56.00)	4535 (17.00)	1572 (6.00)	945 (4.00)	4370(17.00)	26081 (100)
9	Nemmikkal	16581 (52.00)	7414 (23.00)	3212(10.00)	1621 (5.00)	2968 (9.00)	31796(100)
10	Isthalapuram	13981 (58.59)	9200 (38.55)	600 (2.51)	83 (0.35)	0 (0.00)	23864(100)
	Average	20189(53.28)	10138 (26.76)	2531 (6.68)	1730 (4.57)	3300 (8.71)	37890(100)

Figures in the parentheses represent percentages to the row total
Source: ICRISAT VLS survey, 2001-2002

Table 4.3. Changes over time in the shares of different sources (%) and levels (Rs) of household net income in the VLS villages.

Sources of income	Aurepalle		Dokur		Shirapur		Kalman		Kanzara		Kinkheda		Average of six villages	
	1975-78	2001-02	1975-78	2001-02	1975-78	2001-02	1975-78	2001-02	1975-78	2001-02	1975-78	2001-02	1975-78	2001-02
Crops	29.80	15.00	46.10	3.00	33.70	22.80	46.00	26.40	43.90	52.00	43.40	40.00	40.48	26.53
Labor	32.80	24.00	46.30	14.00	42.60	18.80	42.10	18.00	38.70	21.80	40.80	30.00	40.55	21.10
Livestock	25.50	9.00	2.00	18.00	15.00	15.70	0.80	6.50	9.00	5.70	13.10	2.10	10.90	9.50
Non-farm	11.60	13.00	1.20	24.00	0.20	31.80	4.10	37.50	2.40	10.40	5.30	20.10	4.13	22.80
Caste occp.	0.00	28.00	0.00	6.00	0.20	0.30	0.00	2.20	0.00	1.90	0.00	1.80	0.03	6.40
Out-migration	0.00	8.00	0.00	20.00	0.00	0.90	0.00	0.20	0.00	1.60	0.00	1.50	0.00	5.37
Others	0.30	4.00	4.40	15.00	8.50	9.70	7.00	9.20	6.00	6.60	2.60	4.50	4.80	8.17
	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total	2361	31561	2967	36757	2995	51390	1942	43943	3856	60687	2522	36606	2774	43491
	(15205)		(19107)		(19288)		(12506)		(24833)		(16242)		(17865)	

Figures in the parentheses in the last row represent the equivalent current values of base year incomes using wholesale price index at the all India level.
Source: ICRISAT VLS surveys.

price index for agricultural laborers. Highest increase was noted in the case of Kalman where the corresponding increase was by 2.51 times (or a 151% increase over the base level).

Although income is an important indicator of welfare, consumption expenditure also reflects the standard of living of people equally well. In case of rural poor, expenditure on food grains accounts for a significant part of consumption expenditure. Table 4.4 contains data on consumption of food grains by the sample households in the VLS villages. On average, a sample household consumed 799 kg of cereals and 61 kg of pulses per year. In per capita terms, 153 kg of cereals and 12 kg of pulses were consumed during 2001-2002. The per capita food grain consumption of 165 kg falls short of recommended consumption of 180 kg per person per year. Besides the lower average level of consumption, there is a considerable inequality in the consumption of food grains across villages and income groups. These estimates of consumption lend support to the existence of considerable undernutrition in the SAT areas.

Table 4.5 summarizes the data on consumption expenditure of the sample households and its classification into food grains, other food and non-food categories. The average annual consumption expenditure per capita was Rs 6510, which works out to only $0.39 per day per person. Considering the fact that World Bank considers a standard of 1 $ per day per person for drawing the poverty line, most of the sample households in the SAT villages would obviously fall in the category of poor. Expenditures on food grains roughly accounted for one-fourth of the total consumption expenditure while another one-fourth was spent on other food items. The remaining half of the expenditure was spent on non-food items. Thus the analysis of consumption expenditure data showed that there is considerable poverty as well as undernutrition among the sample households of SAT.

Table 4.4. Average annual consumption of food grains by the sample households in VLS villages, 2001-2002 survey (kg).

S.No	Village	Average family size	Cereals	Pulses	Total food grains
1	Aurepalle	4.2	747	56	803
2	Dokur	5.4	742	50	792
3	Sripuram	5.6	1039	45	1084
4	Kaivemula	5.6	1081	59	1140
5	Nemmikkal	5.1	1028	63	1091
6	Isthalapuram	4.5	852	37	889
7	Kanzara	5.3	645	108	753
8	Kinkheda	4.6	554	95	649
9	Shirapur	5.5	630	41	671
10	Kalman	5.7	668	62	730
Average of VLS villages		5.2	799	61	860
Per capita			153	12	165

Source: ICRISAT VLS Studies

Table 4.5. Average annual consumption expenditure of the sample households in the VLS villages (Rs).

		Expenditures on				
S.No	Village	Food grains	Other food items	Total food	Non food	Total
1	Aurepalle	7500	6948	14448	10288	24736
2	Dokur	8063	7042	15105	9429	24534
3	Sripuram	10798	6596	17394	15826	33203
4	Kaivemula	10578	5960	16538	11720	28258
5	Nemmikkal	10279	10789	21068	31025	52093
6	Isthalapuram	9373	6856	16229	18789	35018
7	Kanzara	6721	9618	16339	17331	33670
8	Kinkheda	5986	10129	16115	14639	30754
9	Shirapur	5650	11246	16896	19267	36163
10	Kalman	6470	10417	16887	23179	40066
Average of VLS villages		8142	8560	16701	17149	33850
Average per capita annual expenditure		1566	1646	3212	3298	6510

Source: ICRISAT VLS surveys

4.3 Coping strategies adopted by farmers and agricultural laborers

Besides low incomes, the SAT farmers and agricultural laborers face too many uncertainties with respect to their crop yields, prices and incomes. They face droughts quite often and adopt many strategies to cope with the droughts and their consequences. Laxmaiah and Vijayaraghavan (2003) studied the strategies adopted by households in coping with adverse situations, using the data collected from thirty villages each from the states of Andhra Pradesh, Gujarat and Rajasthan during recent drought years. The results are summarized in Table 4.6.

The most common coping strategies in Andhra Pradesh were borrowing cash or food from neighbors, purchase of low cost food items, migration and reduced food consumption. In Gujarat, purchase of low cost food items, borrowing cash/food from neighbors, reduction in food consumption and use of food stocks/money savings were the dominant strategies. In Rajasthan, the strategies were the same as in Gujarat with a slight change in their rankings. This study concluded that the drought-affected people mainly resort to borrowing, draw down of stocks, reduced consumption, shifting to low cost food items and migration to survive the adverse fallout of droughts. The VLS of ICRISAT had a special module on the strategies adopted by the farmers to cope with the adverse effects of droughts in one year and persistent droughts for more than one year. Table 4.7 presents information on the frequency and impacts of droughts and the strategies followed by the farmers to cope with the adverse effects of drought in the villages of Andhra Pradesh.

There is approximately a 52% probability that a drought may occur in the SAT villages of AP. The average shortfall in income because of a drought was 44.2%. About two-thirds of the farmers adopted alternative coping strategies to face the shortfall of income in a drought year. The most common coping strategies when they face a single year drought are borrowing, shifting to non-farm labor work, reduced consumption expenditure and migration.

In the SAT villages of Maharashtra, the drought incidence is less frequent (25% probability) when compared with the same in villages of Andhra Pradesh. The information on drought impacts and farmers' coping strategies are furnished in Table 4.8. The average shortfall in income during a drought year was about 23% in villages of Maharashtra. Only 36% of the sample farmers reported that they were adopting some strategies to cope with the drought. In Solapur villages, farmers participated as laborers in the works carried out under the Employment Guarantee Scheme (EGS). Cutting down expenditures, changing the cropping pattern and reducing the input use were the other measures adopted by the farmers in Solapur villages. Farmers in Akola villages participated in the local labor market during distress, but not in the EGS works. Other coping measures were the same as in Solapur villages with slight difference in emphasis. When farmers face droughts for more than one year, they avail loans to dig more borewells, lease out their lands, shift to non-farm occupations and migrate to distant places for work to meet their family needs. Other strategies of borrowing, reducing expenditures, and sale of animals and gold are also commonly resorted to.

Diversification: Livelihood diversification is an important adaptive strategy in the SAT areas for

Table 4.6. Distribution of families according to adoption of different coping strategies.

		Percent of families adopting in		
S No	Coping Strategies	Andhra Pradesh	Gujarat	Rajasthan
1.	Use of food stocks/money savings	6.4	45.2	39.4
2.	Purchase of low cost food items	61.3	73.3	31.0
3.	Borrow cash/food from neighbors	63.5	63.7	51.4
4.	Gather food from surrounding areas	2.0	2.3	2.8
5.	Seek additional employment	2.7	10.5	12.2
6.	Obtained Government assistance	10.7	8.3	5.1
7.	Reduction in food consumption	23.3	47.3	35.6
8.	Migration	39.1	10.0	8.1
9.	Sell household or business assets to good food or money	12.7	3.8	9.4

Source: Laxmiah and Vijayaraghavan, 2003

Table 4.7. Impacts of droughts on farmers in AP villages and their response to cope with them.

		Mahaboobnagar			Kurnool	Nalgonda		Average
SI No	Parameter/Strategy	Aurepalle	Dokur	Sripuram	Karivemula	Nemmikkal	Isthlapuram	(six villages)
1	No. of drought years in the last 10 years	4.00	6.00	5.00	6.00	5.00	5.00	5.20
2	Average shortfall in income because of drought	44.50	55.70	40.00	55.00	35.00	35.00	44.20
3	Percentage of farmers adopting coping strategies	74.70	88.30	72.50	70.00	47.10	47.10	66.20
4	Percentage of farmers adopting different coping strategies							
4(a)	Shifted to non-farm labor work	30.40	28.30	13.79	33.93	21.21	21.21	24.81
4(b)	Borrowed money	42.90	32.10	60.10	37.50	12.12	12.12	32.81
4(c)	Sold draft animals/land	5.40	9.40	1.79	3.58	6.06	6.06	5.38
4(d)	Shifted to dairy, toddy tapping, etc.	8.90	9.40	3.45	1.78	3.03	3.03	4.93
4(e)	Migrated	3.60	11.30	10.33	12.50	21.21	21.21	13.36
4(f)	Depended on old savings	3.60	3.80	3.80	1.78	0.00	0.00	2.16
4(g)	Reduced consumption expenditure	5.20	5.70	6.90	8.93	36.37	36.37	16.55

Source: 1CR1SAT VLS survey 2001-2002

Table 4.8. Impacts of drought on farmers in Maharashtra villages and their responses to cope with them.

		Solapur		Akola		
SI No	Parameter / Strategy	Shirapur	Kalman	Kanzara	Kinkheda	Average
1	No.of drought years in the last 10 years	3.00	3.00	2.00	2.00	2.50
2	Average shortfall in income because of drought	20.00	21.68	20.00	30.00	22.92
3	Percentage of farmers adopting coping strategies	30.30	72.90	15.40	25.00	35.90
4	Percentage of farmers adopting different coping strategies					
4(a)	Cutting down expenditure	11.80	11.80	50.00	33.33	26.73
4(b)	Participating in labor market	0.00	0.00	16.67	50.00	16.67
4(c)	Changes in cropping pattern	9.80	9.80	16.67	0.00	9.07
4(d)	Reducing the input use	3.90	3.90	16.67	16.67	10.28
4(e)	Participation in employment guarantee scheme	74.50	74.50	0.00	0.00	37.25

Source: ICRISAT VLS survey 2001-2002.

raising incomes and reducing risk. Ellis (2000) defines livelihood diversification as "the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standard of living". Diversification can mean two things although not necessarily mutually exclusive; the diversification of income sources including farm and non-farm sources and the diversification of rural livelihoods away from farming into the non-farm sector. The consensus so far is that the poorest and the richest are the least diversified but for very different reasons: the poor have fewer *options* and are constrained whereas the rich can afford to specialize in a high return activity. Simplistic analyses have led to policy responses, which seek to expand higher-return non-farm enterprises. But in-depth analyses have shown that non-farm activities at the lower end may be erratic yielding low return because the poor lack the assets to engage in higher return activities (Start, Deshingkar and Farrington, Barrett et al., 2001; Reardon et al., 2000). In addition to this, several non-farm activities are closely dependent on agriculture. Therefore investing scarce resources in the creation of non-farm options to the detriment of improving agricultural productivity may have negative consequences for the poor.

At the aggregate level, agro-ecological, socio-economic, technological and institutional factors influence spatial patterns of diversification. These are broadly classified into demand side and supply side factors. Demand *side* factors include per capita income, urbanization, tastes, and preferences, which influence demand for diversified commodities. Major supply related factors influencing pattern of diversification are rainfall, technology (irrigation, fertilizer, High Yielding Variety (HYV) area, tractorization, improved breeds of livestock and poultry), land area available for livestock production, scale of production and infrastructure availability such as roads and markets.

As a matter of fact, agriculture in the SAT is diversifying at a rapid rate. Between 1980-82 and 1996-98, the share of cereals in total value of crop production declined from 51 to 40%, while the share of oilseeds increased from 13 to 21%, and fruits and vegetables from 14 to 17%. During the same period, the share of crops in total value of agricultural production declined from 84 to 80% but the share of livestock products increased from 16 to 19%. The livestock sector has also been growing faster at 4.5% per annum compared to 3.3% for the crop sector. In recent years the share of high value commodities (HVCs) such as milk, meat, fruits and vegetables in total agricultural production of the SAT is increasing mainly driven by demand side factors (Parthasarathy Rao et al 2002) (see also box 4.1).

Their shares are higher than those for cereals, pulses and oilseeds. In 1980-82, these commodities accounted for 28% of total value of agricultural production (at 1980 prices) and their share has now increased to 33% in 1997-98. Small farmers are the major beneficiaries of the growing demand for these crops. However, there is a need for vertical integration of markets, by eliminating the intermediaries to increase the producer's share in the consumer rupee.

At this stage in the process of agricultural development in SAT, diversification to high value crops such as dryland horticultural crops and tree-based farming systems seems to be a natural choice (Pareek 1999; Bhagmal and Roy 1999; Korwar 1999). Diversification to horticulture can reduce risks, improve profitability of cropping systems and ensure greater nutritional security while the tree-based farming systems can reduce pressure on forest for meeting fuel and fodder requirements of the growing population and in that sense, it improves sustainability. Generally, the production of horticultural crops is thinly spread throughout the SAT but some pockets of concentration do exist and offer potential for further development. However, any horticulture development program must be accompanied by the creation of markets, both in terms of physical infrastructure and consumer demand. Any attempt to increase agricultural production and more particularly horticultural production without market development is bound to fail.

Some new thinking is leading to emergence of agro-forestry as a means of improving the productivity and profitability of less productive and degraded lands. Agro-forestry means growing trees on farms to improve livelihoods and protect the environment. Such agro-forestry systems are important to conserve the top soil and its moisture content required for success of any cropping system. If successfully adopted, this alternative may prove relatively more attractive from the viewpoint of meeting fuel and fodder requirements of growing population, which continues to remain dependent on natural forests and vegetation.

4.4 Current interventions in SAT agriculture and their impacts

As we stated in Chapter 1, India has a long history, perhaps the longest in the world, of government intervention in dryland agriculture with a view to

Box 4.1. Livelihoods diversification - forward and backward linkages

Diversification was a strategy taken up by landless households and by small, medium and large fanners in the villages of Aurepalle and Dokur in Andhra Pradesh, Those with large landholdings and productive assets were not immune to the risks faced in agriculture. In fact, there was only a limited evidence of diversification enabling households in Aurepalle and Dokur to accumulate wealth and assets in significant measures. Those who experienced an erosion of income and assets were then forced into the non-farm sector because there were no opportunities for them in agriculture, except perhaps as very low-paid regular farm servants. The investments made by others in irrigation and machinery, or the benefits accruing to people who received land under distribution programmes offered a life-line to many households in the context of drought and crop failure. Whilst some of the diversification strategies within and outside agriculture appear to have increased incomes in real terms in the villages, diversification strategies are not themselves free of risk and, in the prevailing agro-economic climate, often offered little more than an opportunity to cope and mitigate risk or to tread water and hold on to productive assets for the future. The findings beg an important question about the process of diversification in Aurepalle and Dokur and in the semi-arid tropics of India more generally. Whilst both villages faced drought and a subsequent dearth of water for irrigation, it was not clear whether years of drought, and only average rainfall in intervening years, had brought about short-term or intermediate coping strategies or a more meaningful and long-term change in the livelihood strategies of households. Given that very few households accumulated significant wealth through diversification, it may well be that, if future rainfall is both plentiful and timely, then there will be a return to an overwhelming dependence on agriculture and agricultural labour, and a parallel decline in migrant labour and other non-farm activities. However, even if there is a will to return to agriculture when improved rainfall conditions prevail, it also remains to be seen whether households have, during the drought, disposed off too many of their agricultural assets to make a serious return to farming. Similarly, whilst in Aurepalle, population density declined between 1989 and 2001, population pressure in Dokur continues to increase. The population of both the villages increased between 1975 and 2001. This also has implications for the future of agriculture since a continued rise in population diminishes the possibility of households gaining a livelihood from cultivation. The diversification process, coupled with uncertainty over availability of agricultural assets in the future, also raises important policy questions. Above all, there remains a challenge for the structure in which government policy is made and state interventions are carried out. Whilst policy and interventions are implemented largely along sectoral lines, household livelihoods are highly diverse. How might the linkages between farm and non-farm livelihoods be exploited within existing policy channels to help generate new sources of livelihood? One appropriate strategy here might be to encourage forward and backward linkages to agriculture by supporting enterprises that either enable better agricultural production (for example village repair services for agricultural machinery and implements) or the process of adding value to agricultural production before it leaves the village (for example milling, food processing, packaging and transportation).

Source: Deb et al. 2002

increase and stabilize crop yields. A few of those interventions were listed there.

The Government of India (GOI) have launched several programs from time to time to restore, conserve and enhance the land and water resources in the country; to alleviate rural poverty and unemployment; to improve the livelihoods of the rural poor; and to improve the basic infrastructure. These programs could broadly be classified into the following categories:

- Natural Resources Development and Management
- Human Resources Development
- Agricultural and Livestock Development
- Wage Paid Employment Generating Schemes
- Self-Employment Schemes

A list of selected centrally-sponsored rural development programs currently underway in SAT, India, and a brief critique of some major programs focusing on their effectiveness/impact and the lessons derived from their experience is presented in Appendix 6.

4.5 Concluding remarks

The sustainable livelihood approach and framework, augmented with the inclusion of issues relating to the political economy of poverty, higher focus on markets

and technology, presented in Chapter 2 seem appropriate to comprehend the problems of rural poverty and livelihood insecurity, to diagnose the root cause(s) of the problems, and to identify potential strategies for their amelioration. The framework is holistic, multi-disciplinary and people-centered and deserves to be applied in designing poverty reduction and livelihood improvement programs.

There have been many changes in the patterns and means of livelihood in the SAT region over the last 25 years or so in response to changes in technology, infrastructure, markets, urbanization, and commercialization of agriculture. Diversification of sources of income and shifts in cropping patterns and food habits are the ones that are occurring in most of the SAT areas in India.

To reduce rural poverty and improve the livelihood security in SAT, there is a need for the governments to critically review the performance and impacts of the existing interventions, preferably with the assistance of renowned rural development and management professionals, and redesign/refocus the programs such that their overall effectiveness and efficiency are enhanced. Better interventions are needed in the existing production, marketing, research and development (R&D), institutional/organizational and administration and management systems aimed at attaining food and nutrition security for everyone. This would require, among other things, the diversification of agriculture with introduction of high value horticultural crops and perennial tree crops (agro-forestry) and selective specialization keeping in view the prevailing agro-climatic conditions and availability of marketing infrastructure and facilities, adoption of watershed development approach for improving the productivity of dryland agriculture through better management of land and water resources and using appropriate technologies. Besides, enhancement of farmers' access to well-functioning markets, and reorientation of existing R&D, institutions/ organizations, and administration and management systems would also be needed.

5. Emerging Changes and Issues in SAT Agriculture

5.1 Introduction

Evidence from the literature indicates that sweeping changes have occurred in the village economies of the more favored regions of Asia in the last few decades. The extent and broad-ranging implications of these changes justify an assessment of research and development (R&D) priorities in regions that have been bypassed. These developments suggest some key issues and challenges confronting the SAT of India (Ryan and Spencer 2001). The SAT agriculture in India has not been as responsive to the emerging issues and challenges as agriculture in irrigated areas of the country. This is mainly because it is beset with several problems. Some of the problems are intrinsic to the type of agriculture extant in the SAT whereas others are externally imposed. The problems could also be categorized according to their character such as biophysical, technical, economic, institutional, socio-cultural, and so on. In this chapter, we first take stock of some of the emerging changes in agriculture and then briefly describe the nature, extent and severity of some of the major issues confronting the SAT agriculture in India and alternatives to resolve them.

5.2 Biophysical problems

5.2.1 Water scarcity and droughts

Water scarcity has been and still is the most critical constraint in the SAT agriculture. According to Ryan and Spencer (2001) "water will likely be the primary constraint throughout SAT in coming years (also)". The problems of water scarcity and droughts in the SAT areas, as also in many areas of India, are to a large extent, caused by the low and erratic rainfall, lack of harvesting, storage and conservation of rain water, increased over-exploitation and pollution of both surface water and groundwater, lack of proper allocation and efficient use of water, lack of well-defined property rights in water backed up by law, and the shortcomings in the design and implementation of drought relief programs. Besides, its adverse effect on crop yields, water scarcity also results in competition for and conflicts over water between states (eg, Karnataka and Tamil Nadu), towns and villages, the rich and the poor, and industry and agriculture. For example, in many parts of Gujarat, conflicts between farmers and urban dwellers over the re-allocation of water from irrigation reservoirs have in the recent times become more frequent, intense and occasionally violent (Ballabh and Singh 1997; Ballabh and Pradhan 2000 ; Ballabh 2002).

Since time immemorial, droughts have been a bane of the SAT agriculture in India. They are considered as nature's curse on human beings living in SAT, posing a threat to their survival and livelihood. On average, the SAT in India is prone to droughts once in every three years. The areas/states which are most vulnerable to droughts include western Rajasthan, eastern Rajasthan, Gujarat (Saurashtra, Kutch, and north Gujarat), western Uttar Pradesh, Tamil Nadu, Kashmir, and Rayalseema and Telangana in Andhra Pradesh. In these areas, droughts are expected to occur every 2-3 years over a period of every five years (Singh and Ballabh 2002). Droughts have several physical, economic, social and environmental effects and impacts, and cause immense misery to people and animals living in the drought-affected areas. Loss of agricultural production and incomes lead to several destabilizing effects on the entire economy of the country. Future research could focus on identifying genes (not only from current mandate crops, but also from other species) that can improve water-use efficiency and confer drought tolerance. The research agenda could also include crop and systems modeling, integrated watershed management, water policy, and institutional innovations in water resource trading, allocation, pricing and management.

5.2.2 Land degradation and poor quality of soils

Land degradation is a serious problem in India in general and the SAT in particular. According to an estimate, nearly 107.43 million ha of land in India is affected by various forms of degradation (GOI1974). The soils have low water holding capacity and are deficient in organic matter and several nutrients, and therefore cannot support high crop yields on sustained basis. In view of this, one of the major challenges facing the SAT agriculture in India today is to conserve

and enhance the inherent capacity of its land and other natural resources to sustain agriculture. Any erosion of this inherent capacity will threaten India's food security and sustainability of agriculture.

The SAT agriculture in India is prone to severe soil erosion and other forms of land degradation. Given the fragile nature of natural resources in SAT, there is a need to develop technologies which do not create too much pressure on natural resources and which help replenish the resources used up in the process of production. This will ensure that the stock of natural resources is maintained intact over time. Research is needed to understand the nature, extent, consequences, and trends in land degradation in SAT. This should include the effects of soil loss and nutrient depletion on productivity, water pollution, salinity, and loss of biodiversity.

5.2.3 High risk and uncertainty, and vulnerability

The SAT agriculture is characterized, among other things, by a high degree of risk and uncertainty caused by several weather-related aberrations such as abnormally low and erratic rainfall and its uneven distribution over time and space, droughts, hailstorms and so on. Given their income poverty, most of the farmers do not have the capacity to bear such risks and hence become risk averse. This becomes a constraint in the adoption of new technologies by those farmers. Consequently, their farm production and incomes are lower than what is possible with the adoption of new dryland technologies and they become more vulnerable to such aberrations.

5.3 Technological issues

5.3.1 Low productivity

The SAT agriculture is characterized by low land and labor productivity. It is lagging far behind the non-SAT regions in India in terms of productivity of all major crops grown there (Table 4.1). For example, the average yield of wheat in 1997-98 was 1813 kg ha^{-1} compared to 2801 kg ha^{-1} for non-SAT region, cotton 223 kg ha^{-1} compared to 305 in non-SAT regions. Although most dryland crops yields are marginally higher in the SAT compared to the non-SAT region with a few exceptions, the productivity levels are low compared to global averages for the dry land crops. The average crop productivity in value terms for major crops in the SAT is Rs 16,195 ha^{-1}, while it is Rs 23,534 ha^{-1} in the non-SAT region.

Besides, within the SAT region, there is a wide variation in crop yields. For example, the average yield of sorghum varied from 370 kg ha^{-1} in farmers' fields to 1460 kg ha^{-1} in demonstration fields and 1060 kg ha^{-1} on farmers' fields with assured input supply (Kanwar 1999). This shows that there exists a lot of potential for increasing crop yields in SAT. In view of this, what is required is greater investment in R&D to develop region-specific crop varieties keeping in mind the need for bio-diversity conservation. In addition to stepping up the investments in R&D, it will also be necessary to ensure that the research findings reach the target group and that an enabling environment is created for farmers to be able to adopt the latest research findings so that the R&D impact is maximized.

Fan et al. (2000) have reviewed the performance of India's agriculture in irrigated and rainfed zones over the period, 1970-1994. They found that the average growth in total factor productivity in the irrigated areas over this period of time as 0.92%, which was slightly higher than in the rainfed zones (0.73%). Most of the growth occurred in the 1970s in the irrigated areas and in the 1980s in the rainfed areas. The total factor productivity actually declined in both types of areas in the 1990s. Land productivity had grown at a higher rate in irrigated areas than in rainfed areas. During 1970-73 to 1992-95, the productivity of major dryland crops also increased. For example, the average yield of coarse cereals has increased by 65.4% and that of oilseeds by 57% (Kanwar 1999).

5.3.2 Low level of adoption of new technologies

Although new dryland agricultural technologies are available with research centers, their adoption rate is very low in most of the SAT areas. For example, in 1997-98, the area under High Yielding Varieties (HYVs) in the SAT was nearly 32% as contrasted with 42% in the non-SAT areas in India and the average fertilizer use was 97 kg ha^{-1} vis-a-vis 117 kg ha^{-1} in non-SAT areas (ICRISAT database. Refer to Table 1.2). Consequently, there is a wide gap between the average yields obtained in research plots and the farmers' fields. The gap is due mainly to the inability of farmers to buy new inputs, their risk aversion, lack of adequate extension and other support systems such as access to markets and institutional credit, and the risk involved in the adoption of new technologies (Mahipal and Ramachandran 1999). This is a serious constraint in increasing yield, production and income of the SAT farmers. The gap needs to be bridged through appropriate interventions including establishing an

effective interface between research, extension, support systems and farmers and providing easy access to institutional credit and crop insurance.

5.3.3 Increasing importance of livestock and feed grains

Livestock rearing has been an integral part of farming systems in India since time immemorial, especially in SAT, where crop production is highly risky because of its dependence on uncertain rainfall. So far, livestock research and development has not received as much attention as it deserves. Now that the demand for livestock products in India is increasing at a faster rate than the demand for food grains, livestock production will become more financially attractive than in the past. Besides, the growth in the livestock sector will create growth in the derived demand for feed grains and stover of crops such as sorghum and millet (Kelley and Parthasarathy 1996; Marshland and Parthasarathy 1999). For example, in Sholapur market, the grain to straw price ratio for sorghum declined from 6:1 to 3:1 between early eighties and early nineties (Kelley et al. 1993). There is hence a compelling case to shift emphasis in genetic improvement of sorghum and millet from food grain to feed grain traits and with emphasis on straw yield and quality. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is already addressing projects related to feed use of sorghum and millets as poultry feed, and improving the fodder quality of groundnut, sorghum, and pearl millet funded by the Department for International Development (DFID) and the Australian Center for International Agricultural Research (ACIAR). A bio-economic study of the value and desirability of this shift is required. Increased attention is needed on the integration of livestock in mixed crop-livestock systems, beyond the current emphasis on improving stover quality.

5.3.4 Bridging the gap between research and development

Strengthening the capacities of SAT farmers and national research systems with the aid of information technology will lead to significant rewards. This would help bridge the gap between the potential crop yields as demonstrated in research plots and those obtained in farmers' fields. ICRISAT can play a key facilitative role in the process of information delivery/exchange and training. Improved access to information technology will also enable the SAT farmers to obtain real-time information on markets, prices, weather, and pest and disease epidemic forecasts. This can further open new commercial opportunities and reduce the inherent risks of SAT agriculture.

5.4 Economic problems

5.4.1 Lack of financial viability

Given the low productivity and fragile nature of natural resources in SAT, it would be advisable to improve the financial viability of SAT agriculture through promoting the production of high value crops, having good domestic market and export potential. Examples of such crops include spices, medicinal herbs, fruits and vegetables.

5.4.2 Low public investment in agriculture

The slow pace of growth of agricultural economy and its impact can be partly explained by low investments in agriculture in SAT. Investment in agriculture whether public or private is important part of growth process and, therefore, it is an important resource. The gross capital formation in agriculture has been declining in both public and private sectors over time. The other dimension of this issue is the low returns from these investments, which is reflected in the analysis of incremental capital output ratio (ICOR). It is believed that the public investments in agriculture had a very narrow focus mainly on irrigation but other infrastructure components such as roads, markets, rural electrification, etc, were neglected. Investment in irrigation and infrastructure, particularly roads and markets, have higher marginal returns in the SAT than in most of the irrigated areas (Fan et al. 2000).

5.5 Institutional/organizational problems

5.5.1 Lack of appropriate institutions

It is now clear that the emerging challenges in agriculture transformation would require new institutions with new orientations and functions to cope up with the fast changing requirements of the agricultural production system. There are several forms of institutions extant in SAT. They include Self Help Groups (SHGs), Panchayati Raj Institutions (PRIs), and a host of other public and private agencies.

We would like to emphasize that SHGs, PRIs, and other institutions should form an interlinked chain to have an institutional environment conducive for sustainable agricultural growth and development and conservation of environment. SHGs motivate and activate the poor to participate in the processes of agricultural growth and development. PRIs raise their status in the local community and make them partners in the local-level planning for growth, development and improvement of environment. Public and private agencies of the desired type would enable the poor and the backward to establish themselves in the mainstream. It is this interlinked chain of institutions, which would help the SAT agriculture to step into the mainstream with a fair measure of hope and confidence. It would be necessary for the SAT governments concerned to formulate a strategy for institutions building focused on two objectives: (1) facilitating the formation and growth of self-reliant institutions; and (2) acquiring adequate capabilities to intervene and manage crises beyond the capacity of the normal institutional mechanisms to cope with.

Yet another school of thought views the institutional sub-system in a broad perspective extending beyond the conventional concerns and the role of government-run organizations. The currently fashionable view is that the government is excessively involved, intervenes far too much and that too inefficiently. The remedy, it is argued, would be to trim the government's role and allow the private sector to play a larger role. It is true that there are substantial inefficiencies in the functioning of government and parastatal agencies providing the necessary support facilities and services. But it does not follow, as proponents of privatization assume, that these problems will be automatically and satisfactorily resolved by handing these activities over to private enterprises. While recognizing that there is no escape from the necessity of public systems, we need to focus on devising a better distribution of functions between governmental and private organizations; examine the structure and working of public systems (including regulatory agencies) in key sectors; identify the reasons for their malfunctioning; and devise ways to enable and induce them to be more efficient and accountable for performance.

We believe that ' user-controlled and user-driven institutional structures' characterized by low transaction costs are essential to provide the needed assistance in postharvest technology such as drying, storage, processing, and marketing. In this context, we would suggest that the role of the Small Farmers Agri-business Consortium (SFAC) that was established for this purpose should be reviewed, and appropriate institutional structures, owned and controlled by farm families, should be promoted.

5.5.2 Lack of community participation

The community participation is essential for the sustainability of development programs, as it helps in reducing the monitoring and other recurring costs, besides ensuring appropriate decisions. However, the participation of communities cannot be taken for granted. It will come about and will be sustainable only if appropriate institutions such as empowered panchayats are built or allowed to exist and function. There is a lack of community participation in making decisions that affect the community and their livelihoods in India in general and the SAT in particular. This has had an adverse effect on the implementation of development programs, reducing their effectiveness and impacts.

For enlisting community participation in agricultural development projects, it would be necessary to decentralize decision making and empowering local institutions through training of their personnel and through technical and financial support. Besides, communities also need to be empowered to achieve better implementation of agricultural development programs. Greater involvement of women in decision-making in local institutions dealing with natural resource management should also be deliberately sought and encouraged.

5.5.3 inappropriate property rights and tenures in land and water

In many of the SAT areas, land tenure and land leasing systems are not yet reformed with the result that there are no incentives to the tiller to invest in land development including soil and water conservation. Given the widespread practice of land leasing on oral terms in SAT, as also in the non-SAT areas in India, it is necessary to legally legitimatize it. This would not only provide the needed incentives to the tiller to use new technologies and investment in land development, but also enable him to access institutional credit. Similarly, most of the problems relating to the use and management of water such as overexploitation, depletion and degradation of water resources arise from the lack of well-defined property rights in water. In a nutshell, they suffer from what Hardin (1968) called "The Tragedy of the Commons" (Singh 1995b)

In our opinion, for efficient and equitable water management, it is necessary to vest the ownership rights in the State and usufruct rights in water users'

organisations (WUOs), or the PRIs. This should be done through the enactment of necessary legislation by the concerned state governments.

5.6 Administrative and management problems

Most often policy makers presume that whatever the objectives of agricultural development policy, the existing administrative machinery can achieve them. This has not been borne out by India's experience with the implementation of various agricultural policies and programs in the past. Furthermore, this contradicts a well-known management principle underlying successful development programs that for each objective, an appropriate organization structure should be specified and that both the objectives and the structure should be congruent with the prevailing socio-economic and political environment.

The implementation of the new strategy for agricultural development would require that agricultural development programs be professionally managed. For professionalizing the management of agricultural development, we need appropriately trained agricultural development managers. Such professionally trained managers with the requisite traits, skills and commitment are a scarce commodity in India at present. A very large number of such managers are required for managing agricultural development programs and projects, rural institutions and organizations, rural enterprises and resources. There is, therefore, an urgent need to establish many more institutes of agricultural and rural development management on the pattern of the Institute of Rural Management, Anand. Appropriate programs and facilities are also needed for imparting training to rural producers, rural women, rural bankers, agri-business dealers, local officials, policy makers and planners, and politicians.

5.7 Public policy-related problems

5.7.1 Food and nutrition insecurity

It is rightly stated that India is no longer facing food insecurity, but continues to suffer from nutrition insecurity. This being the ground reality, nutritional considerations should receive highest priority in food production policies. This goal of nutrition and food security becomes all the more important considering the fact that the SAT area is one of the most food insecure regions in India in terms of food availability, food access and food absorption. (Food Insecurity Atlas of Rural India, World Food Programme and MS Swaminathan Research Foundation, 2001).

Considering the above viewpoints, the orientation of this strategic goal should be one of enhancing the access to food for people who are food insecure, to achieve what is known as *'human sustainability '*. In addition, the effort should also be made to improve the diets through nutritional orientation of the existing agricultural production system, eg, inclusion of legumes in the cropping system. Further, one needs to consider the emerging empirical evidences which now suggest that income in the hands of women contributes much more to household food security and child nutrition than income controlled by men. This will call for ways and means to channelize developmental investments in women to improve food security for the whole family. It is felt that if women are left out, the progress of nutrition and food security programs cannot be ensured.

5.7.2 Lack of access to markets and marketing facilities

The marketing of farm produce has been the most neglected dimension of agricultural development strategies followed in India in the past. It is high time that it were accorded its right place in the future strategic action plans of the development of SAT agriculture in line with the 2020 Vision statement. In the process of developing agricultural markets, enough safeguards need to be built to protect the interest of small and marginal farmers and other weaker sections.

In the wake of new world trade regime ushered in by the World Trade Organisation (WTO), the government is withdrawing from procurement, storage, and distribution of food grains. Simultaneously, we are also witnessing the removal of restrictions on storage, sale and movement of agro-products, removal of export controls, and expansion of futures and forward trading in agro-products. How these changes will influence the farm produce markets in the SAT is not yet clear.

However, be that as it may, the future financial viability of agriculture in the SAT will be greatly influenced by the efficiency of farm production systems on one hand and efficiency of marketing, on the other. The past experience suggests that the task is not going to be easy. The issues, which need to be effectively countered include

- overcoming space- and time-related uncertainties faced by farmers in general and small and marginal farmers in particular;

Table 5.1. Comparison of crop yields (kg ha^{-1}) in SAT & Non-SAT regions of India.

	SAT		Non-SAT		All India	
Crops/Year	1970	1998	1970	1998	1970	1998
Rice	1659	1753	801	1871	1120	1880
Wheat	947	1813	1442	2801	1310	2670
Sorghum	250	933	1508	750	470	960
Pearl Millet	517	928	487	693	620	790
Maize	1074	1637	1025	1752	1280	1700
Finger Millet	897	1463	703	1020	870	1350
Barley	1084	1348	1040	2019	1090	1890
Chickpea	549	788	723	796	660	810
Pigeonpea	281	626	1304	817	710	750
Groundnut	595	1166	1427	1089	830	1150
Rape and Mustard	1479	926	355	832	590	1010
Sugarcane[1]	6629	8029	4477	6211	4832	6652
Cotton	80	223	374	305	110	270

1 .Based on gur production
Source: lCRlSAT database

- non-existence and/or inefficient markets for agricultural produce, particularly for perishable commodities;
- structural changes in the marketing system such as privatization and multi-agency competition;
- expanding market opportunities including accessing overseas markets, particularly for progressive farmers growing high value, export-oriented commodities;
- use of latest information and communication technology (ICT) to improve the integration and efficiency of agricultural markets; and
- marketing and extension support to help farmers to 'manage risk' and the process of transition from subsistence agriculture to market-oriented commercial agriculture.

Research on reducing the high marketing and transaction costs through innovative and effective market linkages of producer and end users in the SAT is likely to bring in good rewards than a focus on developing new postharvest and processing technologies.

5.7.3 Weak support systems

Five major crops, viz, oilseeds, cotton, pulses, wheat, and sorghum account for nearly 75% of the gross cropped area (GCA) of SAT. The remainder of the agriculture is highly diversified and includes a wide range of crops. A glance through the schemes and programs in operation in the SAT indicates that the interventions in the SAT are spread too far and too thin. Consequently, the impact of the interventions is not visible. In view of this, there is an immediate need for the state governments concerned to consolidate their manpower and other resources around selected interventions. This consolidation effort may be reviewed from time to time depending on the experience gained.

It must be admitted that the support systems extant in the SAT are weak and farmers face lots of problems in accessing their services. For example, the regulated markets, particularly those located in far flung areas, are thin with low trade volumes and few buyers and sellers. The market makers buy at relatively low price and sell at higher price with large margins. The markets are not properly integrated. A study on price spreads in metro markets sponsored by the Planning Commission revealed that reasons for high spread between the wholesale and retail prices could be the high concentration of trade with few traders, high transaction costs, weak infrastructure and information system and a large number of intermediaries in between the wholesalers and the retailers.

5.7.4 Regional strategies and decentralized planning

The SAT areas in India are highly heterogeneous in terms of natural and human resource endowments, types of farming systems, levels of living, livelihood patterns and infrastructure. In view of this, no uniform R&D strategy would be appropriate for the SAT as a

whole. There is a need for differential strategies suiting to the differential characteristics of various areas. For this, a decentralized system of decision-making and planning is required. The 73rd (Constitution) Amendment Act can facilitate this process if the SAT state governments are willing to devolve administrative and financial powers to PRIs.

5.7.5 Mainstreaming gender in agricultural development strategy

Increased seasonal and permanent male migration from rural to urban areas is leading to the feminization of SAT agriculture in India as well as in Sub-Saharan Africa (SSA). There have been several references to feminization of agriculture in many poor areas of Africa and Asia. As part of the micro-level evidence that ICRISAT is gathering in several watershed management research locations, data were collected in 2002 in six villages in Ranga Reddy district of Andhra Pradesh, India. A census was undertaken before a detailed sample survey. Among the 825 households covered in the census, only 5% were registered as women-headed households. About 52% of the household labor force is composed of male workers, while the balance of about 48% is from women workers. The detailed sample survey (of 120 households) data shows other interesting results. On an average, women contribute 70% of the 124 days ha^{-1} of labor required in crop production activities. About 50% of this labor is hired within the village, from which women labor constitutes about 93%. This indicates that rural agricultural labor markets are highly dominated by women. The findings also show that women provide a significantly high proportion of labor into labor-intensive activities such as transplanting, weeding, harvesting, and threshing of crops. However, the average wage rates for women workers are less than half the rates for male workers on the farm (about Rs 18 day^{-1} vs Rs 40 day^{1}). This indicates the rigidities and institutional barriers that exist within the rural labor markets, which do not respond effectively to the growing role of women and their productivity in SAT agriculture.

This trend is accompanied by increasing labor scarcities. R&D institutions need to recognize the need for labor and capital-saving technology options that are purposefully designed to be gender-sensitive. Besides, it should also be recognized that the success of projects to foster sustainable agricultural development largely depends on the extent to which both women and men participate in project design, planning, implementation and monitoring. There are many ways of institutionalizing a gender-sensitive approach to sustainable development. The first and foremost requirement is the policy of equal involvement of both men and women in development projects. Next, women should be assigned specific roles, responsibilities and rights in making various decisions rather than simply attending project meetings. Besides, the whole project team has to be sensitized to gender issues if gender awareness is to be encouraged. The whole team also has to be trained and made responsible for the implementation of the gender-sensitive approach. Finally, it is also important to clearly define the objectives to be achieved and measures to be employed to achieve each of the objectives, and develop quality and process-oriented indicators in order to monitor the progress of the projects in achieving the intended objectives.

5.8 Concluding remarks

There are several biophysical, technological, economic, institutional/organizational, and public-policy-related constraints that hold back the rate of agricultural growth and development in SAT and thereby contribute to the perpetuation of poverty, hunger, malnutrition, and low levels of living in the region. These constraints must be overcome on the grounds of efficiency, equity and sustainability of agricultural development. India now has the technologies suitable for overcoming, or reducing the severity of most of these constraints. What is needed is a pro-SAT public policy as briefly presented in Chapter 6 that commits enough resources to resolve the endemic problems of SAT.

6. A Development Strategy for SAT Agriculture

6.1 Introduction

The poverty diagnostics and strategic assessments undertaken in Chapter 3,4 and 5 addressing the issues confronting Semi-Arid Tropics (SAT) generated a comprehensive perspective from both micro and macro levels which deepened our understanding of the multi-dimensional nature and dynamics of poverty. A linkage between rural poverty and SAT agriculture is established and the determinants of poverty are identified. This is mainly based on the analysis of the incidence and determinants of poverty in SAT, key issues confronting SAT agriculture, livelihood strategies adopted by the SAT households, and the experience with and lessons of past interventions. This understanding is valuable in identifying and designing appropriate interventions to help the poor achieve preferred livelihood outcomes, improve their access to productive natural resources and technology, and evolve strategies from an investment angle, and enhance their standards of living.

The strategies proposed in this chapter are all subsumed in the Sustainable Livelihoods Approach (SLA) that we briefly presented in Chapter 2. It recognizes that poverty alleviation projects should be more people-centered, responsive and participatory, multi-level through partnerships, sustainable, and dynamic. It calls for a process approach in research and intervention implementation, which means updating the existing knowledge all the time and generating new knowledge about livelihoods. An important manifestation of poverty in SAT is having few or no options and economic opportunities for diversification and improving one's livelihood. Therefore, future policies must try to increase the number of options available to the poor by improving access to technology, appropriate crop and livestock varieties/ species, information, encouraging mobility and promoting markets, creating infrastructure and giving the poor a voice.

The chapter contains set of recommendations on strategies to increase the contribution of SAT agriculture to reduction of poverty. The development of a strategy for SAT agriculture evolved by considering major questions: What is the future of agriculture in less favorable regions such as SAT? What kind of agriculture would be sustainable? What kind of policy, research, and extension support is needed to make agriculture financially viable for the majority of farmers? What priority areas for future investments would increase the contribution of SAT agriculture in reducing poverty in a sustainable manner? Despite the complex relationship between agricultural research and poverty reduction, future research strategy in agriculture should be responsive to the felt needs of the poor farmers and aim at generating yield-increasing, drought-resistant and labor-intensive technologies suitable for agro-climatic conditions in which they live.

6.2 Priority thematic areas for possible development interventions

Based on our characterization of SAT, identification of critical issues in SAT agriculture, and experience with and lessons of current development interventions in SAT presented in Chapters 3,4 and 5, we have identified the following thematic areas for development intervention in SAT in future:

6.2.1 Water as an Entry Point

As we stated in Chapter 3, water scarcity has been the most critical constraint in SAT agriculture. The role of water as a catalyst of socio-economic development in SAT has now been amply demonstrated and established (Singh 1997). In the regression models estimated and reported in Chapter 3, we found that low irrigated areas in all zones have high incidence of poverty. Furthermore, we also found that irrigation is an important determinant of agricultural productivity, which in turn is negatively correlated with poverty. In view of this, optimal harvesting of surface run off, recharge of groundwater, judicious use and management of available water should be the core element of the future strategy. In a nutshell, the following water-related interventions need to be made in SAT on a high priority basis:

Drought Proofing through Harvesting and Storage of Rain Water: As we stated earlier in this report, the

most serious problem of SAT agriculture in India is deficient rainfall and its highly uneven distribution over time and across space. India now has the requisite technology, manpower, and material resources available for solving this problem. Pioneering work in designing and building cost-effective small check dams in project areas comprising over 600 semi-arid villages in three western Indian states of Gujarat, Madhya Pradesh and Rajasthan (Singh and Gupta 1998) can be used as a model. This strategy is people-centered and community-based and seems to be appropriate for replication in SAT areas in India. The financial resources required could be mobilized from the on-going programs.

Recharging of Depleting Groundwater Aquifers and Regulation of Groundwater Extraction: Deficient rainfall together with the overuse of the groundwater in many SAT areas has led to the lowering down of water table. This implies that groundwater extraction in those areas exceeds the natural recharge rate. This has not only increased the cost of water extraction from tube wells, but also has resulted in the drying up of shallow wells in the areas. In view of this, there is a dire need of recharging groundwater aquifers and improvement in the on-farm water management. The extraction of groundwater needs to be regulated by the communities concerned, or water users' associations, wherever they exist. Innovative methods have been tried by the Non-Governmental Organizations (NGOs) that are cost effective and simple to construct and maintain. These are suitable for replication in other SAT areas in India.

Adoption of Watershed Management Approach: Watershed management approach has been found to be the most appropriate strategy for optimum and sustainable use of land, water and other resources in rainfed farming areas. There are many success stories including those of Sukhomajri, Ralegan Siddhi, and PIDOW (Gulbarga), that document how the adoption of watershed approach led to overall development of the watershed and restoration of its natural capital in semi-arid areas of India (Singh 1995a). Improved watershed development technologies are now available with various research institutes in most states in India. What is needed is an organizational structure for compiling, collating, screening and releasing new technologies found suitable for adoption by farmers. (Singh, Research Paper, **IRMA).**

Pricing of Water and Power Reflecting their Opportunity Costs: To promote sustainable use of water, it is necessary to do away with all kinds of distortions in the existing markets in a phased manner. Pricing of water and electricity in India is a highly, politically sensitive issue and there is reluctance on the part of state governments to increase water and power prices for agriculture. However, there is a plenty of evidence now available in India to show that water users in both rural and urban areas are willing to pay much more for dependable, safe, timely, and adequate water supplies and sanitation services. For example, in a sample survey of 100 farmers conducted in two purposively selected villages in Kheda district of Gujarat, it was found that the sample farmers were willing to pay 150 to 300% of the prevailing tariff for timely and adequate supply of irrigation water (Singh and Ghatak 1995).

Improving Water Use **Efficiency of Irrigated Agriculture:** It is well known that agricultural production in the Green Revolution period had grown at a faster rate in areas with assured irrigation and where judicious use of both surface and groundwater resources was practiced. On the other hand, agricultural productivity remained low in areas where water management was poor and SAT is one of those areas. The measures required to improve the water use efficiency in SAT include promotion through subsidies and extension education the use of water saving micro irrigation technologies such as drips and sprinklers and organizing water users' associations to manage on-farm use of water and to levy and recover water charges.

Specification and Enforcement of Property Rights in Water: Most of the problems relating to the use and management of water such as overexploitation, depletion and degradation of water resources arise from the lack of well-defined property rights in water. There are no explicit statements or laws, which clearly recognize and define property rights in either surface water or groundwater (Singh 2001).

In our opinion, for efficient and equitable water management, it is necessary to create property rights in water through water laws and vest the ownership rights in the State and usufruct rights in water users' organisations (WUOs), or Panchayat Raj Institutions (PRIs).

6.2.2 Better Management of Wastelands and Common Pool Lands

In Chapter 3, we found that there is a positive correlation between the extent of fallow lands and poverty. Most of the degraded/waste lands including fallow lands in SAT could be brought under cultivation with relatively low investment and could be used for

agro-forestry, community/social forestry, and horticultural crops. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has also developed improved technology designed to facilitate double cropping in those regions of the Indian SAT, which are endowed with deep Vertisols and having an average annual rainfall of over 750 mm.

6.2.3 Diversification with Higher Focus on Livestock Development

As we stated in Chapter 4, at the micro level, diversification of agriculture is both a coping strategy against risk and an income enhancing strategy subject to available resources of land, labor and capital.

A recent study by Birthal and Parthasarathy Rao (2002) has shown that diversification towards high value crops reduces interpersonal disparities in income. All the livestock products such as milk, meat etc, were identified as inequality reducing. Fruits and vegetables cultivation too reduces income inequality although to a lesser extent compared to livestock products. On the other hand, crops such as oilseeds and pulses and commercial crops are inequality-increasing sources of income.

There is a need for the adoption of regionally differentiated strategies for increasing agricultural production in SAT. This strategy aims at promoting the cultivation of those commodities which are specific to certain geographical areas and have become popular for their differentiated characteristics/quality traits/ suitability for agro-processing. Some of these crops include medicinal and aromatic plants such as *isabgol* and essential oil grasses such as palmarosa, vetiver and lemon grass which are cultivated in many areas in SAT (Pratibha et al. 1999) and floriculture and organic farming.

The crops mentioned above command a high premium in the market and directly contribute to improving the profitability of farming. Reputed organizations of farmers or industry associations or agri-business firms engaged in trading and agro-processing may be encouraged to take over the responsibility of developing these specific crops and areas by establishing linkages between the farmers and markets.

6.2.4 Marketing and Commercial Orientation of Agriculture

To keep with the changing world trade regime characterized by globalization and commercialization of agriculture and changing food habits of people in favor of livestock products and fruits and vegetables, SAT farmers will need to have market orientation in making decisions about crops they should grow. In fact, this is already happening in SAT (Gulati and Kelley 1999).

As we saw in Chapter 3, access to good markets (as measured through market density), which can ensure fair price to the producer, is essential for increasing the production and profitability of agriculture in SAT. The experience gained in India and elsewhere suggests that if agricultural marketing system is inadequately developed, efforts to increase agricultural production are unlikely to succeed. By and large, quite a significant proportion of agricultural produce ranging from 30 to 75% is still sold in villages to middlemen. In most of the cases, the producer does not get a fair price when he sells his produce in the village itself. There is a need for launching a campaign using mass media informing farmers about the prices prevailing in regulated markets and the facilities available to them.

Contract Farming or vertical coordination of various degrees is emerging as an alternative to open markets. Under these arrangements, rather than selling the produce on the commodity market, these transactions rely less on prices and more on private contract negotiations. It is believed that these alternative arrangements will give growers an opportunity to make relatively more profits as compared to open markets. Such arrangements are gradually evolving in the country including SAT. However, there is a need to sort out several issues including the mode of sharing of risks and profits of the new market system among the players from the traditional markets. Such exchange arrangements will have substantial impact on farm marketing and production practices.

Regarding value addition, it is generally felt that the small size of farms does not permit economies of scale. Producing on small farms but processing on large scale to reap the economies of scale can overcome this. Appropriate farmer groups or associations could tie up with processing industries and thus share the benefits of value addition. To overcome some of the problems in the existing scenario, it is necessary that farmers integrate themselves backward for credit and forward for value added processing. Institutional credit may free them from the hold of money lenders-traders and also impart greater flexibility in marketing their product.

6.2.5 Institutional Innovations

In the context of the proposed comprehensive development strategy for the SAT agriculture for the next two decades, it would be necessary to identify

the best practices and institutional/organizational innovations that are already being used by progressive farmers and NGOs in SAT. Some of those innovations are briefly described below:

Demand-Driven Agricultural Extension System: The main objective of the agricultural extension system should be to cater most cost-effectively to the emerging needs and demands of the SAT farmers, especially the small and marginal farmers. The adoption of the Training and Visit (T&V) system during the 1980s was a bold step. A similar innovative measure is required to be taken now. The Union Ministry of Agriculture needs to re-orient the T&V system and the research and extension institutions to complement this. Every state needs to revamp its extension system. Training institutes are in dire need of rehabilitation, whether it is physical infrastructure, training methodologies or trainers. The Government of India (GOI) should put this in the center of their agenda. While an upgrade can be according to a plan and investments need-based, the Union Ministry of Agriculture should not deter from providing support to all the three components cited above. Mainstreaming of gender concerns should also be placed at the heart of this revamp strategy.

Professionalization of Management: There is a need for professionalization of agricultural development management to cope with the rapidly changing national and international economic and political environment. This could be achieved only slowly over a period of time by inducting professionally-trained agricultural development managers at all levels in the hierarchy of development administration. Reorientation of the existing staff through short-term training programs in agricultural development management in good institutes of rural management is also necessary.

Securing Women's Participation: Women are important stakeholders in SAT agriculture. They are responsible for fetching water for meeting their household requirements, collating fuel and fodder, tending animals, and performing various farm operations except ploughing. Therefore, they should be involved in making decisions that affect them. NGOs and community organizations should facilitate women's participation in decision-making at the community level by addressing structural constraints, ensure that women's participation does not increase their already heavy workload, and train women and men and build their capacity.

The government agencies should create and enforce women's rights to land and water either through legal or new institutional mechanisms. Normally, women's rights to water and to 'ownership' of water infrastructure is restricted because of their limited access to land rights or to their recognition as 'heads of households' (Bina Agarwal's "A field of my own", Cambridge University Press). A "Water Campaign" launched in 1995 in selected villages in Gujarat by an NGO, Self-Employed Women's Association (SEWA) is a good example of involving women in decision making, raising their and community's awareness about water-related problems, and building and enhancing their capacity through training and leadership development programs (IRMA-UNICEF 2000).

Using Mass Media to Create Awareness about the Problems of SAT Agriculture: Mass media could play an important role in generating mass awareness about the impending water scarcity and droughts and the need for water conservation in SAT. At present the electronic and print media has not given a high priority to educating and sensitizing the general public and different stakeholders about the water scarcity and the need for conservation of water resources. There is an urgent need to devise innovative ways as well to use the indigenous methods such as folklore and folk songs for the purpose. Programs such as "water campaign", water day, and so on need to be used more widely to cover all parts of India and to generate public opinion on water related issues. There is a need for developing a mass communication strategy and a national campaign for building public consensus on institutional and individual actions with regard to improved SAT agriculture and its management (IRMA-UNICEF 2000).

6.2.6 Building and Strengthening of the Basic Infrastructure

Agricultural productivity and production, and farm and non-farm incomes in SAT are constrained by deficient infrastructure comprising roads, markets, hospitals, electricity, irrigation, means of transport, and communication. This imposes a severe constraint on increasing production. It is now widely accepted that the marginal returns to investment in infrastructure, especially roads, irrigation, electricity and education, in relatively less developed rainfed areas such as SAT are higher than in relatively more developed irrigated areas (Fan et al. 2000; Ryan and Spencer 2001). In view of this and given the higher incidence and severity of poverty in SAT than in the non-SAT areas in India, higher investment in basic infrastructure is justified on both efficiency and equity grounds.

6.2.7 Re-orienting Public Policies

Now, we briefly describe a few of the policies and programs that need to be refocused and streamlined to be meaningful to the SAT farmers, especially as they relate to key factors (identified in Chapters 3,4 and 5) constraining agricultural productivity and hence poverty reduction.

Ensuring Food Security through Provision of Wage-paid Employment: This is the most important element of any pragmatic strategy of management of SAT agriculture. In Chapter 4, we highlighted the need to stabilize food grains prices as a means of reducing the impact of income poverty. For poor families, household food security can be a threat during droughts. It can be strengthened through a more effective Public Distribution System (PDS), uninterrupted and flexible supplementary nutrition through Intensive Child Development Schemes (ICDS) and creation of food grain banks which may also be linked with food for work scheme.

A weekly system of rationing under PDS will be more beneficial as really poor families cannot afford to purchase their whole entitlement in a matter of few days. Another way of improving the performance of PDS is to raise public awareness about the program.

The role of women in the context of food security also needs to be understood. At various stages of household food production, women play an important role. But they are worst sufferers when it comes to food scarcity. The organized women's self-help groups have a better capacity to manage household income, savings and credits. There is a lot of evidence available to suggest that if appropriate training is provided, women's self-help groups could be a better tool to reduce household food insecurity even for those who are living in abject poverty.

Higher Public Investment in Infrastructure and Technology: As discussed earlier in Chapter 5, SAT agriculture is characterized by low levels of input use and low productivity levels. The average quantity of fertilizers used and the proportion of cropped area under High Yielding Variety (HYV) in the SAT areas are much lower than those in the non-SAT areas. To get out of this syndrome, we need to step up the level of both public and private investment in infrastructure and technologies. Fan et al. (2000) have shown that the marginal returns to investment in infrastructure and technology in SAT areas are higher than those in irrigated areas. Further, on equity grounds also, farmers in SAT deserve a better treatment now in terms of allocation of public funds than what has been meted out to them in the past. In the past, farmers in irrigated areas have received better financial support in the form of subsidized institutional credit, subsidies, and public investment in irrigation and infrastructure, perhaps at the cost of their counterparts in SAT. Investment in rural infrastructure particularly will have a direct impact on food security through income, employment and wage impacts.

Higher Inflow of Institutional Credit to SAT Agriculture: The per capita amount of institutional credit provided to farmers in the SAT is markedly lower than that in the non-SAT areas. This is both anti-equity and anti-efficiency, given the higher incidence and severity of poverty and the higher returns to investment in the SAT agriculture. Besides, the terms and conditions of the credit provided are also not appropriate under the ecological and socio-cultural environment obtaining in SAT. It has been observed in chapter 4 that dryland agriculture is profitable over a period of 3 to 5 years even though in any one year it may be a losing concern. In view of this, a new (cyclical) credit policy is required so as to meet the full credit requirements of the dryland farmer over the period of 3 to 5 years even when he becomes a defaulter in one or more than one year.

Covering More Households under Crop and Livestock Insurance: With the cost of cultivation going up and given the risk and uncertainty involved in agriculture, specially in SAT, every farmer is concerned about the investment he makes and the returns he expects for his and his family's labor (as referred in chapter 4 under discussion in drought). It is indeed a matter of satisfaction that the Union Ministry of Agriculture has already launched the National Agriculture Insurance Scheme. While the implementation aspects and difficulties therein are a subject matter for detailed discussion, we would like to offer a suggestion that its coverage should be extended to all the farmers in SAT.

Cover More Crops under the Minimum Support Prices Scheme: Rainfed crops suffered substantial discrimination in the government's procurement and public distribution policies. Although minimum support prices are announced for rainfed crops as well, they are seldom backed by procurement operations. Farmers who have grown these crops often incur loses because of low market prices. Many have shifted their cropping patterns by reducing the areas allocated to coarse cereals. The PDS and the heavily subsidized rice and wheat have further eroded the competitiveness of rainfed crops and altered market price ratios. Substituting the PDS with a food stamps system leaves beneficiaries the option of buying grains

of their choice. In Andhra Pradesh, the use of coupons to distribute kerosene has benefited low-income consumers. Similarly, food stamps worth Rs 150 per month (equivalent to the current level of subsidy) may be given to households below the poverty line to enable them to buy grains of their choice. This will serve two purposes - the benefit of food subsidy will be spread over all grains and the disadvantages that producers of coarse grains face will be partially offset. Unless these policy initiatives to reverse the policy bias are taken up vigorously, rainfed crops and farmers growing them may be marginalized further, forcing them to seek livelihood options outside agriculture.

Rationalize Subsidies on Agricultural Inputs: Fertilizers, irrigation water and power (electricity) are three of the farm inputs that are heavily subsidized at present in Indian agriculture. Irrigation subsidies are justified, as it is unethical to penalize irrigators by charging them high water rates based on real resource costs, which are abnormally high because of the widespread inefficiency and mismanagement in Irrigation Departments. What is needed, in our opinion, is both an improvement in efficiency and management of Irrigation Departments and rationalization of the water pricing policy. It is also true that quite a lot of so-called farm subsidies go to the private industries and public undertakings manufacturing farm inputs to cover up their inefficiency and mismanagement. The existing policy of subsidies on agricultural inputs needs to be reviewed and its direct and indirect impacts on different categories of farmers carefully assessed. There is, therefore, need to streamline the delivery system and to ensure that the benefits from subsidies are widely and equitably distributed. To attain this objective, it is imperative that farmers in SAT are given a high priority in allocation of funds for subsidies on farm inputs.

Facilitating Migration: As we discussed in Chapter 4, in SAT, seasonal, semi-permanent and permanent migration is a predominant coping strategy adopted by the poor to get out of the poverty trap. As a matter of fact, an informal market for migrant labor has developed over time in India. Such informal markets play an important role in balancing the regional supply and demand of casual labor in India.

Although the informal migrant labor markets in India are, by and large, working well, we believe that their efficiency could be improved and many more poor could benefit from them, if an institutionalized system of collection and dissemination of information about the supply, demand, and wage rates is put in place at the district level in selected areas within SAT and other poor areas of India. We would recommend that the state governments must intervene more effectively in labor markets and ensure that the wage rates are fair and reasonable and that there is no exploitation of labor through such practices as bonded labor, attached labor, and so on. This should be done through the involvement of some reputed NGOs having a track record of good social service and committed to serving the cause of the poor labor.

Coping with the Challenges of Globalization and Marginalization: The increasing strides towards globalization of markets through domestic market reforms that encourage integration and liberalization of import and export markets, production efficiency and competitiveness of agricultural products within the domestic market and international markets is becoming an important policy issue in the agricultural sector. Considering agriculture's role as a means of livelihoods for millions of poor people in SAT, enhancing its competitiveness through cutting average costs of production is critical for the survival of many smallholder farmers.

Past empirical evidence in agricultural technology development and infrastructural investments in South Asia lends support to this process of marginalization in less-favored regions, especially the rainfed SAT. In the case of India, Fan and Hazell (2000) show that adoption of improved varieties, road density, market access (number of rural markets per 1000 sq km), and intensity of fertilizer use are consistently lower in rainfed than in more-favored irrigated districts. The high transaction costs and low productivity of agriculture in the rainfed SAT will affect the relative competitiveness of smallholder crop-livestock production activities in these areas. It will also influence farm-household decision behavior in terms of crop and technology choice and ability to hedge risk, both from the market and from the adverse biophysical environment.

6.3 Priority geographical areas for possible interventions

Ideally, and particularly on equity grounds, no area in SAT should be left out in the process of development. But, given the vast extent of the SAT areas in India and the limited financial, human, and material resources available for their development, it is but imperative to prioritize the SAT areas for development interventions. The priority could be determined on the basis of the incidence and severity of poverty, and the potential for agricultural development. The highest priority must be given to those areas, which have the highest

incidence and severity of poverty and where there is medium to high potential for agricultural development in the short run. For areas where the potential for agricultural development is low, a separate strategy focusing on non-agricultural avenues of income including migration should be developed.

Based on these two criteria, and keeping in view the results of the regression analysis presented in Chapter 3, we have identified the following development interventions suited to the natural and human resources endowment and agro-climatic conditions obtaining in SAT (Table 6.1). The priority geographical areas for intervention are the low irrigated SAT areas covering Maharashtra, Madhya Pradesh, Gujarat, Kamataka, Andhra Pradesh, Bihar and Rajasthan. Next in priority, are the medium irrigated areas covering parts of Rajasthan, Madhya Pradesh, Gujarat, Karnataka, Andhra Pradesh and Bihar. Even the high irrigated areas of SAT spanning over Tamil Nadu, Andhra Pradesh, Bihar, and Gujarat, also deserve attention of policy makers in view of high levels of poverty prevalent there. Depending upon the availability of resources, as many of the districts from these areas as possible could be selected for intervention.

6.4 Priority areas for future research

Agricultural research needs to be farmer-oriented and demand-driven so that it can generate profitable technologies suitable for various agro-climatic and socio-cultural conditions obtaining in SAT. For this, it will be necessary to follow both the land-to-lab and lab-to-land approaches; the former for identification of farmers' problems, and the latter for exchange of new technologies. Given the increasing importance of livestock in the sources of livelihood and as a means of minimizing weather-induced risks in SAT (see chapter 4), there is also a need for focusing more efforts on livestock development, improvement of pastures and grazing lands, and on increasing forage yields of various annual and perennial (tree) crops, particularly in SAT. The criteria used to evaluate the appropriateness of new technologies should include, besides grain yield, fodder yield of crops and trees.

Agricultural research should primarily focus on bringing about substantial improvement in productivity and bridging the yield gap between the research stations and the farmers' fields. As already stated, the radical improvements in productivity are possible through new bio-technological research. Therefore, in the long run, there is a need to support bio-technological research and place greater emphasis on adaptive research in the short-run.

In view of the declining public support for agricultural research, it is important for the governments in the SAT areas to work in partnership with the private sector. The trends world over indicate that most of the investments in biotechnology are made by the private sector. Therefore, the state governments concerned need to find ways and means to collaborate with the private sector in an

Table 6.1. High priority SAT areas for development interventions.

S.No.	Type of intervention	SAT with low irrigation	SAT with medium irrigation	SAT with high irrigation
1.	Watershed management and supplemental irrigation	✓✓✓	✓✓	✓
2.	Reclamation and better use of waste and fallow lands	✓✓	✓	✓
3.	Wider diffusion of new dryland technologies	✓✓✓	✓✓	✓
4.	Diversification with higher priority to livestock development	✓✓✓	✓✓✓	✓✓✓
5.	Better targeted wage-paid employment	✓✓	✓✓	✓
6.	Education and training in new skills	✓✓	✓	✓
7.	Revamped and better targeted PDS	✓✓	✓✓	✓
8.	Strengthening of support system and basic infrastructure	✓✓✓	✓✓	✓
9.	Facilitate migration	✓✓✓	✓	X

Note: The number of tick marks (P) in Table 6.1 indicates the priority: 3 means high priority, 2 medium and 1 low priority. (X) means no priority.

environment where issues relating to intellectual property rights are also important. However, it must be remembered that the private sector investment can only be a complement, and not a substitute for public sector investment in research.

While determining high priority areas for research in the context of SAT, it should also be kept in mind that the scope for targeting benefits to the poor through reallocation of research resources among commodities is limited. Hence, enhancing the efficiency and effectiveness of research systems in promoting broad-based technical change and its widespread diffusion should be emphasized more than efforts to target poverty directly (Byerlee 2000). However, we would like to assert that, despite the complex relation between agricultural research and poverty reduction, future research strategy should be responsive to the felt needs of the SAT farmers and aim at generating yield-increasing, drought-resistant and labor-intensive technologies suitable for agro-climatic conditions extant in SAT (see also Otsuka, Keijiro, 2000). Besides, it is now high time that more research resources were allocated to multidisciplinary problem-solving applied research involving, among others, social sciences.

In setting priorities for research, it is necessary to involve the target users in the process. Participatory priority setting can lead to different diagnoses and recommendations for future agricultural research and project implementation. One example of this is the synthesis of a number of participatory surveys and beneficiary assessments from Zambia, which shows how farmers' own perceptions and priorities regarding constraints to production and the quality of agricultural services went beyond just resource endowments and allocation (climatic and environmental factors, access to land, labor, skills, draft power) to the quality of public and private agricultural services (Francis et al. 1997) This process helped to identify the livelihood diversification strategies including changing farming practices, more reliance on non-farm sources of income, and modified patterns of exchange and consumption.

Based on our analysis of the problems and prospects of the SAT agriculture in India attempted in this report, and the results of a consultation held with a sample of stakeholders as reported by Ryan and Spencer (2001), we have identified the following high priority areas for research in future:

1. Breeding of water-efficient drought-tolerant varieties of rainfed crops.
2. Cost-effective methods and techniques of integrated watershed development and management.
3. Techno-economics of water saving micro irrigation technologies and determinants of their adoption in SAT.
4. Alternatives for making the typical farm family financially viable through optimum mix of farm and non-farm enterprises.
5. A study of dynamics of rural poverty and livelihood security in SAT.
6. A study of extent, determinants and consequences of land degradation.
7. Mainstreaming of gender in SAT agricultural development strategies.
8. Economics of postharvest technologies in SAT
9. Commercialization and globalization of agriculture and its impacts on SAT agriculture.
10. Strategies for promoting the use of modern information and communication technologies in SAT agriculture.
11. Institutional innovations for reducing the high transaction costs and marketing costs.
12. A critical appraisal of major public policy interventions in SAT agriculture.
13. A study of Dynamics and determinants of rural-urban migration and its impacts.
14. A bio-economic study of the value and desirability of a shift in the focus of research from improvement of sorghum and millets as food grains to their improvement as feed grains.

6.5 Building partnerships and linkages

There are numerous governmental and non-governmental, and international and national organizations and agencies directly or indirectly involved in the development of SAT. At present there is no institutional mechanism to coordinate their activities. This results in avoidable overlaps in their functions and thereby wastage of scarce financial, human, and material resources. Besides, due to lack of communication and coordination, many of the initiatives are duplicated. In view of this, we suggest that an institutional mechanism in the form of a formal autonomous organization, which may be named India SAT Development Authority (INSATDA), may be created at the national level, with state level constituent organizations. INSATDA may be assigned the main responsibility to network, coordinate, and facilitate the activities of all the Governmental Organizations (GOs) and NGOs involved in the SAT development. In particular, there is a dire need for effective cooperation and collaboration among various

State Agricultural Universities (SAUs), institutes of Indian Council of Agricultural Research (ICAR), and the Consultative Group on International Agricultural Research (CGIAR) institutes for deriving full benefits from the complementarities and synergy that exist among their functions (Paroda 2001).

6.6 Capacity building and development

Given the high incidence and severity of poverty, high illiteracy rate, lack of entitlements and the lack of basic infrastructure in SAT, most of the people living there have very few skills useful for non-farm avocations and they are vulnerable physically, economically, socially, and politically. They need to be empowered and their capacity built through education, training, provision of technical information, and institutional credit in order to enable them to participate in and contribute to the mainstream economic, social, and political activities. In our opinion, the underdevelopment of human resources in SAT is both a cause and a consequence of the underdevelopment of SAT. So, development of human resources through empowerment seems to us a potent instrument of initiating and sustaining the process of development in SAT.

Training of farmers, especially small and marginal farmers, women, rural youth, rural bankers, suppliers of production inputs and services, local officials, and politicians is necessary for agricultural development. Agricultural orientation at primary and secondary levels and organization of vocational and technical training in agriculture and allied activities for intermediate level workers are necessary for catering to the technical manpower requirements of rural enterprises and institutions at the village and block levels.

Although most agricultural and rural development programs provide for the training of their beneficiaries and functionaries at all levels, the trainers, the training curricula, materials, and facilities available are not up to the desired mark and, therefore, there is a need for improvement in all these aspects of training. So far, not much attention has been given to the training of politicians in agricultural and rural development. Properly trained and oriented, motivated, and well-informed politicians can be of great help in promoting the cause of agricultural and rural development and the opposite of it can be a great obstacle to rural development. There is a need to develop appropriate curricula and facilities for training of politicians at all levels. In many cases, training of trainers would also be necessary.

Besides the empowerment of the SAT dwellers, it is also equally important to build the capacity of the SAT institutions and enable institutional learning and innovations. It is now widely accepted that institutions and organizations play an important role in the process of development. Organizations may affect agricultural and rural development in many different ways including provision of production inputs and services, reduction of transaction costs, enhancement of bargaining power of rural producers vis-a-vis those to whom they sell their produce and from whom they buy production inputs and services, influencing investments and savings and bringing the two together, and so on.

6.7 Concluding remarks

Given the fragile natural resource base, under-developed human resources, weak institutions and organizations, and the inadequacy and poor quality of basic infrastructure in SAT, the Green Revolution strategy will need to be suitably modified to be applicable to SAT. In fact, a completely different set of technologies, institutional arrangements and policies is required. One of the lessons of the experience of Green Revolution was that its benefits did not reach the poor people and the backward areas. In view of this, we will need to better target the poor and the relatively more backward areas in SAT through institutional and other innovations.

Given the serious and persistent problems of water scarcity and droughts in SAT in India, using water as an entry point and as a catalyst of development should receive the highest priority. The major areas of intervention include harvesting, storage and conservation of rain water, recharging of groundwater aquifers, ensuring efficient use of water, and improving the design and implementation of drought relief programs.

The mission of ICRISAT should be to direct and facilitate the SAT agriculture to emerge as a market-oriented, commercially viable, and ecologically sustainable means of producing food, fiber, raw materials and other commodities such that farmers find it profitable and respectable to do so.

A broad vision for SAT agriculture is to reduce poverty, hunger, and malnutrition, and ensure sustainable livelihoods for everyone. This vision could be actualized through a multi-pronged strategy mainly comprising (1) water as a catalyst of development; (2) diversification and selective specialization; (3) marketing and commercial orientation; (4) institutional innovations; (5) building and strengthening of the basic infrastructure; (6) better targeting of development interventions to the most needy people

and the most backward geographical areas within SAT as well as ensuring the poor to access resources, institutions, technology and markets via build up of social capital and empowerment; (7) focusing research on the most relevant and salient problems of SAT; and (8) building partnerships and linkages. This strategy deserves to be pilot-tested in selected SAT areas involving both governmental and non-governmental organizations engaged in and committed to promoting sustainable livelihoods in SAT.

There is a need to prepare a National Advocacy plan for action at village, block, district, state and national levels. The plan should aim at creating awareness among people in SAT including politicians about the need to manage their natural resources, especially land and water resources judiciously, mobilize people's energies and resources and catalyze action. Through creating an awareness among people in general and primary stakeholders in particular about the extent and severity of poverty and insecurity of livelihoods and changing their attitude towards SAT agriculture, many of the current problems could be resolved effectively.

Bibliography

Adato M and **Meinzen-Dick R.** 2002. Assessing The Impact of Agricultural Research on Poverty Using The Sustainable Livelihoods Framework. Food Consumption and Nutrition Division (FCND). Discussion Paper 128/ Environment and Production Technology Division (EPTD) Discussion Paper 89. Washington DC, USA: International Food Policy Research Institute (IFPRI).

Agarwal B. 1989. Social security and the family in rural India: coping with seasonality and calamity. DEP no 21. Suntory-Toyota International Centre for Economics and Related Disciplines, London, U.K.

Arnold JEM. 1990. Common property management and sustainable development in India, Working paper 9. Forestry for sustainable development program. USA: University of Minnesota.

Atkinson AB. 1987. On the measurement of poverty. Econometrica 55:749-764.

Ballabh V. 2002. Emerging Water Crisis and Political Economy of Irrigation Reforms in India. Paper presented at a workshop on Asian Irrigation in Transition Responding to the Challenges Ahead. Asian Institute of Technology, Bangkok, Thailand, 22-23 April 2002.

Ballabh V and **Choudhary K.** 1999. Small Water Harvesting Structures: Technology, Institution and Management. Workshop Report No. 15, Institute of Rural Management, Anand

Ballabh V and **Shah T.** 1989. Efficiency and Equity in Groundwater Use and Management. Workshop Report No. 3. Institute of Rural Management, Anand.

Ballabh V and **Singh K.** 1997. Competing Demands for Water in Sabarmati Basin: Potential and Future Conflicts. Paper presented at the IDPAD seminar, Amersfoort: The Netherlands, 11-17 October 1997.

Ballabh V and **Ujjawal P.** 2000. India's Water Crisis and Institutional Challenges: An Overview. Paper presented at the 8th Beinnial Conference of the LASCP, Indiana University, Bloomington, 31 May - 4 June 2004.

Balooni and **Singh K.** 2001. Tree Plantations for Restoration of Degraded Lands and Greening of India: A Case Study of Tree Growers' Cooperatives. Natural Resources Forum: A United Nations Journal 25(1).

Bauman P. 2001. Sustainable livelihoods and political capital: Arguments and evidence from decentralisation and natural resource management in India. Working Paper 136. London: Overseas Development Institute.

Bhardan PIC 1989. The New Institutional Economics and Development Theory: A Brief Critical Assessment. World Development 17(9): 1389-1395.

Birthal PS and **Parthasarathy Rao P.** 2002. Technologies For Sustainable Livestock Production In India. Proceedings of a workshop on documentation, adoption and impact of livestock technologies in India, 20-21 January 2001, ICRISAT, Patancheru, Andhra Pradesh, India (Birthal PS and Parthasarathy Rao P, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics; and New Delhi, India: National Centre for Agricultural Economics and Policy Research.

Birthal PS, Joshi PK and **Parthasarathy Rao** P. 2002. Vertical integration in agriculture sector studies: dairy, poultry and fruits and vegetables. Paper presented at the workshop on agricultural diversification in South Asia, jointly organized by RGOB, MoA, ICAR and IFPRI, Paro, Bhutan, 21-23 November 2002.

Bromley DW and **Cernea MM.** 1989. The management of common property natural resources: some common conceptual and operational fallacies. World Bank Discussion Paper 57. Washington DC, USA: World Bank.

Buvinic M and Gupta GR. 1994. Targeting poor women-headed households and women-maintained families in developing countries: views on a policy dilemma. Mimeo, Washington DC: International Centre for Research on Women.

Carney D (ed.). 1998. Sustainable rural livelihoods: What contribution can we make? London: Department for International Development (DFID).

Chambers R and Conway G. 1992. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper 296. Brighton: IDS.

Chambers R, Pacey A and Thrupp LA. 1989. Farmer first: Farmer innovation and agricultural research. London: Intermediate Technology Publications.

Chen MA. 1991. Coping with seasonality and drought. New Delhi, India: Sage Publications.

Coleman JS. 1990. Foundations of Social Theory. London: Belknap Press of Harvard University Press.

CRIDA (Central Research Institute for Dryland Agriculture). 1997. Vision-2020. CRIDA Perspective Plan. Central Research Institute for Dryland Agriculture, Indian Council for Agricultural Research, Hyderabad.

Davies S. 1996. Adaptable Livelihoods: Coping with food insecurity in the Malian Sahel. London: Macmillan.

Deaton A and **Dreze J.** 2002. Poverty and Inequality in India: A re-examination. Working Paper No. 107. New Delhi, India: Centre for Development Economics, Delhi School of Economics.

Deshingkar P and **Start D.** 2003. Seasonal Migration for Livelihoods in India: Coping, Accumulation and Exclusion. Working Paper 220. London, UK: Overseas Development Institute.

Dorward A, Poole N, Morrison J, Kydd J and **Urey** 1.2003. Markets, Institutions and Technology: Missing Links in Livelihoods Analysis. Development Policy Review, 2003, 21(3): 319-332.

Ellis F. 1999. Rural Livelihood Diversity In Developing Countries: Evidence And Policy Implications Natural Resource Perspectives Number 40, April 1999. London, UK: Overseas Development Institute.

Ellis F. 2000. Rural livelihoods and diversity in developing countries. Oxford: Oxford University Press.

Fan S and **Hazell P.** 2000. Should India invest more in Less-Favored Areas. Environment and Production Technology Division (EPTD) Discussion Paper.25. Washington DC. International Food Policy Research Institute

Fan S, Hazell P and **Thorat S.** 1998. Government Spending, Growth and Poverty: An Analysis of Interlinkages in Rural India. Environment and Production Technology Division (EPTD) Discussion Paper no. 33. Washington DC. International Food Policy Research Institute

Fan S, Hazell P and **Haque T.** 2000. Targeting public investments by agro-climatic zone to achieve growth and poverty alleviation goals in rural India. Food Policy, Vol. 25, No, 4, pp. 411-427.

Partington J. 2001. Sustainable Livelihoods, Rights and The New Architecture of Aid. Natural Resource Perspectives. No 69. London: Overseas Development Institute.

Foster J. 1984. On economic poverty: A survey of aggregate measures', *Advances in Econometrics*, 3:215-251

Francis P, Milimo JT, Njobvu CA and **Tembo SPM.** 1997. Listening to Farmers: Participatory Assessment of Policy Reform in Zambia's Agriculture Sector. World Bank Technical Paper 375, Washington D.C.: World Bank.

Gaiha R. 1989. Are the chronically poor also the poorest in India', *Development and Change* 20(2), 295-322.

Gaiha R and **Imai K.** 2003. Vulnerability, shocks and persistence of poverty - Estimates for Semi-Arid rural South India.

GOI (Government of India). 1973. Task Force Report 1973, Planning Commission, New Delhi.

GOI (Government of India). 2002. Annual Report 2001-2002, Ministry of Rural Development, New Delhi, 2002.

Gujarati DN. 1995. Basic Econometrics, 3/e. Singapore: McGraw-Hill. 838 pp.

Gulati A and **Tim Kelley.** 1999. Trade Liberalization and Indian Agriculture. New Delhi, India: Oxford University Press. Pp 15-36.

Hardin G. 1968. The Tragedy of the Commons. Science 162:1243-48.

Hewitt de Alcantara C (ed.). 1993. Real markets: Social and political issues of food policy reform United Nations Research Instituted for Social Development

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1998. Sustainable rainfed agriculture research and development project: database development, typology construction, and economic policy analysis, Module 1. Submitted to Indian council of Agricultural Research (ICAR) and Department of Agricultural Research and Education (DARE).

ICRISAT-ICAR (International Crops Research Institute for the Semi-Arid Tropics and Indian Council for Agricultural Research). 1999. Typology construction, and economic policy analysis. Sustainable rainfed agriculture research and development project (Module 1): Jointly published by ICRISAT and ICAR. 137 pp.

IRMA-UNICEF (Institute of Rural Management, Anand and United Nations Children's Fund). 2000. White Paper on Water in Gujarat, Institute of Rural Management, Anand and United Nations Children's Fund, Gandhinagar, Gujarat.

Jackson C. 1995. Rescuing gender from the poverty trap. Gender Analysis in Development Series, 10. Norwich: University of East Anglia School of Development Studies.

Jodha NS. 1996. Common property resources and the rural poor in dry regions of India. Economic and Political Weekly, 21.

Jodha NS. 1988. Poverty debate in India: a minority view, Economic and Political Weekly, Special Number, November 1988,2421-2428.

Kabeer N. 1995. Targeting women or transforming institutions? Policy lessons from NGO anti-poverty efforts. Development in Practice, 5,2. Oxford: Oxfam.

Kanwar JS. 1999. Need for a Future Outlook and Mandate for Dryland Agriculture in India. In Fifty Years of Dryland Agricultural Research in India, Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad.

Kelley TG, Jayawant M and **Parthasarathy Rao P.** 1997. Rainfed Agriculture typology in India. Economic and Political Weekly 32(26):A68-A70.

Kelley TG and **Parthasarathy Rao P.** 1993. Production and research environment for sorghum and millet in Asia, pp. 93-124 *in* Sorghum and Millets Commodity and Research Environments, Byth D.E. (ed.). ICRISAT, Patancheru.

Kelley TG and **Parthasarathy Rao P.** 1995. Marginal environments and the poor: evidence from India, Economic and Political Weekly 33(40).

Kelley TG and **Parthasarathy Rao P.** 1996. Availability and requirement of different sources of livestock feed in India with special reference to sorghum and millet straw. Pages 53-65 *in* Global Agenda for Livestock Research Proceedings of the Consultation for the South Asia Region, 8-6 June 1995, ICRISAT Asia Center, Patancheru. ILRI, Kenya.

Kelley TG, Parthasarathy Rao P and **Walker TS.** 1993. The Relative Value of Cereal Straw Fodder in India: Implications for Cereal Breeding Programs at ICRISAT, pp. 88-105 *in*

Social Science Research for Agricultural Technology Development: Spatial and Temporal Dimensions, Dvorak, K. (ed.). CABI, London.

Kerr J, 2000. Development Strategies For Semiarid South Asia **2020** Focus 4 (Promoting sustainable development in less-favored areas), Brief 6 of 9, November, Washington: **IFPRI**

Laxmiah A and Vijayaraghavan K. 2003. Health Action, April, **pp** 13-15.

Lockwood M. 1995. Beyond the feminisation of poverty: gender-aware poverty Reduction. BRIDGE Development and Gender in Brief, 2, pp. 1-3.

Marshland N and **Parthasarathy Rao P.** 1999. Marketing of *kharif and rabi* Sorghum in Andhra Pradesh, Karnataka, and Maharashtra. Socioeconomics and Policy Program, Progress Report. ICRISAT, Patancheru. (Being finalized).

Mehta AK and **Shah A.** 2003. Chronic poverty in India: Incidence, causes and policies. World Development 31(3):491-511.

Mortimore M, Adams B and Harris F. 2000. Poverty And Systems Research In The Drylands. Gatekeeper Series no. 94, London: International Institute for Environment and Development

Padmaja R. 1998. Women in SAT Agriculture. Socioeconomics and Policy Program Working Paper, International Crops Research Institute for the Semi-Arid Tropics.

Parthasarathy Rao P and **Birthal PS.** 2002. Crop-livestock systems research and policy issues: India. Policy Brief 1. Strategic assessment and development pathways for agriculture in the Semi-Arid Tropics. ICRISAT

Parthasarathy Rao P, Birthal PS, Joshi PK and **Kar D.** 2002. Agricultural diversification in India, role of urbanization and factors influencing diversification. Paper presented at the workshop on agricultural diversification in South Asia, Jointly organized by RGOB, MoA, ICAR and **IFPRI, Paro,** Bhutan, 21-23 November 2002.

Poulton C, Al-Hassan R, Cadisch G, Reddy C and **Smith L. 2001. The** cash crop versus food crop debate. Issues Paper - 3, January 2001 Crop Post-Harvest Programme, **Department for International Development (DFID).**

Putnam RD. 1993. Making Democracy Work: Civic Traditions in Modern Italy. Chichester: Princeton University Press.

Ryan JG and Spencer DC. 2001. Future challenges and opportunities for Agricultural R &D in Semi-Arid Tropics, International Crops Research Institute for the Semi-Arid Tropics

Scoones I. 1998. Sustainable Rural Livelihoods: A Framework for Analysis. IDS Working Paper No. 72. Brighton: Institute of Development Studies at the University of Sussex, June.

Scoones I and Thompson J (eds.). 1994. Beyond **Farmer** First: **Rural** People's Knowledge, Agricultural Research and Extension Practice. London: Intermediate Technology Publications.

Sen AK. 1981. Poverty and Famines: An Essay on Entitlement and Destitution. Oxford: oxford University Press.

Sen **AK.** 1984. Commodities and capabilities, North Holland, Amsterdam, The Netherlands.

Sen **AK.** 1990. Gender and cooperative conflicts, in I.Tinker (ed.) Persistent inequalities: women and world development, Oxford University Press, U.K.

Shah T. 1993. Groundwater Markets and Irrigation Development: Political Economy and Practical Policy, Oxford University Press, Delhi.

Sharma M, Brown L, Qureshi A and Garcia M. 1995. An Ecoregional Perspective on Malnutrition, IFPRI 2020 Vision Brief, 14, April 1995

Singh K. 1988. Managing Dry Land Watershed Development Programmes; Lessons of Karnataka Experience, Research Paper 1, Institute of Rural Management, Anand.

Singh K. 1991a. Dryland Watershed Development and Management: A Case Study in Karnataka, Indian Journal of Agricultural Economics, Vol. 46, No. 2, April - June, pp. 121-131.

Singh K. 1991b. Determinants of People's Participation in Watershed Development and Management: An Exploratory Case Study. Indian of Agricultural Economics, Vol. 46, No. 3, July-September, pp. 278-286.

Singh K. 1994a. People's Participation in Micro Watershed Management - A Case Study of an NGO in Gujarat, Indian Journal of Soil Conservation, Vol. 22, No. 1-2, pp. 271-78.

Singh K. 1994b. Managing Common Pool Natural Resources: Principles and Case Studies, Oxford University Press, New Delhi.

Singh K. 1995 a. The Watershed Approach to Sustainability of Renewable Common Pool Natural Resources: Lessons of India's Experience, Research Paper 14, Institute of Rural Management, Anand.

Singh K. 1995 b. Co-operative Property Rights as an Instrument of Managing Groundwater, in Moench (ed.) Groundwater Law : The Growing Debate, VIKSAT - Pacific Institute Collaborative Groundwater Project, Ahmedabad, Gujarat, India.

Singh K. 1995c. People's **Participation in Managing Common Pool Natural Resources. Social Change, Vol. 25, No. 1, March.**

Singh K. 1997a. Measurement of Poverty: A Critique of Common Methods and Indicators. Book chapter in R.C.

Choudhury and S. Rajakutty (Eds.), Fifty Year of Rural Development in India: Retrospect and Prospect, Vol. 1, National Institute of Rural Development, Hyderabad, pp. 183-196.

Singh K. 1997b. Property Rights and Tenures in Natural Resource, Book chapter in John Kerr, Dinesh Marothia, Katar Singh, C. Ramasamy and William Bentley (eds.) Natural Resource Economics: Theory and Applications in India, Oxford & IBH Publishing Co. New Delhi, 1997.

Singh K. 1999a. Sustainable Development: Some Reflections. Indian Journal of Agricultural Economics, 54 **(1).**

Singh K. 1999b. Rural Development: Principles, Policies and Management, Second edition, Sage Publication, New Delhi.

Singh K. 2001a. Managing India's Water Resources: Some Policy Issues and Options. Paper presented at the Curtain Raiser Function of Water Resources Day 2001 and World Water Day organized by the Indian Water Resources Society (Delhi Centre) on March 22, 2001 in Teen Murti Auditorium, New Delhi.

Singh K. 2001b. Managing India's Water Resources: Some Policy and Institutional Issues and Strategies for Resolving Them. Proceedings of Curtain Raiser Function of Water Resources Day, 2001 and World Water Day, Indian Water Resources Society (Delhi Centre), New Delhi.

Singh **K** and **Ghatak** RN. 1995. Pricing of Canal Irrigation Water: An Application of the Contingent Valuation Method, Arhta Vikas, July-December.

Singh K and **Gupta KK.** 1998. The Sadguru Model of Community-Based Natural Resources Management. Occasional Publication No. 14, Institute of Rural Management, Anand.

Start D, Deshingkar P and **Farrington J.** (forthcoming). The influence of wealth on patterns of livelihood diversification - evidence from field studies in **Andhra** Pradesh and Madhya Pradesh to be published in a book on the rural non-farm economy published by IHD, **New** Delhi.

Swift J. 1989. Why are rural people vulnerable to famine? IDS Bulletin, 20, 2.

Thirtle C, Beyers L, Lin L, McKenzie-Hill V, Irz X, Wiggins S and **Piesse J.** 2002. The impact in changes in agricultural productivity on the incidence of poverty in developing countries. Report to Department for International Development (DFID) No 7946.

Thomas D, Zerbini E, Parthasarathy Rao P and **Vaidyanathan A.** 2002. Increasing animal productivity on small mixed farms in South Asia: A system perspective. Agricultural Systems 71 (2002) 41-57

UNDP (United Nations Development Programme). 1997. Sustainable livelihoods: Concepts, principles and approaches to indicator development. A draft discussion paper. New York: United Nations Development Programme.

Uwe Deichmann. 1999. Geographic aspects of inequality and poverty, January 1999, http://www.worldbank.org/poverty/inequal/povmap/povmap.pdf

Wood GD. 1992. Parallel rationalities in service provision: the general case of corruption in rural development. Paper to European Network of Bangladesh Studies conference, CDR, Copenhagen.

World Bank. 1999. Can Anyone Hear Us? Voices from 47 countries. Poverty Group, PREM, Washington DC, USA: World Bank.

Appendixes

Appendix 1. The Semi-Arid Tropics and Other Agro-Ecological Zones

Appendix 1.1. The semi-arid tropics

The Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR) and FAO defines SAT as those areas, which have (a) (crop) growing period of 75-180 days; (b) mean monthly temperature higher than 18 degrees Celsius for all the twelve month of the year; and (c) daily mean temperature during the growing period higher than 20 degrees Celsius (Ryan and Spenser 2001). According to this definition, India has a SAT area of 1,289,713 sq km, which was nearly 42% of the total geographical area of the country (Ryan and Spenser 2001). Troll (1964) as quoted in Gulati and Kelley (1999) defines SAT as those tropical regions where rainfall exceeds potential evapotranspiration for two to seven months a year. Gulati and Kelley (1999) have used a slightly modified version of the agro-ecological region (AER) classification system used by the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) of the Indian Council of Agricultural Research (ICAR). The NBSS&LUP has divided India into 20 AERs, using soil and various bio-climatic parameters. Following AER classification, Gulati and Kelley delineated SAT by superimposing the AER map on to the All-India district map. Districts, which had 50% or more of their land area falling within the AERs 2 through 10, were considered as constituting SAT.

Appendix 1.2. List of districts by AEZ and irrigation levels

	HIGH Irrigation (>40% of GCA)	MEDIUM Irrigation (25- 40% of GCA)	LOW Irrigation (<25% of GCA)
AEZ	State/District Name	State/District Name	State/District Name
Humid (LGP:> = 180 days)	**Andhra Pradesh** Srikakulam, East Godavari, West Godavari, Khammam	**Andhra Pradesh** Vijayanagaram, Visakhapatnam	**Assam** Dhubri, Kokrajhar, Bongaigaon, Goalpara, Golaghat, Nalbari, Kamrup, Darrang, Sonitpur, Lakhimpur, Dhemaji, Morigaon, Nagaon, Barpeta, Jorhat, Sibsagar, Dibrugarh, Tinsukia, Karbi Anglong, North Cachar Hills, Karimganj, Hailakandi, Cachar
	Bihar Gopalgunj, Champaran (West), Champaran (East), Saharsa, Madhepura, Purnea, Katihar, Khagaria, Supaul	**Bihar** Seethamarhi, Darbhanga, Madhubani, Bhagalpur, Araria, Banka	**Bihar** Godda, Sahebganj, Dumka, Dhanbad, Hazaribagh, Lohardagga, Gumla, Ranchi, Singhbhum (West), Singhbhum (East), Kishangunj, Bokaro, Chatra
	Himachal Pradesh Kinnaur	**Himachal Pradesh** Kangra, Solan, Sirmaur	**Himachal Pradesh** Chamba, Hamirpur, Una, Bilaspur, Mandi, Kullu, Simla
	Karnataka Shimoga	**Karnataka** Dakshina Kannara	**Karnataka** Chickmagalur, Hassan, Kodugu, Uttara Kannara
	Kerala Thrissur	**Kerala** Kasaragod, Ernakulam, Alappuzha/Allepey	**Kerala** Kannur, Wayanad, Kozhikode, Malappuram, Palakkad, Idukki, Kottayam, Pathanamthitta, Kollam/Quilon, Thiruvananthapuram
		Madhya Pradesh Narsimhapur, Balaghat	**Madhya Pradesh** Mandla, Seoni, Rajnandgaon, Bastar
	Maharashtra Bhandara	**Maharashtra** Gadchiroli	**Maharashtra** Thane, Raigad, Ratnagiri, Sindhudurg, Kolhapur, Chandrapur

	HIGH Irrigation (>40% of GCA)	MEDIUM Irrigation (25 - 40 % of GCA)	LOW Irrigation (<25% of GCA)
AEZ	State/District Name	State/District Name	State/District Name
	Maharashtra Thane, Raigad, Ratnagiri, Sindhudurg, Kolhapur, Chandrapur	**Orissa** Cuttack, Balangir, Ganjam, Puri, Bhadrah, Jagatsinghpur, Jajpur, Kendrapara, Nayagarh, Khurda, Gajapati, Sonepur	**Orissa** Kendujhar, Mayurbhanj, Dhenkanal, Phulbani, Kalahandi, Koraput, Boudh, Nawapara, Malkangiri, Nawarangapur, Rayagada, Angul
	Tamil Nadu Chengalpattu MGR, Cuddalore (S. Arcot), Villupuram Ramaswamy Padaiyatchiar		**Tamil Nadu** The Nilgiris
	Uttar Pradesh Dehradun, Nainital, Haridwar, Kheri, Mahrajgunj, Gorakhpur, Deoria	**Uttar Pradesh** Bahraich, Gonda, Sidharthnagar	**Uttar Pradesh** Tehri Garhwal, Garhwal, Pithorgarh, Almorah
	West Bengal Hooghly, Bankura, Burdwan, Birbhum	**West Bengal** Midnapore, Purulia	**West Bengal** Jalpaiguri, Darjeeling, West Dinajpur, Malda, Murshidabad, Nadia, 24-Paraganas (N), 24-Paraganas (S), Howrah
Semi Arid Temperate (LGP:75-179 days, Temp:< = 18°C)	**Bihar** Saran, Sivan, Begusarai, Samastipur	**Bihar** Muzaffarpur, Vaisali	
	Haryana Ambala,Yamunanagar, Kurukshetra, Kaithal, Karnal, Panipat, Sonipat, Faridabad, Gurgaon, Rewari, Mahendragarh, Jind		
	Madhya Pradesh Morena, Gwalior, Datia, Tikamgarh	**Madhya Pradesh** Bhind, Chhatarpur	**Madhya Pradesh** Panna, Satna, Rewa
	Punjab Gurdaspur, Amritsar, Ludhiana, Jalandhar, Kapurthala, Hoshiarpur, Roopnagar, Patiala		
	Rajasthan Jaipur, Dausa	**Rajasthan** Alwar, Bharatpur, Dholpur, Sawai Madhopur, Sikar, Baran	**Rajasthan** **Alwar, Bharatpur, Dholpur, Sawai Madhopur, Sikar, Baran**

	HIGH Irrigation (>40% of GCA)	**MEDIUM Irrigation (25- 40% of GCA)**	**LOW Irrigation** (< **25 % of** GCA)
AEZ	State/District Name	State/District Name	State/District Name
	Uttar Pradesh Bijnor, Moradabad, Rampur, Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Bulandshahar, Aligarh, Mathura, Agra, Ferozabad, Etah, Mainpuri, Budaun, Bareilly, Pilibhit, Shajahanpur, Sitapur, Hardoi, Unnao, Lucknow, Rae Bareily, Farukkabad, Etawah, Kanpur (Dehat), Kanpur (Nagar), Jhansi, Fatehpur, Pratapgarh, Allahabad, Barabanki, Faizabad, Sultanpur, Basti, Azamgarh, Jaunpur, Ballia, Gazipur, Varanasi, Mirzapur	**Uttar Pradesh** Jalaun, Hamirpur, Banda	**Uttar Pradesh** Jalaun, Hamirpur, Banda
Semi-Arid Tropic (LGP: 75- 179 days, Temp > 18° C)	**Andhra Pradesh** Krishna, Guntur, Nellore, Chittoor, Cuddapah, Nizamabad, Karimnagar, Warangal, Nalgonda	**Andhra Pradesh** Prakasam, Mahabubnagar, Ranga Reddy, Medak	**Andhra Pradesh** Kurnool, Adilabad
	Bihar Patna, Nalanda, Bhojpur, Rohtas, Aurangabad, Jahanabad, Gaya, Nevada, Mungair, Buxar, Babhua, Jamui	**Bihar** Palamau, Gadva	**Bihar** Devghar, Giridih, Giridih
	Gujarat Mehsana, Gandhinagar, Kaira, Sura	**Gujarat** Bhavnagar, Banaskantha, Sabarkantha, Ahmedabad, Vadodara, Valsad	**Gujarat** Jamnagar, Rajkot, Surendranagar, Amreli, Junagadh, Panch Mahals, Bharuch
	Karnataka Mandya	**Karnataka** Belgaum, Chitradurga, Mysore, Raichur	**Karnataka** Bangalore (Urban), Bangalore (Rural), Bidar, Dharwad, Gulbarga, Kolar, Tumkur
	Madhya Pradesh Hoshangabad	**Madhya Pradesh** Shivpuri, Mandsaur, Ratlam, Ujjain, Shajapur, Dewas, Dhar, Indore, West Nimar, East Nimar, Rajgarh, Sehore, Bilaspur (MP), Durg, Raipur	**Madhya Pradesh** Guna, Sagar, Damoh, Shahdol, Sidhi, Jhabua, Vidisha, Raisen, Betul, Jabalpur, Chhindware, Surguja, Raigarh

	HIGH Irrigation (>40% of GCA)	MEDIUM Irrigation (25 - 40% of GCA)	LOW Irrigation (<25% of GCA)
AEZ	State/District Name	State/District Name	State/District Name
	Rajasthan Sirohi, Bundi, Kota	**Rajasthan** Ajmer, Pali, Bhilwara, Udaipur, Chittorgarh, Banswara, Jhalawar, Rajsamand	
		Maharashtra Satara	**Maharashtra** Nasik, Dhule, Jalgaon, Ahmadnagar, Pune, Sangli, Solapur, Aurangabad, Jalna, Parbhani, Beed, Nanded, Osmanabad, Latur, Buldhana, Akola, Amravati, Yeotmal, Wardha, Nagpur
	Uttar Pradesh Lalitpur		**Orissa** Sundargarh
	Tamil Nadu Vellore (N. Arcot), Tiruvannamalai, Erode (Periyar), Coimbatore, Trichy, Tanjavur, Puddukottai, Madurai, Tirunelveli Kattabom, Kanyakumari, Nagai Quaid-E-Milleth	**Tamil Nadu** Salem, Dindigul, Ramanthapuram, Kamarajar	
Arid (LGP: 0 - 74 days)	**Haryana** Rohtak, Bhiwani, Hissar, Sirsa	**Karnataka** Bellary	**Andhra Pradesh** Ananthapur
	Punjab Ferozpur, Sangrur, Bhatinda, Faridkot, Mansa		**Gujarat** Kutch
	Rajasthan Ganganagar	**Rajasthan** Jalore	**Rajasthan** Bikaner, Churu, Jhunjhunu, Jaisalmer, Jodhpur, Nagaur, Barmer
			Uttar Pradesh Chamoli, Uttar Kashi

Appendix 1.3. Relative importance of SAT with respect to the various climatic zones of India

Table 1.3.1. Relative importance of SAT and non-SAT districts of India: 1997-98.

Item	Share of All India (%)	
	SAT	**Non-SAT**
Geographical area	37.2	62.8
Population	36.9	63.1
Net cropped area (NCA)	46.2	53.8
Gross cropped area (GCA)	42.9	57.1
Gross irrigated area (GIA)	31.9	68.1
Coarse cereals (area)	58.7	41.3
Pulses (area)	52.6	47.4
Oilseeds (area)	59.7	40.3
Commercial crops (area)	60.0	40.0
Fruits and vegetables (area)	28.6	71.4
Coarse grains (production)	60.5	39.5
Pulses (production)	51.5	48.5
Oilseeds (production)	62.8	37.2
Value of Agricultural production (crops + livestock)	36.9	63.1

Source: ICR1SAT database

Table 1.3.2. Relative importance of various climatic zones of India: 1970-71.

Importance/regions	Share to total (%)*			
	Arid	Humid	Semi-arid temperate	**Semi-arid tropics**
Geographical area	12.3	30.0	13.8	43.9
Population	4.0	33.6	21.9	40.5
Net cultivated area	10.9	21.4	19.4	48.3
Gross cropped area	10.3	22.8	21.6	45.4
Gross irrigated area	11.2	19.3	35.7	33.9
Coarse cereals area	14.9	8.2	19.3	57.6
Pulses area	12.3	13.1	22.0	52.6
Oilseeds area	7.7	12.4	13.6	66.2
Commercial crops area	10.8	5.8	14.8	68.6
Fruits and vegetables area	5.0	26.2	18.6	50.2
Production of coarse grains	7.3	27.4	24.2	41.1
Production of pulses	4.2	30.1	35.0	30.7
Production of oilseeds	13.8	19.5	11.8	54.9
VOP agriculture	6.9	29.9	24.2	39.1

***Refers to the sum of 16 major agricultural states of India**

Source: ICRISAT database

Table 1.3.3. Selected indicators of SAT and non-SAT districts of India 1997-98.

Importance/regions	Arid	Humid	Semi-arid temperate	Semi-arid tropics	All India
Population density (No./Sq. km of geog. Area)	132	405	586	300	
Literate rural female (%)	36	41	35	39	39
Urban population %	24	20	24	30	28
Land size (ha)	4.5	1.0	1.1	1.9	1.6
Livestock units per ha (NCA)	0.9	2.8	2.1	1.7	2
Livestock Units Per capita	0.39	0.28	0.28	0.33	0.31
No. of small land holders	37	87	83	69	78
Net Area Sown Per Capita per 100 person	0.038	0.010	0.012	0.018	0.015
Per capita gross value of agricultural produce (Rs person^{-1})	7480	3215	4606	3919	3989
Gross value of agricultural produce (Rs ha^{-1})	19613	31570	39310	21985	27209
Tractor density (No/10'000 ha)	9.3	3.9	20.6	4.5	8.3
Diesel & Electric pump sets density (No/10'000 ha)	26.8	58.5	125.9	74.2	74.9
Cropping intensity (%)	126.6	140.3	148.0	124.2	139.2
HYV crop area (%)	26.5	41.2	51.5	31.7	40.7
Gross irrigated (%)	42.5	30.4	65.4	28.9	38.3
Fertilizer (kg ha^{-1} of NCA)	78	104	168	97	101
Fertilizer (kg ha^{-1} of GCA)	62	74	113	78	85
Mean normal rainfall (mm)	483	1835	956	965	1212
Market density (No/10,000 sq km)	14.1	23.8	34.2	21.3	22.1
Road density (km/sq. km)	0.3	0.7	0.5	0.5	0.75

Source: ICRISAT Database

Table 1.3.4. Selected indicators of SAT and Non-SAT districts of India 1970-71.

Indicators	SAT	Non-SAT	Total
Population density (No./sq km of geog. Area)		206	185
Literate rural female (%)	12.0	13.6	13.0
Urban population%	20.7	15.9	17.9
Land size (ha)	3.7	1.9	2.8
Livestock units per ha (NCA)	1.5	1.9	1.7
No. of small land holders	50.2	74.2	62.0
Tractor density (No/10,000 ha)	0.5	1.7	1.1
Diesel 8c Electric pump sets density (No/10,000 ha)	31.4	17.7	24.2
Cropping intensity (%)	111.1	124.8	118.2
HYV crop area (%)	8.7	9.9	9.4
Gross irrigated (%)	17.8	30.0	24.4
Fertilizer (kg ha^{-1} of NCA)	16.9	21.0	19.0
Fertilizer (kg ha^{-1} of GCA)	15.2	16.8	16.1
Market density (No/10,000 sq km)	13.7	15.7	14.7
Road density (km/sq. km)	0.3	0.2	0.2

Source: ICRISAT Database

Appendix 2. Evolution and Current Thinking of the Sustainable Livelihoods Approach

2.1 The genesis, evolution and current thinking

The Sustainable Livelihoods Approach (SLA) is now used by a number of governments and international development agencies including the Department for International Development (DFID), United Nations Development Programme (UNDP), SIDA, CARE and the International Fund for Agricultural Development (IFAD) as their overarching framework for poverty reduction. The concept of sustainable livelihoods was arguably first introduced by the Brundtland Commission on Environment and Development, and then advocated by the 1992 UN Conference on Environment and Development as a broad goal for poverty eradication. It was around that time that Chambers and Conway (1992) defined a livelihood and this is still the underlying premise of the SLAs today:

> *A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term.*

The sustainable livelihoods framework (as opposed to the approach) is an analytical tool, which provides a structure to help us understand livelihoods and ensure that external support is congruent with peoples' livelihood strategies and priorities.

2.2 Applying the SL approach to SAT agriculture - understanding risk and vulnerability

Understanding complexity: SAT livelihoods are complex and differ from place to place and even between individuals and households. There are big differences between the poor and the better-off in relation to the sources of income that feature most strongly in their respective livelihood strategies (Ellis 1999) The focus on assets also alerts us to the possibility that policies and projects targeting individuals or households with more assets, are likely to improve the incomes of those who are already better-off.

SAT livelihoods are typically a changeable combination of farm work, non-farm work and migrant remittances. The importance of migration (both temporary and permanent) needs to be recognized and has far-reaching implications for poverty in SAT areas. There is growing evidence that migration may be accumulative and remittances are an important part of the economy in remote, dry, rural areas (Deshingkar and Start 2003).

Understanding Change: It is important to understand that livelihoods progress in a non-linear, iterative fashion. The SLA offers scope for a 'dynamic' approach in that it attempts to understand change over time. It calls for a process approach in research and intervention implementation, which means updating existing knowledge all the time and generating new knowledge about livelihoods.

Taking a multi-dimensional view of poverty: The SLA recognizes the need for a more 'holistic' and 'non-sectoral' approach, which is multidisciplinary with multiple actors and influences because it is dealing with complex livelihoods that cannot be understood through one perspective. It is essentially a 'people-centred' approach, and puts the perceptions and priorities of the poor first because outside experts usually have very different perceptions from those who actually experience poverty This has fundamental implications for the understanding and measurement of poverty. Poverty should not be viewed only in terms of income or quantifiable indicators but also in terms of other less tangible factors such as status, happiness, safety, dignity and autonomy. In fact recent definitions of poverty include qualitative dimensions because it is now widely recognized that it is important that intangible processes and resources are incorporated into assessments of poverty (see for example participatory poverty assessments conducted by the World Bank year).

Adato and Dick (2002) for example argue that conventional poverty measures based on income, consumption, or nutrition are broadened to address

additional aspects of poverty and well-being, eg, access to land, water, credit, or education, vulnerability to natural disasters, political rights, physical safety, and social relationships that provide economic security and social well-being. Adato and Meinzen-Dick identify the following aspects of SL as being relevant to integrating social and economic assessment in the area of agricultural research and technology development:

- Defining poverty more broadly than by simple income or consumption standards, to include other aspects of well-being and empowerment;
- Distinguishing the impacts of agricultural research on socially differentiated groups;
- Attention to the importance of vulnerability and a whole range of assets in influencing adoption and impact of new technologies;
- Consideration of the nature of research and dissemination processes and how they impact on poverty; and
- Recognition that households and individuals are not only 'farmers' or 'consumers', but may employ a range of livelihood strategies, and that this influences the impact of agricultural research.

The following checklist, which builds on the one proposed by Scoones (1998) is useful for diagnosing the nature, extent and severity of poverty:

- Who are the poor - by caste, gender, and class - An important point here is to bear in mind that the poor are not just farmers. Much of the literature on dryland farming systems and SAT agriculture relates to the management of constraints and opportunities by *smallholders.* In the Indian context, an approach to SAT would not be complete without addressing the specific constraints, priorities and livelihood strategies of *assetless laborers* who form close to 40% of the working population in several locations. In fact the continued supposition that the poor are mainly poor farmers is inaccurate and even dangerous because it excludes a majority of those who need to be helped out of poverty.
- What are the main livelihood strategies pursued by different groups of people? An important guide for agriculture research is that *a priori* assumptions about the survival strategies of rural households cannot be made. It has been argued that assuming a particular rural social group is mainly dependent on the production of a particular crop or farming system for survival is likely to be wrong. In reality livelihood strategies are a great deal more complicated than assumed (Ellis 1999).
- Sequencing - What is the starting point for successfully establishing a particular livelihood strategy? Is one type of livelihood resource an essential precursor for gaining access to others?
- Substitution - Can one type of capital be substituted for others? Or are different forms of capital needed in combination for the pursuit of particular livelihood strategies?
- Clustering - If you have access to one type of capital, do you usually have access to others? Or is there a clustering of particular combinations of livelihood resources associated with particular groups of people or particular livelihood strategies?
- Access - Different people clearly have different access to different livelihood resources. A socially differentiated view to analyzing livelihoods is therefore critical, one that disaggregates the chosen unit of analysis - whether community, village or household - and looks at individuals or groups of social actors and their relationships, in relation to the range of relevant dimensions of difference (wealth, gender, age and so on) and the distribution of control over resources.
- Trade-offs - In pursuing a particular portfolio of livelihood strategies, what are the trade-offs faced by different people with different access to different types of livelihood resource? Depending on who you are, differential access to different types of capital may have positive or negative implications in terms of the success or otherwise in the pursuit of a sustainable livelihood.
- Trends - What are the trends in terms of availability of different types of livelihood resource? How are different capital assets being depleted and accumulated, and by whom? What are the trends in terms of access? What new livelihood resources are being created through environmental, economic and social change?
- Power - who holds power over investment decisions, resource allocation, providing access to services?
- Voice - How can we empower the poor and give them more voice to demand their entitlements and challenge power structures?
- Technology - which needs of the poor (expressed in their own terms) are amenable to technical solutions and do they have the capacity to utilize technologies that may be developed?
- Markets - which markets are important for the poor and how can interventions help to create markets or fill gaps where markets are missing? For instance are interlocked markets pro-poor in some circumstances?

Appendix 3. Determinants of Poverty

Table 3.1. Distribution of population across agro-ecological zones.

Agro-ecological zone	Rural		UrbanPopulation		Total	
	Number (millions)	% to all India	Number (millions)	% to all India	Number (millions)	% to all India
Humid High	70.387	10.2	14.452	6.2	84.839	9.2
Humid Medium	57.010	8.2	10.728	4.6	67.738	7.3
Humid Low	123.077	17.8	33.364	14.4	156.441	16.9
Humid	250.474	36.2	58.544	25.2	309.018	33.4
Semi-Arid Temperate High	122.133	17.7	39.611	17.0	161.744	17.5
Semi-Arid Temperate medium & low	23.599	3.4	3.637	1.6	27.236	2.9
Semi-Arid Temperate	145.732	21.1	43.248	18.6	188.980	20.4
Semi-Arid Tropic High	81.316	11.8	34.089	14.7	115.405	12.5
Semi-Arid Tropic Medium	75.845	11.0	28.343	12.2	104.188	11.3
Semi-Arid Tropic Low	90.315	13.1	0.492	0.2	90.807	9.8
Semi-Arid Tropic	247.476	35.8	62.924	27.1	310.400	33.6
Arid High	1.161	0.2	2.980	1.3	4.141	0.4
Arid Low & Medium	13.979	2.0	1.012	0.4	14.991	1.6
Arid	15.140	2.2	3.993	1.7	19.132	2.1
Unclassified[1]	32.692	4.7	63.688	27.4	96.651	10.5
All India	691.784	100.0	232.397	100.0	924.181	100.0

1. Information for classification was not available for some districts and some Urban districts were not included.
Source: ICRISAT Database, 1998.

Table 3.2. Water availability and infrastructure indices.

Agro-ecological zone	Rainfall (mm)	Irrigation ratio	Fallow land (%)	Market density	Road density	Infrastructure index
Humid high	1003	56.0	9.88	36.1	0.71	99.9
Humid medium	1273	34.3	9.26	20.8	0.99	81.7
Humid low	1768	16.3	15.09	23.3	0.63	83.6
Humid	1495	31.0	12.46	25.7	0.72	87.0
Semi-Arid Temperate high	776	71.7	9.13	29.9	0.18	104.2
Semi-Arid Temperate medium & low	727	33.6	9.32	18.9	0.11	82.4
SEMI-ARID TEMPERATE	766	62.1	9.17	26.9	0.16	98.3
Semi-Arid Tropic high	815	56.8	24.54	29.1	0.81	105.8
Semi-Arid Tropic medium	1009	31.1	16.64	21.3	0.35	86.9
Semi-Arid Tropic low	924	15.6	11.64	21.7	0.43	86.0
Semi-Arid Tropic	919	28.4	15.98	23.3	0.49	90.9
Arid high	393	79.3	5.61	58.6	0.39	128.9
Arid low & medium	587	20.5	20.17	12.5	0.17	85.3
Arid	506	39.9	15.88	22.3	0.22	94.6
All India	1099	36.0	14.0	24.4	0.49	91.0

Market density: Number per 10,000 per sq km
Road density: Per km^2
Source: ICRISAT Database, 1998

Table 3.3. Incidence of rural poverty across agro-ecological zones.

Agro-ecological zone	Head count	Poverty gap	Squared poverty gap	Sen's Index	MPCE
Humid High	22.1	3.7	7.1	5.2	462.0
Humid Medium	21.6	4.0	8.7	5.5	458.6
Humid Low	25.6	5.0	9.9	6.9	487.2
Humid	23.7	4.4	8.8	6.1	473.6
Semi-Arid Temperate High	13.7	2.1	3.8	3.0	512.1
Semi-Arid Temperate medium & low	19.5	2.8	4.1	3.8	462.8
Semi-Arid Temperate	14.6	2.2	3.8	3.1	504.1
Semi-Arid Tropic High	24.0	4.4	8.1	6.1	480.7
Semi-Arid Tropic Medium	23.2	4.1	8.5	5.7	468.5
Semi-Arid Tropic Low	25.5	4.7	9.2	6.6	467.8
Semi-Arid Tropic	24.3	4.4	8.6	6.2	472.3
Arid High	2.8	0.3	0.5	0.5	738.9
Arid Low & Medium	13.4	2.1	4.0	3.0	532.2
Arid	12.6	2.0	3.7	2.8	548.1
All India	21.3	3.8	7.4	5.3	485.9

Note: MPCE: Monthly Per Capita Total Expenditure in rupees.
Source: ICRISAT Database, 1998 and National Sample Survey 1999-2000

Table 3.4. Distribution of rural poor across agro-ecological zones.

	Poor on head count basis	
Agro-ecological zone	Number (millions)	Percentage to total poor
Humid high	15.591	10.6
Humid medium	12.304	8.3
Humid low	31.479	21.3
Humid	59.374	40.3
Semi-Arid Temperate high	16.783	11.4
Semi-Arid Temperate medium & low	4.604	3.1
Semi-Arid Temperate	21.387	14.5
Semi-Arid Tropic high	19.478	13.2
Semi-Arid Tropic medium	17.632	12.0
Semi-Arid Tropic low	23.071	15.6
Semi-Arid Tropic	60.180	40.8
Arid high	0.309	0.2
Arid low & medium	1.874	1.3
Arid	2.182	1.5
All India	147.478	100.0

Source: National Sample Survey 1999-2000

Table 3.5. Distribution of poor according to severity of poverty (percentages).

Agro-ecological zone	Very poor	Moderately Poor	Non poor	Rich
Humid high	5.3	16.9	39.7	38.1
Humid medium	6.3	15.3	41.5	36.9
Humid low	7.9	17.7	38.0	36.4
Humid	6.8	16.9	39.3	37.0
Semi-Arid Temperate high	2.6	11.1	35.2	51.1
Semi-Arid Temperate medium & low	2.8	16.7	38.3	42.2
Semi-Arid Temperate	2.6	12.0	35.7	49.7
Semi-Arid Tropic high	6.7	17.2	39.1	37.0
Semi-Arid Tropic medium	5.8	17.4	40.4	36.4
Semi-Arid Tropic low	7.2	18.3	37.9	36.5
Semi-Arid Tropic	*6.6*	17.7	39.1	36.6
Arid high	0.3	2.4	20.8	76.4
Arid low & medium	2.2	11.2	36.2	50.4
Arid	2.1	10.5	35.0	52.4
All India	5.6	15.7	38.0	40.7

Note: Very Poor: MPCE less than 75% of Poverty Line
Moderately Poor: MPCE between 75% and 100% of Poverty Line
Non Poor: MPCE between 100% and 150% of Poverty Lin
Rich: MPCE above 150% of Poverty Line
Source: National Sample Survey 1999-2000

Table 3.6. Incidence of head count poverty across social groups.

	Scheduled tribes		Scheduled castes		Others	
Agro-ecological zone	Incidence (%)	Population	Incidence (%)	Population (%)	Incidence (%)	Population (%)
Humid high	37.06	5.5	30.56	13.1	17.88	11.1
Humid medium	39.88	5.7	30.21	8.2	17.52	9.4
Humid low	48.30	35.4	26.61	12.3	19.54	20.8
Humid	43.2	44.3	28.5	33.3	18.6	41.3
Semi-Arid Temperate high	11.88	0.6	22.30	16.9	10.88	12.5
Semi-Arid Temperate medium & low	15.78	1.1	32.61	3.6	16.57	3.6
Semi-arid temperate	12.5	1.5	24.0	20.8	11.8	16.2
Semi-Arid Tropic high	40.05	5.6	36.90	18.2	18.35	13.5
Semi-Arid Tropic medium	35.15	17.4	30.76	10.2	17.65	10.9
Semi-Arid Tropic low	42.38	26.3	35.54	12.1	18.13	13.6
Semi-Arid Tropic	39.4	49.5	34.5	40.1	18.1	37.9
Arid high	Neg	Neg	5.77	0.6	0.95	0.1
Arid low & medium	36.20	0.6	20.07	1.4	10.68	1.5
Arid	33.4	0.6	19.0	3.3	9.9	2.2
All India	39.64	100.0 (28.771)	28.54	100.0 (40.323)	16.40	100.0 (78.200)

Note: Figures in parenthesis indicate total population of the corresponding group in millions.
Neg. = Negligible
Source: National Sample Survey 1999-2000

Table 3.7. Percentage of poor among occupational groups.

Agro-ecological zone	Self employed in non-agricultural activities	Agricultural labor	Non-agricultural labor	Self employed in agriculture	Other occupations
Humid high	16.9	33.3	21.6	13.9	12.2
Humid medium	17.0	31.9	31.6	15.9	8.3
Humid low	18.0	41.4	25.2	20.3	10.6
Humid	17.5	36.5	25.6	17.4	10.4
Semi-Arid Temperate high	14.4	28.0	16.0	8.2	11.5
Semi-Arid Temperate medium & low	17.9	46.3	18.9	10.3	17.5
Semi-Arid Temperate	14.9	31.1	16.5	8.6	12.2
Semi-Arid Tropic high	20.4	35.7	22.6	15.5	11.4
Semi-Arid Tropic medium	17.7	36.5	19.7	15.1	12.4
Semi-Arid Tropic low	17.2	38.1	27.6	18.3	7.4
Semi-Arid Tropic	18.6	36.8	23.5	16.4	10.0
Arid high	1.2	6.1	5.4	1.0	0.7
Arid low & medium	5.1	34.2	11.7	10.1	9.6
Arid	3.5	17.4	9.5	6.5	5.6
All India	16.9	35.5	22.2	13.9	10.5

Source: National Sample Survey 1999-2000

Table 3.8, Incidence of poverty by farm size.

Agro-ecological zone	Marginal	Small	Medium	Large
Humid high	15.1	16.3	9.9	0.6
Humid medium	14.9	18.3	17.7	7.4
Humid low	16.8	23.6	23.3	24.0
Humid	15.9	20.3	18.3	13.6
Semi-Arid Temperate high	11.4	7.8	3.7	1.4
Semi-Arid Temperate medium & low	15.9	10.3	7.7	5.8
Semi-Arid Temperate	12.1	8.2	4.3	2.1
Semi-Arid Tropic high	18.1	17.0	10.4	9.1
Semi-Arid Tropic medium	20.2	13.5	16.8	10.4
Semi-Arid Tropic low	22.8	19.2	20.4	12.4
Semi-Arid Tropic	20.5	16.7	16.0	10.7
Arid high	0.0	0.8	0.1	2.0
Arid low & medium	8.9	14.0	10.3	9.3
Arid	8.2	13.0	9.5	8.7
All India	15.2	15.0	13.4	9.0

Source: ICRISAT Database 1998 and National Sample Survey 1999-2000

Table 3.9. Poverty among male and female headed households.

Agro-ecological zone	Male headed	Female headed	All households	% of female headed households	Sample size
Humid High	22.5	18.5	22.1	9.1	626
Humid Medium	22.1	17.8	21.6	11.8	784
Humid Low	26.3	20.1	25.6	11.3	1961
Humid	24.3	19.2	23.7	10.9	3371
Semi-arid temperate High	13.0	21.0	13.7	8.2	875
Semi-arid temperate medium & low	18.6	29.1	19.5	8.2	167
Semi-arid temperate	13.9	22.2	14.6	8.2	1042
Semi-arid tropics High	23.5	28.6	24.0	10.3	788
Semi-arid tropics Medium	22.9	26.0	23.2	8.7	578
Semi-arid tropics Low	25.5	25.0	25.5	7.3	558
Semi-arid tropics	24.1	26.8	24.3	8.8	1924
Arid High	2.6	5.6	2.8	5.1	63
Arid medium & low	13.7	10.5	13.4	9.5	111
Arid	12.9	9.1	12.6	7.3	174
India	21.2	21.8	21.3	10.3	6947

Source: National Sample Survey, 1999-2000

Table 3.10. Calories derived from various food items.

Agro- ecological zone	Total per capita per day (in Rs)	Percentage of calories derived from						
		Cereals	Pulses	Milk	Meat fish & egg	Vege-tables	Others	Total non-cereals
Humid high	2145	71.2	4.4	4.8	1.2	6.2	12.2	28.8
Humid medium	2148	74.2	3.8	3.5	1.1	6.7	10.7	25.8
Humid low	2055	71.3	3.5	3.9	1.7	6.6	13	28.7
Humid	2101.5	71.9	3.8	4.1	1.4	6.5	12.3	28.1
Semi-Arid Temperate high	2326	64.0	5.1	9.5	0.3	6.8	14.3	36.0
Semi-Arid Temperate medium and low	2344	69.5	4.1	9.5	0.2	5.1	11.6	30.5
Semi-Arid Temperate	2328.9	64.9	4.9	9.5	0.3	6.5	13.9	35.1
Semi-Arid Tropic high	1958	69.4	4.6	5.9	0.7	5.5	13.9	30.6
Semi-Arid Tropic medium	1985	67.5	4.7	7.1	0.5	4.7	15.5	32.5
Semi-Arid Tropic low	2042	66.6	5.6	5.6	0.4	5.6	16.2	33.4
Semi-Arid Tropic	1996.9	67.8	5.0	6.1	0.5	5.3	15.3	32.2
Arid high	2638	54.0	3.8	21.2	0.1	4.1	16.8	46.0
Arid low & medium	2307	64.8	3.8	13.1	0.2	3.6	14.5	35.2
Arid	2332.4	63.9	3.8	13.8	0.2	3.6	14.6	36.0
All India	2138	67.9	4.5	6.6	0.8	6.0	14.2	32.1

Source: National Sample Survey 1999-2000

Table 3.11. Levels of expenditure and inequality.

Agro-ecological zone	Monthly per capita food expenditure (Rs)	Percentage of MPCE*	Price of cereals (Rs kg^{-1})	Expenditure Inequality
Humid high	284.9	61.7	8.1	30
Humid medium	280.8	61.2	8.4	29
Humid low	301.8	61.9	8.8	26
Humid	292.3	61.7	8.5	28
Semi-Arid Temperate high	291.1	56.8	7.1	27
Semi-Arid Temperate medium & low	278.7	60.2	7.3	33
Semi-Arid Temperate	289.1	57.4	7.1	28
Semi-Arid Tropic high	285.3	59.4	7.7	28
Semi-Arid Tropic medium	270.2	57.7	7.7	29
Semi-Arid Tropic low	266.4	56.9	7.0	28
Semi-Arid Tropic	273.8	58.0	7.4	28
Arid high	410.4	55.5	6.5	28
Arid low & medium	322.6	60.6	7.2	32
Arid	329.3	60.1	7.1	32
All India	287.5	59.2	7.9	29

* Share of food in total production
* * Ratio of bottom quintile to top quintile
Source: National Sample Survey 1999-2000

Table 3.12. Wage rates (Rs day^{1}) in agriculture and non-agriculture.

	Agricultural activities			Non-agricultural activities		
Agro-ecological zone	Males	Females	Persons[1]	Males	Females	Persons
Humid high	39.5	30.4	36.5	69.8	38.1	65.6
Humid medium	36.1	28.1	33.8	71.5	43.2	67.1
Humid low	39.7	28.2	36.3	80.0	131.6	88.2
Humid	38.8	28.8	35.8	75.2	85.2	77.0
Semi-Arid Temperate high	44.0	30.7	40.7	76.2	48.4	74.7
Semi-Arid Temperate medium & low	35.1	28.9	33.2	63.7	52.6	62.2
Semi-Arid Temperate	42.6	30.4	39.5	74.2	49.1	72.7
Semi-Arid Tropic high	42.9	30.2	37.4	74.1	110.3	81.3
Semi-Arid Tropic medium	34.0	26.0	30.3	70.8	37.2	64.1
Semi-Arid Tropic low	36.8	25.2	31.4	75.0	48.1	69.7
Semi-Arid Tropic	37.9	27.1	33.0	73.4	65.2	71.8
Arid high	63.9	61.5	63.6	107.5	50.7	103.7
Arid low & medium	33.8	24.0	28.4	60.8	41.3	56.5
Arid	36.1	26.9	31.1	64.4	42.0	60.1
All India	39.2	28.0	35.0	75.5	74.1	75.3

1. Persons relate to both males and females
Source: National Sample Survey 1999-2000

Table 3.13. Children (6-14 years) participating in economic activities.

Agro-ecological zone	Boys(%)	Girls (%)	Children (%)
Humid high	11.7	8.1	10.1
Humid medium	7.6	5.2	6.4
Humid low	7.7	7.1	7.4
Humid	8.8	6.9	7.9
Semi-Arid Temperate high	6.6	5.0	5.8
Semi-Arid Temperate medium & low	4.3	6.0	5.0
Semi-Arid Temperate	6.2	5.2	5.7
Semi-Arid Tropic high	10.8	11.1	11.0
Semi-Arid Tropic medium	13.8	15.9	14.8
Semi-Arid Tropic low	13.6	12.5	13.1
Semi-Arid Tropic	12.7	13.1	12.9
Arid high	10.3	2.5	6.7
Arid low & medium	14.5	23.0	18.5
Arid	14.2	21.4	17.6
All India	9.8	9.1	9.5

Source: National Sample Survey 1999-2000

Table 3.14. Work participation and unemployment rates.

	Person day unemployment rate (%)			Work participation rates (%)		
Agro-ecological zone	Males	Females	Persons[1]	Males	Females	Persons
Humid high	12.9	11.9	12.6	86.1	42.0	65.6
Humid medium	12.0	11.5	11.9	83.1	36.8	61.2
Humid low	11.8		11.6	83.9	44.2	65.1
Humid	12.2	11.4	11.9	84.3	41.9	64.4
Semi-Arid Temperate high	5.2	2.4	4.5	83.6	37.4	61.8
Semi-Arid Temperate medium & low	3.4	3.0	3.3	83.5	46.2	65.5
Semi-Arid Temperate	4.9	2.5	4.3	83.6	38.8	62.4
Semi-Arid Tropic high	11.8	10.7	11.4	86.1	56.3	71.8
Semi-Arid Tropic medium	5.9	5.4	5.7	87.1	64.3	76.0
Semi-Arid Tropic low	7.2	6.9	7.1	86.2	62.8	74.9
Semi-Arid Tropic	8.3	7.7	8.1	86.4	61.1	74.2
Arid high	5.4	1.0	4.3	83.5	47.8	66.2
Arid low & medium	8.9	6.1	7.8	82.5	54.6	68.1
Arid	8.6	5.7	7.5	82.6	54.1	68.0
All India	9.1	8.0	8.8	84.9	49.2	67.9

1 .Persons relate to both males and females

Source: National Sample Survey 1999-2000

Table 3.15. Percentage of children attending educational institutions.

Agro-ecological zone	Boys (6-14 years)	Girls (6-14 years)	Children (6-14 years)	Males (15-19 years)	Females (15-19 years)	Persons[1] (15-19 years)
Humid high	70.4	62.9	66.8	44.8	30.6	38.3
Humid medium	57.1	47.6	52.7	40.9	20.8	32.0
	72.2	60.9	66.8	61.1	28.3	44.6
Humid	68.3	58.4	63.6	51.9	27.2	40.0
Semi-Arid Temperate high	70.4	62.4	66.6	43.0	26.7	35.5
Semi-Arid Temperate medium & low	67.6	57.6	62.9	52.1	27.8	41.3
Semi-Arid Temperate	69.9	61.6	66.0	44.5	26.9	36.4
Semi-Arid Tropic high	66.6	57.1	62.2	42.8	27.3	35.5
Semi-Arid Tropic medium	66.0	53.5	60.4	42.5	17.4	31.3
Semi-Arid Tropic low	64.9	49.4	57.6	49.1	34.3	41.5
Semi-Arid Tropic	65.8	53.2	60.0	45.0	26.8	36.4
Arid high	61.7	49.1	55.8	39.6	20.8	31.2
Arid low &. medium	58.9	46.0	53.2	42.5	19.2	32.3
Arid	59.1	46.2	53.4	42.3	19.3	32.2
All India	66.7	56.8	62.0	43.4	26.3	35.5

1. Persons relate to both males and females
Source: National Sample Survey 1999-2000

Table 3.16. Primary and secondary education completion rates.

	Primary in 12-14 years age group (%)			Secondary in 15 -19 age group (%)		
Agro-ecological zone	Males	Females	Persons[1]	Males	Females	Persons
Humid high	70.0	58.6	64.5	23.8	17.8	21.0
Humid medium	54.3	41.4	48.8	13.2	10.1	11.9
Humid low	58.7	47.3	52.6	19.5	16.4	18.0
Humid	60.9	49.1	55.1	19.3	15.4	17.5
Semi-Arid Temperate high	65.9	58.0	62.0	22.4	18.1	20.4
Semi-Arid Temperate medium & low	59.7	41.4	50.5	17.9	10.9	14.8
Semi-Arid Temperate	64.9	55.3	60.1	21.7	16.9	19.5
Semi-Arid Tropic high	66.8	55.8	61.7	21.8	17.8	19.9
Semi-Arid Tropic medium	54.9	44.7	50.2	16.4	9.1	13.1
Semi-Arid Tropic low	51.7	43.7	48.1	20.4	13.0	16.6
Semi-Arid Tropic	57.6	48.0	53.2	19.6	13.4	16.6
Arid high	57.0	43.9	51.1	19.9	14.3	17.4
Arid low & medium	45.1	36.6	41.2	14.8	8.4	12.0
Arid	46.0	37.2	42.0	15.2	8.9	12.4
All India	63.0	52.3	57.9	21.1	16.3	18.8

1. Persons relate to both males and females
Source: National Sample Survey 1999-2000

Table 3.17. Number of dependents per worker.

Agro-ecological zone	Young	Old	All
Humid high	0.9	0.1	1.6
Humid medium	0.9	0.1	1.7
Humid low	0.9	0.1	1.6
Humid	0.9	0.1	1.6
Semi-Arid Temperate high	1.3	0.1	2.1
Semi-Arid Temperate medium & low	1.0	0.1	1.6
Semi-Arid Temperate	1.3	0.1	2.0
Semi-Arid Tropic high	0.7	0.1	1.1
Semi-Arid Tropic medium	0.7	0.1	1.0
Semi-Arid Tropic low	0.7	0.1	1.1
Semi-Arid Tropic	0.7	0.1	1.1
Arid high	1.1	0.2	2.1
Arid low & medium	0.8	0.1	1.3
Arid	0.8	0.1	1.4
All India	0.9	0.1	1.5

Source: National Sample Survey 1999-2000

Table 3.18. Agricultural characteristics.

Agro-ecological zone	Fertilizer Use (kg ha $^{-1}$)	Crop Output per hectare (Rs)	Crop Output per capita (Rs)	Livestock output per capita (Rs)
Humid High	131	30505	3737	1107
Humid Medium	61	22825	2816	906
Humid Low	59	21070	2956	1349
Humid	79	23995	3147	1173
Semi-Arid Temperate High	126	32926	4285	1333
Semi-Arid Temperate Medium & Low	48	14435	3184	1195
Semi-Arid Temperate	109	28284	4103	1310
Semi-Arid Tropic High	148	23314	3574	1290
Semi-Arid Tropic Medium	80	15721	4118	1566
Semi-Arid Tropic Low	63	13649	4637	1586
Semi-Arid Tropic	85	16417	4137	1486
Arid High	117	34041	13273	3354
Arid Low & Medium	37	9275	4894	1911
Arid	70	17464	8251	2489
All India	86	20350	3946	1375

Source: ICRISAT Database 1998, National Sample Survey 1999-2000

Table 3.19. Percentage share of public distribution system in total quantity purchased.

Agro-ecological zone	Rice & wheat	Sugar	Kerosene
Humid high	13.8	48.1	71.4
Humid medium	12.2	49.6	68.2
Humid low	16.1	45.4	88.4
Humid	14.6	47.1	79.0
Semi-Arid Temperate high	2.2	18.1	68.5
Semi-Arid Temperate medium & low	1.7	27.8	75.1
Semi - Arid Temperate	2.1	19.7	69.6
Semi-Arid Tropic high	13.3	51.1	70.6
Semi-Arid Tropic medium	15.1	38.3	79.1
Semi-Arid Tropic low	17.5	29.8	59.4
Semi-Arid Tropic	15.4	39.4	69.1
Arid high	0.9	16.1	81.8
Arid low & medium	17.0	29.9	77.3
Arid	15.8	28.8	77.6
All India	12.4	34.8	76.5

Source: National Sample Survey 1999-2000

Table 3.20. Prices in the open market and public distribution system.

	PDS price (Rs kg^{1})			Percentage of PDS price to open market price		
Agro-ecological zone	Rice& wheat	Sugar	Kerosene	Rice& wheat	Sugar	Kerosene
Humid high	4.1	10.4	4.0	42.7	65.0	41.7
Humid medium	6.0	11.4	4.3	63.8	69.9	45.7
Humid low	7.2	11.4	1.3	69.2	80.3	13.8
Humid	6.1	11.1	2.7	60.9	73.2	29.0
Semi-Arid Temperate high	5.8	11.9	4.3	73.4	76.3	43.0
Semi-Arid Temperate medium & low	4.0	12.2	4.2	50.0	75.3	47.2
Semi-Arid Temperate	5.5	11.9	4.3	69.6	76.1	43.6
Semi-Arid Tropic high	4.0	11.9	3.8	71.4	75.8	39.6
Semi-Arid Tropic medium	4.6	11.5	3.8	50.0	74.2	46.3
Semi-Arid Tropic low	4.8	11.3	4.1	51.6	74.8	53.2
Semi-Arid tropic	4.5	11.6	3.9	55.6	75.0	46.1
Arid high	4.1	11.4	4.0	62.1	70.8	54.1
Arid low & medium	5.1	11.8	3.9	66.2	71.1	58.2
Arid	5.0	11.8	3.9	66.0	71.1	57.9
All India	5.3	11.5	2.9	62.4	74.7	31.9

Source: National Sample Survey 1999-2000

Table 3.21. Percentage of poor not purchasing and non-poor purchasing from public distribution system.

Agro-ecological zone	Percentage of poor not purchasing from PDS			Percentage of non-poor purchasing from PDS		
	Rice& wheat	Sugar	Kerosene	Rice& wheat	Sugar	Kerosene
Humid high	47.3	25.2	17.5	32.2	67.0	79.1
Humid medium	49.9	21.3	17.6	32.2	65.3	81.1
Humid low	49.4	21.4	18.8	37.8	71.8	81.5
Humid	48.9	22.4	18.2	35.0	69.0	80.7
Semi-Arid Temperate high	63.6	42.8	16.3	4.5	41.4	72.3
Semi-Arid Temperate medium & low	67.5	39.1	23.8	4.7	49.2	72.8
Semi-Arid Temperate	64.2	42.2	17.5	4.5	42.7	72.4
Semi-Arid Tropic high	30.3	16.8	17.6	49.9	67.3	74.5
Semi-Arid Tropic medium	42.1	19.4	15.0	38.8	70.7	79.0
Semi-Arid Tropic low	40.4	28.1	33.3	41.4	61.7	63.0
Semi-Arid Tropic	37.6	21.7	22.5	43.4	66.3	71.7
Arid high	80.3	56.2	15.3	2.9	65.3	72.9
Arid low & medium	33.0	16.9	14.4	29.3	65.0	71.5
Arid	36.6	19.9	14.5	27.3	65.0	71.6
All India	45.8	24.7	19.9	31.2	62.2	75.3

Source: National Sample Survey 1999-2000

Table 3.22. Coverage under anti-poverty programs during previous five years.

Agro-ecological zone	IRDP (%)	Employment (%)
Humid high	4.8	3.5
Humid medium	5.2	3.1
Humid low	6.4	3.8
Humid	5.7	3.6
Semi-Arid Temperate high	5.7	2.4
Semi-Arid Temperate medium & low	5.7	2.4
Semi-Arid Temperate	5.7	2.4
Semi-Arid Tropic high	3.5	2.0
Semi-Arid Tropic medium	5.5	2.8
Semi-Arid Tropic low	5.7	2.5
Semi-Arid Tropic	4.9	2.4
Arid high	6.9	1.3
Arid low & medium	3.8	2.7
Arid	4.0	2.6
All India	5.3	2.8

Source: National Sample Survey 1999-2000

Table 3.23. Percentage of households using electricity for lighting and gas for cooking.

Agro-ecological zone	Electricity For lighting	Gas for cooking
Humid high	35.79	5.44
Humid medium	24.89	3.70
Humid low	39.39	5.49
Humid	35.1	5.1
Semi-Arid Temperate high	36.48	5.25
Semi-Arid Temperate medium & low	38.48	1.56
Semi - Arid Temperate	36.8	4.7
Semi-Arid Tropic high	63.09	8.58
Semi-Arid Tropic medium	66.96	5.10
Semi-Arid Tropic low	69.27	5.91
Semi-Arid Tropic	66.5	6.5
Arid high	81.12	10.74
Arid low & medium	55.83	5.95
Arid	57.8	6.3
All India	48.35	5.71

Source: National Sample Survey 1999-2000

Table 3.24. Computation of human development index for different zones.

Agro-ecological zone	STDLIVING	KNOWLEDGE	HEALTH	HDI
Humid High	0.253	0.466	0.416	0.378
Semi-Arid Temperate High	0.287	0.453	0.360	0.367
Semi-Arid Tropical High	0.249	0.434	0.454	0.379
Arid High	0.394	0.371	0.499	0.421
Humid Medium	0.240	0.352	0.375	0.322
Semi-Arid Temperate Low and Medium	0.273	0.403	0.292	0.323
Semi-Arid Tropical Medium	0.243	0.372	0.399	0.338
Arid Low and Medium	0.306	0.318	0.398	0.341
Humid Low	0.241	0.423	0.462	0.375
Semi-Arid Tropical Low	0.249	0.389	0.472	0.370

Source: National Sample Survey 1999-2000

Table 3.25. Coefficients of correlation between poverty and socio economic variables.

	India	Humid High	Humid Medium	Humid Low	Humid	Semi-Arid Temp High	Semi-Arid Temp Low & Medium	Semi-Arid Temperate
Crop output per capita	–0.285***	–0.132	–0.043	0.095	0.028	–0.548***	–0.624***	–0.533***
Crop output per hectare	–0.341***	–0.347**	–0.433***	–0.323***	–0.349***	–0.440***	0.089	–0.392***
Live stock output per capita	–0.394***	–0.186	–0.160	–0.537***	–0.370***	–0.476***	–0.464***	–0.454***
Percentage of Fallow lands	0.204***	0.137	0.201	0.130	0.156**	0.446***	0.420	0.394***
Population density	–0.025	–0.051	–0.231	–0.372***	–0.312***	0.241***	0.382	0.224**
Fertilizer per hectare	–0.289***	–0.303	0.089	–0.414***	–0.328***	–0.446***	0.231	–0.357***
Primary education completion rate	–0.258***	–0.019	–0.385**	–0.721**	–0.532***	–0.279**	–0.376	–0.303***
Secondary education completion rate	–0.245***	–0.192	–0.602***	–0.579***	–0.517***	–0.114	–0.017	–0.107
Literacy rate	–0.321***	–0.118	–0.568***	–0.692***	–0.535***	–0.419***	–0.094	–0.379***
Percentage of SC Population	–0.003	0.227	0.00	–0.086	–0.061	0.338***	0.031	0.263*
Percentage of ST Population	0.469***	–0.034	0.581***	0.735***	0.630***	–0.157	–0.013	–0.040
Percentage of Agri–cultural Laborers	0.433***	0.446***	0.630***	0.635**	0.431***	0.628***	0.284	0.522***
Percentage of Non–Agricultural Laborers	–0.279***	–0.365**	–0.421**	–0.469**	–0.392***	–0.407***	0.003	–0.363***
Work Participation rates	0.175***	0.155	0.218	0.272***	0.259***	–0.001	–0.022	0.018
Female work Participation rate	0.118**	0.004	0.174	0.144	0.150	0.033	0.028	0.051
Child work	0.138***	–0.299	0.168	0.523***	0.286***	0.078	–0.323	–0.061
Un–employment rate	0.127**	0.228	–0.107	–0.052	–0.043	0.170	0.081	0.128
Market density	–0.268***	–0.172	–0.210	–0.323***	–0.255***	–0.349***	–0.275	–0.337***
Infrastructure Index	–0.326***	–0.234	–0.189	–0.518***	–0.374***	–0.343***	–0.130	–0.305***
Cereal Price	0.024	–0.053	–0.372**	–0.264**	–0.210***	–0.100	0.499**	–0.027
Agricultural Wage	–0.464***	–0.486***	–0.563***	–0.544***	–0.508***	–0.468***	–0.322	–0.453***
Non–Agricultural Wage	–0.266***	–0.259	–0.288	–0.493***	–0.387***	0.095	0.075	0.096

Table 3.25. Coefficients of correlation between poverty and socioeconomic variables (contd...)

	Semi-Arid Tropic High	Semi-Arid Tropic Medium	Semi-Arid Tropic Low	Semi-Arid Tropic	Arid High	Arid Medium & Low	Arid
Crop output per capita	-0.236	-0.336**	-0.242	-0.249***	-0.006	0.015	-0.383
Crop output per hectare	-0.120	-0.315**	-0.253	-0.196**	-0.277	-0.112	-0.438**
Live stock output per capita	-0.158	-0.353**	-0.494***	-0.327***	-0.081	-0.575	-0.464**
Percentage of Fallow lands	0.096	0.156	0.173	0.123	-0.045	0.204	0.439**
Population density	0.079	0.083	0.137	0.069	-0.048	0.014	-0.017
Fertilizer per hectare	-0.032	0.015	-0.238	-0.820	-0.386	0.513	-0.201
Primary education completion rate	-0.045	-0.099	-0.129	-0.059	-0.355	0.469	0.042
Secondary education completion rate	0.002	0.217	-0.190	0.010	-0.456	0.138	-0.040
Literacy rate	-0.288	-0.225	-0.139	-0.169**	-0.622	-0.301	-0.452**
Percentage of SC Population	0.370**	0.255	0.124	0.231***	0.648**	0.205	-0.130
Percentage of ST Population	-0.076	0.126	0.297**	0.142	-0.433	0.282	0.340
Percentage of Agricultural Laborers	-0.008	0.300**	0.346**	0.225***	0.145	0.712***	0.445**
Percentage of Non-Agricultural Laborers	-0.160	-0.397***	-0.283**	-0.255***	-0.253	-0.291	-0.460**
Work Participation rates	-0.125	0.077	-0.135	-0.086	0.648**	0.334	0.287
Female work Participation rate	-0.134	0.074	-0.051	-0.063	0.508	0.247	0.264
Child work Participation rate	-0.096	-0.173	0.125	-0.052	0.594	0.522	0.618***
Un-employment rate	-0.019	-0.004	0.260	0.097	-0.120	0.604**	0.465**
Market density	-0.283	-0.055	0.086	-0.096	0.168	0.536	-0.235
Infrastructure Index	-0.095	-0.230	-0.195	-0.148	-0.650**	0.029	-0.431**
Cereal Price	-0.219	0.025	-0.139	-0.114	-0.754**	-0.119	-0.065
Agricultural Wage	-0.127	-0.357**	-0.492***	-0.332***	0.100	-0.771***	-0.631***
Non-Agricultural Wage	-0.132	-0.388***	-0.175	-0.190**	-0.279	-0.586**	-0.581***

**Significant at 5% level

***Significant at 1% level

Source: ICRISAT Database. 1998 and National Sample Survey 1999–2000

Table 3.26: Results of regression equations – Dependent variable: incidence of head count poverty (percentage).

Variable	Humid Low	Semi-Arid Temperate High	Semi-Arid Tropic Medium	Semi-Arid Low	Humid	Semi-Arid Temperate	Semi-Arid Tropic	Arid	All India
Constant	168.1	94.3	124.7	228.0	143.9	97.4	140.2	77.6	136.6
Ln crop Output per capita		–7.144 (–4.845)	–5.975** (–2.069)	–54.57** (–2.008)	–8.967*** (–3.982)	–8.295*** (–5.061)	–6.624*** (–3.769)		
Ln crop Output per hectare		–3.199* (–1.569)		–18.069*** (–2.653)	–3.321 (–1.413)			–5.243*** (–3.998)	–2.915*** (–2.984)
Ln live. OutputPer capita	–19.241*** (–7.163)								–6.549*** (–4.699)
Fallow Land (%)									
Literacy Rate	–0.220*** (–2.659)				–0.083 (–1.026)				–0.064 (–1.421)
ST (%)	0.420*** (7.314)				0.414*** (7.652)				0.305*** (9.119)
Ag. Labor (%)	0.393* (1.737)	1.802*** (5.645)	0.481* (1.727)		0.348** (1.975)	0.856*** (2.738)	0.382* (1.869)	0.767*** (4.032)	0.324*** (2.954)
Non-ag.Labor (%)		–0.161** (–1.901)	–0.413** (–2.659)	–0.263 (–1.272)		–0.139* (1.524)	–0.176* (–1.553)		
Work Particip. Rate (%)									
Unemploy. Rate (%)								0.644** (2.633)	0.359*** (3.55)
Ln cereal price	–5.161								
Ln ag. wage rate	(–0.832)			–17.644** (–2.463)	–7.739** (–2.010)	–5.127 (–1.440)	–11.684** (–2.031)		–11.872*** (–4.851)
Ln non-ag. Wage Rate	–8.964*** (–2.142)		–13.142 (–1.438)		–5.252 (–1.497)		–5.884* (–1.573)	–7.166* (–1.567)	–5.873*** (–2.852)
R Square	0.809	0.657	0.388	0.416	0.617	0.539	0.237	0.786	0.526
F	59.973***	31.089***	6.332***	8.559***	35.501***	23.642***	8.312***	15.656***	55.551***

Figures in parentheses are t ratios
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Source: ICRISAT Database, 1998 and National Sample Survey 1999-2000

Table 3.27. Results of regression equations of crop productivity dependent variable: logarithm (crop output per hectare).

Variable	Humid	Semi-Arid Temperate	Semi-Arid Tropic	Arid	All India
Constant	8.900	8.281	7.969	7.400	8.495
Ln Fert. Per Hectare	0.078**	0.367***	0.203***	0.1390*	0.119***
	(2.202)	(3.696)	(4.287)	(1.718)	(4.556)
Irrigation Ratio	0.009***	0.016***	0.005***	0.015***	0.009***
	(4.825)	(3.880)	(3.900)	(3.120)	(9.930)
Literacy Rate	0.007***	0.003	0.008***	0.018***	0.010***
	(4.002)	(0.627)	(3.811)	(2.929)	(7.496)
Ln. Market Density	0.040	-0.019***	0.093**	0.075	0.018
	(1.143)	(-2.921)	(2.408)	(0.745)	(0.716)
R Square	0.312	0.577	0.511	0.909	0.455
F	17.6	27.2	34.8	40.0	83.8
Significance of F	0.0	0.0	0.0	0.0	0.0

Figures in parentheses are t ratios
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level
Source: ICRISAT Database 1998, and National Sample Survey 1999-2000

Appendix 4. Identifying Determinants of Income Poverty - Framework

We try to elaborate how far the theory of production can help explain the existing level of income poverty, or alternatively, its opposite income growth and identify its determinants. We know that profit or net income from production of a commodity or provision of a service (Y) can be expressed as follows:

$$Y = PQ - (R_1 X_1 + R_2 X_2 + \text{—} + R_n X_n) \quad (4.1)$$

Where

Y = Profit or net income from production or provision of some service;

P = Price of the commodity produced or remuneration from the service provided

Q = Quantity of produce or extent of service rendered;

R_1, R_2 — R_n = Prices of inputs X_1, X_2, — X_n ; and

X_1, X_2 — X_n = Inputs used in the production of the commodity or provision of the service.

In words, this means that net income is the value of the commodity produced or the remuneration for the service rendered less the cost of production of the commodity or the provision of the service. We know that in perfectly competitive markets, prices of output and inputs cannot be affected by the decisions of a single producer/consumer. This means that a rational producer has to take the market prices of his produce and production inputs as given and then try to maximize the production with a given bundle of production inputs, or alternatively try to minimize the cost of producing a given level of output in order to maximize his income. For this, the producer must understand the nature and type of the underlying production function and cost function. A typical farm production function could be expressed as follows:

$$Q = f(X_1, X_2, - X_n) \quad (4.2)$$

Where Q is the quantity of farm output and X_1, X_2, ---X_n are production inputs such as land, seeds, fertilizers, irrigation water, labor, mechanical and animal power, machinery, management etc. These inputs together represent all the major categories of factors of production, ie, natural resources, human resources, technology, capital, and management. The model could be used to estimate the nature and extent of effect of various inputs on output of a given farm commodity. When expressed in monetary terms, it could also be used to estimate the effect of various factors on aggregate value of farm output. In that case, the dependent variable (Q) should be an index of value of total farm output and the independent (explanatory) variables could also include measures of infrastructure such density of markets, or infrastructure index. Shenngen et al. (2000) have used the Tornqvist-Theil index of agricultural output as the dependent variable in their model.

In the context of a rural household in SAT, we could express them as a typical income generating function as follows:

$$Y = Y_{fi} + Y_{nfi} \quad (4.3)$$

Where

Y = Household income in rupees per annum;

Y_{fi} = Income from farm enterprises; and

Y_{nfi} = Income from non-farm sources.

In words, this means that the total household income is equal to the income from farm and non-farm enterprises or activities.

Given this formulation and the knowledge of underlying production functions, we could identify various factors that affect household income. Those factors could be classified into the following categories

1. Natural resources such as land, water (rainfall), humidity, solar radiation, temperature and so on;
2. Human resources including their knowledge, skills, motivation, etc.;
3. Technology comprising improved seeds, fertilizes, pesticides, machinery, etc.
4. Financial capital;
5. Physical capital embodied in Infra-structure such as roads, schools, hospitals, means of transport and communication, markets, etc.;
6. Organization and Management; and
7. Public policies and programs.

Now, drawing upon the theory of production and based on the knowledge of the underlying production functions, we could formulate a set of hypotheses about the possible relation between the level of income poverty or, alternatively, income growth and a particular set of factors as specified above. For example, we could formulate a hypothesis that the level of farm income (poverty) in an area is affected,

among other things, by the quantity and quality of land resources available - higher the per capita quantity and better the quality of land (in terms of productivity), *ceteris paribus,* higher the per hectare crop yield and hence higher the farm income, or lower the level of farm income poverty. This hypothesis could then be tested empirically using appropriate statistical tools and techniques.

We have used per capita household consumption expenditure as a proxy for per capita household income. This is because of the lack of availability of estimates of household income for SAT and the availability of household consumption estimates from a recent National Sample Survey (NSS) round. The use of household consumption expenditure as a proxy for household income is universally recognized as a sound practice as it is based on a relation between income and consumption, We know that income is normally used for consumption and saving, ie,

$$Y = C + S, \text{ or } C = Y - S \quad (4.4)$$

Where;
Y - Household income;
C = Household consumption expenditure; and
S = Household savings.

So, from Equation 4.4, we know that, in equilibrium, household consumption is equal to household income minus household savings. If S = 0, then, C = Y; if S > 0, then, C is less Y; and if S < 0, then, C is higher than Y. For a large sample from SAT, all these three conditions may hold and negative savings may offset the positive savings, rendering household consumption almost equal to household income in the long run. From macro economic theory of income determination, we know that

$$C = a + bY \quad (4.5)$$

In words, this means that consumption is a function of some constant (threshold level of fixed expenditure) and some fraction (b < 1) of income. This also establishes a definite relation between income and consumption.

Based on the concepts, measures, and determinants of income poverty presented in earlier paragraphs of this chapter, we have developed a conceptual framework connecting the context of poverty, causal factors, interventions, and poverty reduction. It is presented in Figure 2.1. This framework is intended to connect logically the materials presented in subsequent chapters of this report. An algebraic version of this framework could be expressed as follows:

$$P_{0i} = f(FP_i, W_i LP_i , II_i , AL_i , ST_{pI} \quad (4.6)$$

Where
P_{oi} = The proportion of rural population that is poor (Headcount index) for the ith district.
FP_i = Farm productivity index for the ith district.
W = Wage rates for the ith district.
LP. = Livestock Productivity Index for the ith district.
II_i = Infrastructure index for the ith district.
AL_i = Percentage of Agricultural Labor in the Rural Population
ST_{pi} = Percentage of Scheduled Tribes in the Rural Population

Appendix 5. Methodology for Computing Poverty Indicators

The analysis is based on ungrouped household data of the 55th Round (1999-2000) of the National Sample Survey (NSS) on Consumer Expenditure and Employment and Unemployment. The sample consisted of 1,20,309 households (71,385 rural and 48,924 urban) in the Consumer Expenditure Survey 1,21,373 households (71,859 rural and 49,514 urban) in the Employment and Unemployment survey. The household data is aggregated for the ten agro-climatic zones using the household level multipliers developed by the National Sample Surveys Organization (NSSO). Initially, we started with 12 zones (four broad zones-Humid, Arid, Semi-Arid Temperate and Semi-Arid Tropical and each again divided into three irrigation levels viz., less than 25% (low), 25 to 40% (medium) and above 40% (high). As our analysis focuses on rural poverty, purely urban districts and a few districts for which data for classification were not available were not taken into account. Since the number of districts turned very small, low and medium irrigation zones were clubbed together in case of Arid and Semi-Arid Temperate zones, reducing the number of zones for analysis to ten. As validation for proper use of multipliers, the monthly per capita expenditures at the State level are first derived and compared with the results published by the NSSO. In addition to these major sources, district-wise data on agricultural statistics of the Ministry of Agriculture and Cooperation and decennial population census data from Registrar General of Census operations are also used.

Poverty line is the most important parameter needed in the estimation of poverty. The official poverty lines adopted by the Planning Commission for 1999-2000 are available for each of the major states. Angus Deaton (2003) has also estimated poverty lines for the same year on the basis of the price indices derived from NSS consumption data. These rural poverty lines are lower than those adopted by the Planning Commission in the official estimates for all the states except Andhra Pradesh, Tamil Nadu, Karnataka and Gujarat (Appendix 3 Table 3.1) Deaton estimated poverty in India fusing these lines. However, he has adjusted the consumer expenditure data of the 55th Round for overstatement. As a result of these two adjustments in opposite direction, his estimate of rural poverty is very close to the official estimate at 25.3%. We have adopted the poverty lines derived by Deaton, but no correction is made for the overstatement of expenditure. As a result, the level of rural poverty is found to be 21.3% in 1999-2000 as compared to Deaton's estimate of 25.3%. Further reduction in poverty is possible only through interventions in the high poverty areas and predominantly poor socio-economic classes. Rural poverty is always related to the structure and performance of agriculture. Time series analysis clearly shows positive association between poverty decline and agricultural growth. But the relation between rural poverty, agricultural development and agro-climatic conditions is not very clear.

The second step in the measurement of poverty is to choose the appropriate measure. Though Head Count is the most popularly used measure, three other measures viz., Poverty Gap, Squared Poverty Gap and Sen's Index are also important for their properties. The first three measures belong to a class of additive measures. There are good surveys on the measurement of poverty (Foster 1984; Atkinson 1987). We briefly mention the main issues having a bearing on policy analysis. Let y denote per capita consumer expenditure and z denote the poverty line. Let f(y) be the density function and F(y) be the cumulative distribution function (CDF). A function f(y, z), non-increasing in y and non-decreasing in z is a measure of poverty. A desirable property for the function is homogeneity. In other words, the measure is scale neutral. Various ways of aggregating the p(y, z)'s have been proposed in the literature. However, additive measures satisfy sub-group consistency, which means that when poverty increases in any sub-group of the population (say agricultural laborers) without a decrease elsewhere, the aggregate poverty should also increase. A sub-group inconsistent measure may mislead policy analysis, as the measure may not show decline in national poverty even when it declined in a particular area. The class of additive poverty measures is given by

$$P(z) = \int p(y.z) \quad f \quad (y) \quad dy \qquad (5.1)$$

The limits of integration are 0 and q. All the three measures of poverty viz., Head Count, Poverty Gap and Squared Poverty Gap are derived by taking $\{1-y/z\}^{\alpha}$ for p (y, z) and giving 0,1 and 2 to a:

$$P(z) \int [1-y/z]^{\alpha} f(y)\, dy \quad \ldots\ldots (5.2)$$

The limits of integration are 0 and q. The widely used head count index (H) is simply the proportion of population whose consumption (y) is less than the poverty line (z). This is simply the value of P (z) when $\alpha = 0$ in equation (5.2). The measure is easy to understand and communicate, but it has two serious drawbacks which effect policy analysis. First, it violates monotone axiom of welfare, which states that an improvement in the income of some people, given the incomes of others, should reduce poverty. Head count ratio is not sensitive to changes in income as long as these changes do not move a person from one side of poverty line to the other. The measure also violates transfer axiom of welfare - an idea first formulated by Dalton (1920). The axiom states that transfers from a richer to a poorer person should reduce poverty. This violation has a serious implication that a given improvement of incomes through policy interventions will have high impact if those who are close to the poverty line are selected.

The poverty gap index (PG) is obtained by setting $\alpha = 1$ in equation (5.2). It measures the depth of poverty as it depends on the distances from the poverty line as well as the number of poor. The widely used income gap ratio is $I = 1 - \mu^{p} / z = PG / H$, where, μ^{p} is the mean value of y for the poor. It measures average proportionate shortfall below the poverty line. This is a deceptive measure because if a poor person with a standard of living above μ^{p} escapes poverty, the income gap ratio will rise, though no one is worse off and one of the poor is, in fact, better off. Therefore, PG is a better measure than the income gap ratio. While it satisfies the monotone axiom, it is insensitive to transfers from a better off poor to another poor person, as the gap remains the same as long as both remain poor. While it gives depth of poverty, it does not indicate the severity of poverty, as it uses no weight for the gap from the poverty line. The squared poverty gap (SPG) index proposed by Foster-Greer - Thorbecke (1984) indicates severity of poverty and it is obtained by talcing $\alpha = 2$. This is a strictly convex function, a desirable property of a welfare function.

Sen (1976) proposed an index of poverty that combines the number of poor, the depth of poverty, and the distribution of the poor with in the group. The formula is given by

$$P_{s} = 2/(q+1)\, n \sum (1-yi/z)\, (q+i+1) \quad \ldots\ldots (5.3)$$

Where q is the number of poor and q+i+1 is the weight accorded to the i^{th} poor person from the poverty line. The formula can be expressed in terms of the average of the Head Count (P_o) and Poverty Gap (P_1) measures weighted by the Gini coefficient of inequality among the poor (G^{p}).

$$P_{s} = P_o\, Gp + P_1\, (1-G^{p}) \quad \ldots\ldots (5.4)$$

All the four measures of poverty are computed for each zone and also for each district and State. The district level estimates of poverty are likely to suffer from high standard errors because of the small size of the sample at that level. Hence, they are used as observations for the correlation and regression analysis to find the correlates and determinants of poverty.

The four measures of poverty viz., Head count, poverty gap, squared poverty gap and Sen's Index are computed for each zone and also for each district and State. The district level estimates of poverty are likely to suffer from high standard errors because of the small size of the sample at that level. They are, however, used as observations for the correlation and regression analysis to get an idea about the correlates and determinants of poverty. Errors in dependent variable will give unbiased estimates of the parameters, but the variances will be high. As a result, the regression coefficients are likely to become insignificant. Errors in independent variables create a more serious problem as the parameters are unbiased as well as inconsistent (Gujarati 1988). Errors in variables will not create a serious problem in correlation analysis as both the variables under consideration are assumed to be random.

Since poverty is a multi-dimensional concept, an attempt is also made to examine other aspects of deprivation such as education and health. Using the indicators of standard of living, knowledge and health, Human Development Index (HDI) is constructed adopting the methodology of United Nations Development Programme (UNDP) (UNDP 2002). However, the choice of the variables is dictated by the availability of data at the district level. The HDI is computed in two steps. In the first step, indices of standard of living, education and health are constructed. The index of standard of living is constructed using five variables viz., monthly per capita consumer expenditure, per capita calorie intake, inequality in consumer expenditure as measured by the ratio of per capita income of bottom quintile to top quintile of population, share of non-cereal food in total calorie intake and calorie intake of the bottom quintile of population. The index of knowledge is measured by five variables viz., adult literacy rate, participation of children in education, participation of the 15-19 age group persons in education, primary education completion rate among

children in the 12-14 age group and secondary education completion rate among persons in the 15-19 age group. For generating the index of health, child mortality and hospital and dispensary beds per lakh population are adopted. After constructing the three broad indices, they are combined into a single index giving equal weights. In this process, each health indicator has got a higher weight than standard of living and knowledge indicators.

Before HDI is calculated, an index (dimension index) is created for each of the 12 variables considered. To calculate these dimension indices, minimum and maximum values (goalposts) are chosen for each underlying indicator from the district level values.

$$\text{Dimension index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

The standard of living index is calculated as the simple average of the five dimension indices relating to the standard of living. Similarly, the education index is computed by taking the simple average of the five dimension indices relating to education. The health index is the average of the two dimension indices of health. The HDI index is the simple average of the standard of living, education and health indices.

Further, the regression analysis for identifying the determinants of poverty is carried out only for 4 zones for want of sufficient degrees of freedom. In the case of semi-Arid Temperate zone, separate regression was worked out only for high-irrigated districts. Similarly, a separate regression was estimated only for the low irrigated districts of the Humid zone. In case of Semi-Arid Tropical zone, two separate regressions were fitted for low irrigated and medium irrigated sub-zones. In case of Arid zone, no separate regression was worked out for any of the sub-zones. Regression equations were estimated for the pooled data of the four agro-climatic zones and for the country as a whole. Thus, nine regression equations were estimated in all. In the regression equations the dependent variable was the Head Count ratio and some of the independent variables were introduced in logarithmic form. Regressions were also run for the four zones and for the country to know about the determinants of crop productivity.

Appendix 6. A List of Selected Centrally-Sponsored Rural Development Programs Currently Underway in SAT, India

1. **Natural resources development and management programs**
   Desert Development Programme (DDP);
   National Watershed Development Programme for Dryland Areas (NWDPDA);
   National Wasteland Development Programme;
   Integrated Tribal Development Programme (1TDP); and
   Million Wells Scheme;
   Afforestation, Social Forestry, and Joint Forest Management.

2. **Human resource development**
   Training of Youth for Self-Employment (TRYSEM);
   Development of Women and Children in Rural Areas (DWCRA);
   Integrated Child Development Programme (ICDP);
   Mid Day Meal Scheme;
   Scholarships for SC, ST and BC students;
   Reservation in government jobs for SC, ST and other BC persons; and
   Adult Literacy campaigns.

3. **Programs for enhancing the productivity of crops** and **livestock productivity**
   All India Coordinated Projects sponsored by the Indian Council of Agricultural Research (ICAR);
   Technology Missions - Oilseeds, Pulses, & Dairy Development;
   Operation Flood Programme

4. **Programs for reducing risk and vulnerability**
   Crop insurance;
   Livestock insurance;
   Drought relief works;
   Postponement of recovery of loans in times of natural calamities;
   National Old Age Pension Scheme
   National Family Benefit Scheme

5. **Poverty alleviation and employment generation**
   Sampoorna Grameen Rojgar Yojana (SGRY);
   Swarnajayanti Gram Swarozgar Yojana (SGSY)
   Employment Assurance Yojana (EAY)
   Jaiprakash Rozgar Guarantee Yojana (JPRGY)

6. **Programs for strengthening basic infrastructure**
   Pradhan Mantri Gramodaya Yojana (PMGY)
   Central Rural Water and Sanitation Programme/Rajiv Gandhi Drinking Water Mission;
   Pradhan Mantri Gram Sadak Yojana;
   Rural Housing Schemes/Indira Awas Yojana (IAY);
   Rural Godowns Scheme; and
   Rural Electrification Scheme.

Appendix 7. A Brief Critique of Some Major Programs and Lessons Learned

1. Natural resources development and management programs

Soil conservation programs were the first in this categories to have been initiated in the fifties to reduce erosion and run off loses. The Drought Prone Areas Programme (DPAP) was the first area development program launched by the Central Government in 1973 -74 to tackle the special problems engendered by droughts. These areas are characterized by large human and cattle population, which continuously exert heavy pressure on the already fragile natural resources base for food, fodder and fuel. The major problems are continuous depletion of vegetative cover, increase in soil erosion and fall in groundwater levels because of continuous exploitation without any effort to recharge the underground aquifers.

The program aims at promoting the overall economic development and improving the socio-economic condition of the resource poor and disadvantaged sections inhabiting the program areas through creation, widening and equitable distribution of resource base and increased employment opportunities. The objectives of the program are being addressed in general by taking up development works through watershed approach for land development, water resource development and afforestation/ pasture development.

There are 183 districts spread over 16 states in India that are classified as drought prone districts. They are all covered under DPAR All DPAP districts are classified under four regions, namely, arid (with less than 375 mm annual rainfall); semi-arid (with 375 to 750 mm rainfall); dry sub-humid (with 750 to 1125 mm rainfall) and humid region (with rainfall of 1125 mm and above). At present the DPAP is under implementation in 971 blocks of 183 districts in 16 States of India. The Desert Development Programmes (DDPs) cover the arid areas of the country.

The DDP adopted the watershed approach in 1987. The Integrated Wasteland Development Programme launched by the National Wastelands Development Board in 1989 also aimed at developing wastelands on watershed basis. The Desert Development Programme focused on re-afforestation to arrest the growth of hot and cold deserts, whereas DPAP concentrated on non-arable lands. Drainage lines for *in-situ* soil and moisture conservation, agro-forestry, pasture development, horticulture and alternate land use were its main components. The Integrated Wasteland Development Programme made silvi-culture and soil and moisture conservation in lands under government or community or private control as its predominant activity.

In 1994, the Ministry of Rural Development, Government of India appointed a Technical Committee on DPAP and DDP under the chairmanship of Dr. C.H. Hanumantha Rao to evaluate the implementation and impact of these programs. The Committee recommended that a common set of operational guidelines, objectives, strategies and expenditure norms for these three projects based on the watershed development approach should be evolved. The new guidelines, emphasizing community participation in the program and capacity building, are now being implemented, as a follow up of the Technical Committee's recommendations.

An evaluation study of these programs has revealed that with the sole exception of J&K, the revised guidelines for implementing these programs are being followed. The felt needs of the communities for physical works are addressed. However, community's actual involvement in planning and designing these works was generally weak. The condition of the physical assets ranged from "poor" to "fair" where these were maintained by Watershed Associations / Committees or Panchayats except in Rajasthan and Tamil Nadu, where the Community took 'good' care of these works. Government departments maintained these assets in Punjab and Manipur and their condition was good. However, the projects have succeeded in arousing community awareness of the need for managing the land and water resources in an eco-friendly manner.

The impact of the program was perceptible both in terms of increase in irrigation coverage, reduction in soil erosion and containing the process of soil degradation. Productivity increase in crops cultivated was also significant. In several States such as Karnataka, Uttar Pradesh, Kerala, Manipur, Meghalaya this impact was, however, not significant. There was no perceptible shift in cropping patterns except in Maharashtra where horticulture crops were

introduced. The impact of the program on encouragement of mixed farming or livestock related activity was also not very significant. The impact on farm incomes was positive but not significant except in States such as Maharashtra, Punjab and Haryana.

One of the most striking features of the DPAP and other watershed-based schemes is the wide variation in quality of implementation (and of the assets created) which appears to correlate consistently with type of implementing agency: government agencies rarely have the time or skills to create (and help to maintain) the degree of consensus which is necessary for strong local ownership of the resource. Non-Governmental Organizations (NGOs) generally perform much better. The difficulty lies in the small number of NGOs relative to the size of the task (and to the volume of disbursement of funds for watershed development) and the slow pace at which adequately skilled new ones can be created, though again some agencies have demonstrated foresight in training some members of watershed committees in rehabilitated watersheds to form NGOs which can act as Project Implementing Agencies (PIAs) in other nearby watersheds (Farrington and Lobo 1997).

2. Human resources development programs

Some important Human Resources Development Programmes include Training of Youth for Self-Employment (TRYSEM), Development of Women and Children in Rural Areas (DWACRA), National Social Assistance Programme (NSAP), Mid-day Meal Scheme, scholarships for the Scheduled Castes (SC), the Scheduled Tribes (ST), and the Backward Castes (BC) students, Adult Literacy Campaigns, Job reservations etc., However, these are not unique to the rural people in SAT areas. They can avail these schemes just as people from other regions can also do.

A TRYSEM evaluation study covering a sample of 6686 beneficiaries arrived at e the following conclusions: Of the total beneficiaries covered, around 54% were women, which is more than the prescribed norm that 40% of the TRYSEM beneficiaries should be women. Caste-wise distribution shows that 32% of the total beneficiaries belonged to SC and 21% to ST, which is as per the norms of the program (that 50% beneficiaries should be SC or ST). More than 85% of the sample beneficiaries were living in *kaccha* or semi-pucca houses. Around 70% of them were reported to be from below poverty line (BPL) category. More than two-thirds of the beneficiaries trained were in the age group of 18 to 29 years.

Most of the states/UTs have not been able to achieve their physical targets in terms of the number of youth to be trained. A look into the individual performance of all the States/UTs reveals that in the reference period of three years, namely 1996 to 1999, Himachal Pradesh, Punjab, Gujarat and Haryana were among the top performers while Andaman & Nicobar Islands, Maharashtra, Jammu & Kashmir and Bihar performed badly. While the reservation targets for women and SC/ST categories were achieved, the same for handicapped (3%) has totally been neglected. There has been a 20% increase in the employment levels of the beneficiaries after training under TRYSEM. About 15% of them have started their own employment ventures. Only 26% of these received any subsidy/rebate/concession. More than 80% of the TRYSEM beneficiaries were satisfied with the quality of training imparted and stipend offered to them during training.

The DWCRA program was launched in 1982, as part of the Integrated Rural Development Program (IRDP). Its aim was to empower rural women living below the poverty line (BPL) by way of organizing them to create sustainable income generating activities through self-employment. It was the first program of its kind that specifically focused on improving the quality of life of rural women. A unique feature of DWCRA, unlike other IRDP components, was that along with the improvement in income, it also focused on access to health, education, safe drinking water, sanitation, nutrition etc., Thus it not only aimed at economic development, but also intended promoting social development. Another unique feature of the program was that it emphasized group activity. It was thought that in the long run women's empowerment depends on creation of a movement that promotes awareness and self-reliance.

An evaluation study of DWCRA brought out that DWCRA had a direct and significant impact on employment and group activities. As high a proportion as 93% of the beneficiaries reported that DWCRA had created a desire for self-employment. Whereas about 89% of the beneficiaries felt that DWCRA had raised their incomes. DWCRA had a visible impact on savings, economic conditions and social prestige, but it had less impact on health, sanitation, drinking water and children's education, which are more of community services. According to their overall performance, the major states could be ranked (from best to worst) as follows: Nagaland, Arunachal Pradesh, Kerala, Andhra Pradesh, Assam, West Bengal, Mizoram, Tamil Nadu, Maharashtra, Orissa, Punjab, Karnataka, Madhya Pradesh, Tripura, Bihar, Jammu & Kashmir, Gujarat, Uttar Pradesh and Haryana.

The National Social Assistance Programme (NSAP), sponsored by the Ministry of Rural Development (MoRD), Government of India, came into effect from August 15,1995, with the purpose of providing social assistance to the rural poor in India. It aims at improving the quality of life of the rural poor ensuring equality and effective peoples' participation in the process. The program extends 100% central assistance to the States and Union Territories to provide the benefits under it in accordance with the norms, guidelines and conditions laid down by the Central Government. The NSAP introduces a national policy for social security assistance to the poor families in the case of old age, death of primary breadwinner and maternity. It provides an opportunity for linking the social assistance package to schemes for poverty alleviation and provision of basic needs. The program is being implemented through a synergistic partnership with State Governments and under the direct supervision of District Rural Development Agencies (DRDAs) in close collaboration with the various Panchayat Raj institutions. It has three components, namely, National Old Age Pension Scheme (NOAPS), National Family Benefit Scheme (NFBS) and National Maternity Benefit Scheme (NMBS).

Mid-day meal schemes are being implemented through out the country to improve enrollment ratios and to supply nutritive food to the school children. Recently, Prime Minister has announced that this scheme will be extended up to secondary school level. Scholarships and job reservations are being implemented to take care of the interests of socially disadvantaged groups. Adult Literacy campaigns are also being implemented to improve the literacy levels and participation of people in the development programs.

3. Agricultural and livestock development programs

A number of initiatives and programs were launched by the government over the last five and half decades but they are not unique to SAT region. All India Coordinated Research Projects were initiated on all major crop and live stock commodities to coordinate the efforts of different research stations located all over the country and to evolve location specific production technologies for different regions. Technology missions were launched on pulses, oilseeds, maize and cotton, most of which are rainfed crops. These missions strived to further intensify research and gave fillip to technology adoption by removing some bottlenecks and constraints.The All India Coordinated Research Project for Dryland Agriculture tried to identify efficient crops and varieties suitable to the growing seasons of different dryland zones in the country. While all these programs contributed to the agricultural and livestock development of the country in general and dryland regions in particular, the technological and production constraints are still constraining the growth of agricultural and livestock development in the SAT regions.

Operation Flood is the world's biggest dairy development program. It was designed and launched in 1970 by the National Dairy Development Board, then a non-governmental organization but now a statutory corporate body. The program sought to replicate the Anand Pattern dairy co-operative structure in selected milk sheds in India. The Anand Pattern dairy co-operatives formulate and implement their own policies and programs for dairy development in their area and hire professional managers and technicians for their implementation. The role of the government is limited to assisting the co-operatives financially in implementing their own programs. The government funds for dairy development are placed at the disposal of the co-operatives.

Of is a living example of a non-governmental system that has been successful in promoting people-centered development more efficiently and effectively than the governmental system. OF has enabled India to emerge as the world's highest milk producing country. Evaluation studies of OF show that the program has significantly improved the income of rural milk producers, especially marginal and small farmers and landless laborers (Singh 1999). OF has great potential for replication in many SAT areas, where livestock production is catching on.

4. Wage paid employment generating schemes

Both the Swarnajayanti Gram Swarozgar Yojana (SGRY, formerly Food for Work) and Employment Assurance Scheme (EAS) aim to provide additional wage employment in rural areas, particularly during lean' seasons. Among the differences between them are the stronger emphasis on paying part of the daily wage in the form of food grains under the SGRY, and a stronger provision for materials to allow the creation of durable assets under the EAS (Nayak et al. 2000). Both schemes are to a large degree self-targeting, since only the poorest will work for the basic minimum

wage. The strong role played by 'payments in kind' - via food grains - in the case of SGRY, and the cost and difficulty of storing and transporting grains, means that there is little scope for local-level misappropriation of resources by officials. However, within-distrtct responsibilities for storage, transport and distribution of food grains are contracted out to fair price shops and private contractors, and there is considerable scope here for fraudulent practices when (as until recently has been the case) the public distribution price is lower than the market price. The use of food grains for payment in kind is minimal in the EAS, and EAS regulations prohibit the engagement of contractors or middlemen, but this provision is widely flouted, and has been accompanied by falsification of attendance lists and other irregularities. Some estimates suggest that, given the combination of malpractice among administrators and contractors, only 25% of the wage funds to which beneficiaries are entitled actually reaches them, the remaining 75% disappearing through leakages of various kinds.

5. Self-employment generating schemes

The Integrated Rural Development Programme (IRDP) is one of the largest and longest-standing efforts towards self-employment generation in India and is implemented by government agencies. By contrast, the National Credit Fund for Women, popularly known as Rashtriya Mahila Kosh (RMK) is relatively new, still small, and implemented through NGOs. The IRDP operates through a mixture of subsidy and bank loan. The subsidy element has been substantial, in the range of Rs 4000 to Rs 6000 depending on beneficiary characteristics. As with the National Housing Scheme, subsidies of this magnitude have attracted the interest of politicians wishing to divert the subsidies to their current or potential supporters. This has contributed to low repayment rates on the loan component, since defaulters (and bank staff) are aware of the political support enjoyed by this category of beneficiaries. It has also meant that a high proportion of beneficiaries are not below the poverty line.

Malpractice by lower-level officials has been pervasive. Surveys in some areas indicate that a 10% deduction was made by bank officials as informal 'charges'. In other localities, over 20% of the subsidy component was charged in various ways as 'speed money'. Another common form of corruption in some areas was for officials in collusion with local middlemen to provide the asset specified by beneficiaries, contrary to the regulations which require these to be provided by approved suppliers in exchange for cash payments by the beneficiaries. Working in collusion with administrators, the banks have also made illicit 'charges' on beneficiaries.

There is a large literature on the limitations of the IRDP in helping to create a sustainable productive asset base for the low-income self-employed. Difficulties include the fact that the production systems for assets specified for investment under the IRDP are not supported by services available through other relevant government departments. In addition, in many cases there is no insurance provision for assets such as livestock, so that their death will make it impossible for beneficiaries to repay loans. Other problems include the limited capacity of government to identify investment opportunities (resulting in excessive investment in one particular kind of asset - such as dairy cows - within limited areas, so that markets quickly become flooded); Frequent loan moratoria instigated by politicians, so that few beneficiaries take seriously the requirement to repay; Inadequate monitoring at activity or output levels so that problems of inappropriate assets, high risk levels and low returns are rarely detected; and Complex application procedures, which are near impossible for low-income people to understand.

By contrast, the RMK focuses entirely on women below the poverty line and uses minimal procedures to disburse loans through NGOs. These then are required to identify women's groups eligible for loans and to contribute a 10% margin on the loan. There is no subsidy component. Funds disbursed through the RMK attract very little political attention, largely because of the absence of any subsidy component. Government officials have very little to do with disbursement procedures, and little corruption occurs. Evaluations indicate the substantial contribution made to women's livelihoods by the assets purchased. However, the limited number of NGOs suitable for implementing this scheme is likely to constrain its expansion severely.

RA-00415

About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political, international organization for science-based agricultural development. ICRISAT conducts research on sorghum, pearl millet, chickpea, pigeonpea and groundnut - crops that support the livelihoods of the poorest of the poor in the semi-arid tropics encompassing 48 countries. ICRISAT also shares information and knowledge through capacity building, publications, and information and communication technologies (ICTs). Established in 1972, it is one of 15 Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

Contact information

ICRISAT-Patancheru
(Headquarters)
Patancheru 502 324
Andhra Pradesh, India
Tel +91 40 23296161
Fax +91 40 23241239
icrisat@cgiar.org

ICRISAT-Nairobi
(Regional hub ESA)
PO Box 39063, Nairobi, Kenya
Tel +254 20 524555
Fax +254 20 524001
icrisat-nairobi@cgiar.org

ICRISAT-Niamey
(Regional hub WCA)
BP 12404
Niamey, Niger (Via Paris)
Tel +227 722529, 722725
Fax +227 734329
icrisatsc@cgiar.org

ICRISAT-Bamako
BP 320
Bamako, Mali
Tel +223 2223375
Fax +223 2228683
icrisat-w-mali@cgiar.org

ICRISAT-Bulawayo
Matopos Research Station
PO Box 776,
Bulawayo, Zimbabwe
Tel +263 **83** 8311-15
Fax +263 83 8253/8307
icrisatzw@cgiar.org

ICRISAT-Lilongwe
Chitedze Agricultural Research Station
PO Box 1096
Lilongwe. Malawi
Tel +265-1-707297/071/067/057
Fax +265-1-707298
icrisat-malawi@cgiar.org

ICRISAT-Maputo
c/o INIA, Av. das FPLM No 2698
Caixa Postal 1906
Maputo. Mozambique
Tel +258-1-461657
Fax +258-1-461581
icrisatmoz@panintra.com

Visit us at **www.icrisat.org**

ISBN 92-9066-474-6 Order code BOE 035 614-2004