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FOREWORD

The need for appropriate land use planning has been felt in India for a very long time. All our Five Year Plans emphasised the need for efficient use of land, water and other natural resources for accelerated as well as sustainable economic development. Nevertheless, the problems of land degradation, ground water depletion and environment pollution have assumed alarming proportions in many areas. Hence, there was a felt need for a national debate on how to address various issues related to land use planning.

This workshop was jointly organised by Planning Commission and NCAP on November 28-29, 1997. The Indian Council of Agricultural Research provided funding support for the workshop.

We are extremely grateful to Prof. S.R. Hashim, Member, Planning Commission and Dr. R.S. Paroda, Secretary, DARE & DG, ICAR for taking initiatives to organise the workshop at NCAP and for providing all the necessary support and encouragement.

Apart from Dr. T. Haque who shouldered the onerous task of coordinating the workshop and editing this volume, all my colleagues at NCAP have worked hard for making the workshop successful and bringing out the publication for wider circulation of the issues discussed and views expressed.

Dayanatha Jha
Director

Summary

Introduction

The National Workshop on Land Use Planning was organised jointly by the Planning Commission and NCAP on November 28-29, 1997. Eminent social scientists, administrators and policy makers participated in the workshop. Prof. Y.K. Alagh, the then minister of state for planning power and Science & Technology inaugurated the workshop. Prof. S.R. Hashim, member, Planning Commission presided over the inaugural session. Prof. Alagh mentioned that policy makers often forget the long term perspective in pursuit of short term goal at a great peril. According to him, given the present technological development in the country, it is possible to have a plot by plot survey of available land and thus upgrade the nation's land record. He said that water logging also could be prevented at a nominal cost, but even then nothing concrete had taken place. Prof. S.R. Hashim cautioned that market forces can help in productivity growth, but not so much in environment protection for which people's participation is necessary.

Thirteen papers were presented for discussion in the workshop dealing with various aspects of land use planning. Dr. T. Haque, National Fellow presented the theme paper, highlighting major issues involved in land use planning. The theme paper pointed out the need for checking any indiscriminate use of land, water and other natural resources that pose threat to sustainability of livelihood system of the people.

The paper by Rita Sharma underlined the necessity of formulating land use policy to ensure systematic and scientific land resource management and adequate administrative as well as financial support by the state governments to the state land use boards.

Dr. Sulbha Brahme mentioned how India is facing a critical situation in relation to land use planning, particularly in the wake of economic liberalisation. According to Brahme, relaxation of restrictions on acquisition of land and other immovable property and conversion of agricultural land to non-agricultural use pose a real threat to sustainability of livelihood system of the common people. The paper by Prof. N.V. Ratnam summarised the objectives of land use planning and suggested plan of action for efficient use of land resources.

The paper by Prof. Samar K Datta and Mr. Milindo Chakravarti entitled 'Perspective on Land Use Planning for Eastern India' raised various policy issues regarding the management of land under various agro-climatic situations. The paper also dealt with the necessary measures to improve the crop-livestock and forestry systems.

D. Mahadevia and Indira Hirway presented a paper entitled 'Impact of Structural Adjustment Programme on Land and Water Resources of Gujarat'. The paper pointed out how unplanned industrialisation programme in Gujarat has tended to affect the land use planning and food security situation in the region.

Prof. R.B. Singh in his paper entitled 'Land Use Change, Diversification of Agriculture and Agro-forestry in North West India' indicated the measures necessary for integrated and sustainable land and forest development based on land information systems and preparation of human and livestock carrying capacity, ground water availability etc.

Niti Mathur presented a paper on Land Use Planning in context of Agro-climatic sub-regional planning. Agro-climatic planning is designed to effectively utilise the regional potentials.

The paper entitled 'Integrated Mission for Sustainable Development by D.P. Rao et al of NRSA, showed the results of Integrated Mission for Sustainable Development (IMSD) project conceived by the Department of Space, which aims at providing practical solutions to the problem of land use planning, through satellite remote sensing. Krishnamurthy and Adiga of NRSA also presented a paper which highlighted the importance of remote sensing and CIS for land use planning. According to them, the potential of remote sensing technology should be effectively harnessed for the management of natural resources.

1 LAND USE PLANNING IN INDIA - RETROSPECT AND PROSPECT

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Ever since independence, India's planners and Policy makers have shown concern for efficient use of land, water and other natural resources for accelerated as well as sustainable economic development. The questions of efficiency, equity and environment protection have been flagged in almost all Five Year Plans. However, notwithstanding these concerns, it is often reported that the problems of land degradation and groundwater depletion have assumed serious proportions in many areas which threaten not only the sustainability of agriculture, but also the overall livelihood system of the people. To make the situation worse, there is a growing misconception in the minds of many scholars and administrators, particularly in the wake of economic liberalisation that market alone should determine the land use patterns, even though in reality the relevance of land use planning for efficiency, equity and sustainability remains intact. The present workshop primarily intends to discuss the need for and major issues in land use planning in India for efficiency, equity and overall sustainable development.

Need for Land Use Planning

In a developing country like India, land is not only an important factor of Production, but also the basic means of subsistence (if not prosperity) for majority of the people. Agriculture contributes less than 30 percent to India's Gross Domestic Product, but absorbs nearly 64 percent of the country's working population. About three-fourth of the total population draw their livelihood from agriculture. But there is evidence to indicate that the land sector cannot bear the burden of growing population, not withstanding the untapped potentials for agricultural productivity growth in many regions. Therefore, there is a felt need for both horizontal and vertical diversification of the agricultural economy. This is particularly so because all lands and locations are not equally suitable for profitable, alternative farming and hence, there is need for cluster approach to development.

However, tend is required for both agriculture and non-agricultural purposes, including establishment of industries, housing, roads, parks, railway lines etc. The problem arises because market driven, albeit unplanned diversification as well as urbanisation often results in non-sustainable patterns of development. A market driven land use pattern may yield higher returns in the short run, but may pose several unmanageable problems for future generations due to unplanned overexploitation of land, water and other natural resources. Hence arises the need for appropriate land use planning. There is no denying the fact that under free market forces, it is the relative profitability of various enterprises and their suitability from the points of view of agro-climatic characteristics which largely determine the land use patterns. But, while market forces should be allowed to operate, the management of land, water and other natural resources and also our orientation of technological and institutional changes should be such as to meet both present and future needs. In other words, the development process should be sustainable both in the short run and long run, based on conservation, of land, water, plant and animal genetic resources. Besides, such sustainable development would be environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

Changes in Land Use Patterns Over Time

At the macro level, there are two main sources of land use data, namely Bureau of Economics and Statistics and National Remote Sensing Agency. However, there are some definitional and consistency problems with these two main sources of data, although some

attempts have been made to reconcile and reduce the inconsistencies in recent years. Table 1 shows the changes in land use pattern overtime, based on the data collected from Bureau of Economics and Statistics. It may be seen from Table 1 that area under forests increased from 40.5 million hectares in 1950-51 to 68.4 million hectares in 1993-1994. Forests account for nearly 22.4 percent of the total reporting area. The NRSA puts this figure at 14. 5 percent (excluding area under degraded forest and forests blanks which accounts for 5.5 percent). Area under non-agricultural uses increased from 9.4 million hectares in 1950-51 to 22.0 million hectares in f 993-1994. In percentage terms, this increased from 3.3 in 1950-51 to 7.2 in 1993-94. The NRSA estimated the built up land to be 4.2 percent of the total reporting area. According to the Bureau Statistics, the proportions of area under barren and unculturable wasteland, lands under miscellaneous trees, groves etc, culturable wasteland and permanent fallow lands decreased significantly overtime. The net area sown increased from 118.8 million hectares in 1950-51 (41.8 percent) to 142 million hectares (46.6 percent) in 1993-94. This was largely due to extension of cultivation in marginal lands including culturable waste and lands under miscellaneous trees, groves etc. During the past several years, nearly 10 million hectares of land have been kept permanently fallow. During the past four and a half decades, cropping intensity increased from 111 in 1950-51 to 131 in 1993-94, mainly due to rise in the gross irrigated area from 22.6 million hectares in 1950-51 to 68.4 million hectares in 1993-94 plus the HYV technology. Table 2 further gives the land use patterns for various states. It is borne out from Table 1 that at the national level, net sown area increased only marginally in the 80's and remained constant at about 142 million hectares in the early 90's. But the area under non-agriculture uses are continuously rising. Although the available data do not reveal how much of prime agricultural land has been Taken away for non-agriculture purposes, it is often reported that unplanned urbanisation often leads to conversion of prime agricultural lands for non-agricultural purposes. However, Table 2 further shows that in several states including Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Tamil Nadu and West Bengal, there have been a marginal decline in the net area sown. In the states of Gujarat and Orissa, even forest area is reported to have declined.

Table-1 :
Changes in Land Use Patterns Over Time

(in Million Ha)

Categories	1950-51	1980-81	1993-94
Reporting Area For Land Utilization Statistics	284.3 (100)	304.2 (100)	304.9 (100)
Forest	40.5 (14.2)	67.5 (22.2)	68.4 (22.43)
Area Under Non-Agril. Uses	9.4 (3.3)	19.7 (6.48)	22.0 (7.26)
Barren and Unculturable Land	38.2 (13.4)	20 (6.57)	19 (6.23)
Permanent Pastures And Other Grazing Lands	6.7 (2.36)	12 (3.94)	11.2 (3.67)
Land Under Miscellaneous Tree Crops and Groves not Included In Net Area Sown	19.8 (6.96)	3.6 (1.18)	3.7 (1.21)
Culturable Wastelands	22.9 (8.05)	16.7 (5.49)	14.5 (4.76)
Fallow Land Other than Current Fallows	17.4 (6.12)	9.9 (3.25)	9.7 (3.18)
Current Fallows	10.7 (3.76)	14.8 (4.87)	14.3 (4.69)
Net Area Sown	118.8 (41.79)	140 (46.02)	142.1 (46.61)
Cropping Intensity	111	123	131

Note: Figures in the parentheses indicate percentage Share to Reporting Area of the Corresponding Year
Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Ministry of Agriculture, Govt. Of India, New Delhi, 1997

Table-2 :
Changes in Land use Patterns Over Time By State

(As % of Reporting Area)

State	Forest		Area Put to Non-Agl. Uses		Culturable Wasteland		Fallow Land Other Than Current Fallow		Net Area Sown	
	1983	**1993**	**1983**	**1993**	**1983**	**1993**	**1983**	**1993**	**1983**	**1993**
Andhra Pradesh	22.59	22.84	8.08	8.41	3.26	2.84	5.03	5.02	41.68	40.17
Arunachal Pradesh	93.88	93.80	0.00	0.52	0.86	0.00	1.06	0.88	2.15	2.69
Assam	25.28	25.27	11.61	11.64	1.36	1.32	1.10	1.06	34.34	34.46
Bihar	16.87	17.02	10.71	12.18	2.41	2.15	6.20	5.76	43.74	44.44
Goa	28.30	29.09	5.66	5.54	22.64	24.93	0.00	-	38.54	36.29
Gujarat	10.44	10.03	5.74	5.87	10.56	10.20	0.40	0.32	40.27	49.35
Haryana	2.96	3.88	6.80	7.31	1.07	0.48	0.00	0.0	81.93	81.66
Himachal Pradesh	27.06	30.85	5.56	5.73	4.05	3.71	0.44	0.45	18.61	17.31
Jammu & Kashmir	61.23	60.98	6.77	6.46	3.22	3.06	0.18	0.13	16.18	16.23
Karnataka	15.91	16.14	6.00	6.24	2.55	2.34	2.41	2.40	55.67	54.49
Kerala	27.82	27.82	7.16	7.64	3.32	2.45	0.69	0.69	56.11	57.84
Madhya Pradesh	31.68	32.31	5.03	5.37	3.94	3.56	2.11	1.86	43.48	44.11
Maharashtra	17.25	17.59	3.30.	3.61	3.21	3.34	2.58	3.19	59.50	58.33
Manipur	27.23	27.23	1.18	1.18	0.00	0.00	0.00	0.00	1.81	6.33
Meghalaya	36.10	41.94	3.78	3.75	20.19	22.02	11.61	7.46	8.58	9.02
Mizoram	61.99	61.99	0.48	0.48	3.52	3.52	12.32	12.32	3.09	3.09
Nagaland	25.67	56.27	2.50	1.83	5.53	6.46	23.53	7.18	16.49	12.40
Orissa	42.73	35.24	4.18	4.80	1.58	3.84	1.27	1.38	38.85	40.57
Punjab	4.39	4.41	8.84	6.80	0.66	0.70	0.08	0.56	83.69	83.82
Rajasthan	6.32	6.87	4.44	4.35	16.77	16.25	5.42	5.63	47.42	47.81
Sikkim	36.20	36.20	13.66	13.66	0.14	0.14	1.27	1.27	10.99	13.38
Tamil Nadu	15.62	16.55	13.82	13.98	2.43	2.23	4.22	8.02	44.99	42.85
Tripura	55.15	57.77	11.45	12.49	0.19	0.09	0.19	0.10	23/7	25.74
Uttar Pradesh	17.21	17.33	7.90	8.21	3.99	3.47	2.60	2.97	58.04	58.06
West Bengal	12.33	12.33	16.32	18.42	1.99	1.20	0.99	0.58	60.38	60.30
Total	**22.13**	**22.29**	**6.64**	**6.96**	**5.08**	**4.92**	**3.02**	**3.14**	**46.93**	**46.63**

Further, the detailed data provided by NRSA (Table 3) throw useful insights into the problem of land degradation. According to NRSA, there are about 16.3 million degraded forest area in the country. Besides, there are 1.99 million hectares of salt affected land, 1.22 hectares of water logged land, 0.82 million hectares of marshy land, 2.02 million hectares gullied / ravinous land, 26.51 million hectares of land with or without scrub, 5.57 million hectares of sandy area and 2.82 million hectares of area under shifting cultivation. How to reclaim and put these lands into cultivation or afforestation should be an area of concern. Table 4 and 5 further show the distribution of area under various kinds of wastelands, including degraded forests in different states. Saxena (1989) estimated the reclaimable wastelands to be in the order of nearly 92.7 million hectares, of which 36.5 million hectares are owned by private individuals and 35.9 million hectares are other public wastelands. According to the Ministry of Agriculture, Govt. of India, degraded land is of the order of 92 million hectares, of which 73 million hectares are arable land and 19 million hectares are non-arable land. While there are ongoing efforts to improve the quality of these lands through various soil and water conservation and watershed development programmes, there is also a growing threat of land degradation due to high incidence of groundwater depletion in low rainfall areas - and because of the poor drainage and water management as well as low utilisation of available groundwater in high rainfall areas. The past efforts to check these tendencies have remained far from satisfactory. Furthermore, a number of research studies point out that due to indiscriminate use of land, water and other natural resources, there is a threat not only to sustainability of agriculture, but also to overall livelihood system of the people in many green revolution as well as non-green revolution areas.

Table-3 : Area Under Detailed Land Use/Land Cover Categories, India

Category	Area in Hectare	% To Total Geographic Area
Build Up Land	139.1	4.2
Agricultural Land		
Kharif land	1205.9	
Rabi Crop Land	763.0	
Double Cropped Area	531.1	
Net Area Sown ($)	1514.8	46.1
Fallow Land	137.6	4.2
Forest		
Evergreen/Semi-Evergreen	141.8	4.3
Deciduous Forest	318.1	9.7
Degraded Forest	162.7	5.0
Forest Blank	18.1	0.55
Forest Plantations	11.2	0.3
Mangroves	5.0	0.15
Wastelands		
Salt Affected	19.9	0.6
Waterlogged	12.2	0.4
Marshy/Swampy	8.2	0.25
Gullied/Ravinous	20.2	0.6
Land with or without Scrubs	265.1	8.1
Sandy Area (Coastal & Desertic)	55.7	1.7
Barren Rocky/Stony Waste/	62.5	1.9
Sheet Rock Area		
Water Bodies		
River/Stream	84.1	2.55
Lake/Reservoir/Tank/Canal	22.0	0,7
Others		
Grassland/Grazing land	31.0	0.9
Mining/Industrial Waste	1.2	0.03
Shifting Cultivation	28.2	0.9
Snow covered/Glacial Area	69.9	2.1
Salt Pans	0.4	0.01
Unclassified	74.5	2.3
Unsurveyed (*)	83.3	2.5
Total	**3287.3**	**100.0**

Note: $ includes 77.00343 Lakh hectares or 2.34 per cent of Area under Agricultural Plantations also.

* Unsurveyed Area is in Jammu and Kashmir due to hanging boundaries

Source: NRSA, 1988-89

Emerging Issues

Some of the emerging issues that would merit discussion are as follows:

i. The Low level of agricultural productivity coupled with inadequate farm and non-farm diversification, low level of technological change and lack of infrastructural facilities of irrigation, roads, market etc. act as major constraints to rural development in general. But high rates of soil erosion, land degradation and groundwater depletion in many regions due to indiscriminate use of land, water and other natural resources have posed additional threat to ecological balance and sustainability of livelihood system of the people. Therefore, any planning for land use should attempt to solve the general problems of underdevelopment and arrest area specific non-sustainable trends and patterns of development.

ii. All types of lands and locations are not equally suitable for profitable, albeit alternative enterprises. Hence, cluster approach to development, based on agro-climatic as well as techno-economic potentials of each region would be essential. The Agro-climatic Regional Planning Unit of the Planning Commission, ICAR, Land Use Boards and several other organisations have generated lot of data and also developed plans for efficient use of land for a number of selected areas. The feasibility of experimentation of these plans would have to be explored. Moreover, recently, the Twenty Five Years Perspective Plan for the Development of Rainfed Areas has indicated the location specific needs and potentials of various agro-economic zones, which can serve as guidelines for future land use planning.

iii. It is clearly borne out from the past experience that market determined land use patterns have often far reaching adverse impact on equity and sustainability of agriculture as well as overall livelihood system of the people. Hence regulations not only for egalitarian access to land, water and other natural resources, but also for appropriate land use planning would be necessary. But the question is how to enforce such regulations? In the past, most of the land laws have remained largely ineffective. Several state governments passed laws for the prevention of conversion of agricultural lands to non-agricultural uses. But under various market forces, there is a growing tendency towards conversion of prime agricultural lands to non-agricultural uses, particularly around the urban centres. More recently, some state governments have even relaxed the laws for conversion of agricultural lands. Should there be an appropriate, albeit clear cut future policy in this regard? What kind of institutional arrangement or community action at the local level would be required to either plan or regulate land use patterns for efficient as well as sustainable development. How far such regulations would be either desirable or effective in the wake of economic liberalisation?

iv. What would be the required research and development priorities as well as policy imperatives for sustainable use of land, water and other natural resources or for that matter the implications of land use planing for future agricultural research?

v. Finally, there is need for update and accurate land use data for various regions. The differences in data from the available sources would have to be reconciled.

Table-4 : Area Under Various Categories of Wastelands by State

('000 Hectares as of 1988-89)

State	Salt Affected Area	Water Logged Area	Marshy/ Swampy Area	Gullied/ Ravinous Area	Land with or without Scrubs	Sandy Area	Barren/Stony/ Sheet/Rock Area	Total Wasteland
Area								
Andhra Pradesh	85.52	0.35	77.78	7.75	3009.02	63.73	391.94	3636.10
Arunachal Pradesh	0.00	0.00	16.68	0.00	1.00	0.00	97.06	1"14.73
Assam	0.00	17.21	58.13	1.14	501.54	0.00	0.00	578.03
Bihar	0.00	124.66	37.30	44.22	667.38	122.14	108.22	1103,91
Goa	0.00	0.00	12.75	0.00	18.50	2.74	1.12	35.11
Gujarat	728.15	57.89	142.83	173.26	2231.78	60.95	426.17	3821.00
Haryana	38.75	23.66	0.00	0.00	191.10	66.98	9.65	330.13
Himachal Pradesh	0.00	3.21	0.00	116.60	317.37	0.00	453.02	890.19
Jammu & Kashmir	0.00	0.00	13.70	3.77	666.56	80.38	672.82	3437.23
Karnataka	30.62	0.00	1.50	32.45	1494.35	8.74	261.73	1829.38
Kerala	0.00	4.22	0.00	0.00	52.02	1.35	14.17	71.75
Madhya Pradesh	1.44	0.00	0.00	777.05	5253.10	3.40	765.99	6800.90
Maharashtra	45.53	5.02	42.94	53.28	4706.63	15.31	246.38	5115.10
Manipur	0.00	0.00	29.01	0.00	0.00	0.00	0.00	29.01
Meghalaya	0.00	1.40	0.00	0.00	1.15	0.00	0.00	2.55
Mizoram	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nagaland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orissa	0.00	5.55	44.94	15.44	1230.65	18.78	46.64	1361.99
Punjab	51.98	26.61	0.04	2.78	48.30	173.44	0.00	303.23
Rajasthan	252.00	5.87	0.00	399.30	2752.70	4589.44	424.98	8424.27
Sikkim	0.00	0.00	0.00	0.00	133.45	0.00	82.98	216.43
Tamil Nadu	59.54	29.46	23.43	11.26	1079.23	142.60	76.73	1422.24
Tripura	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Union Territories	0.92	1.17	1.73	0.14	20.22	10.54	0.10	34.81
Uttar Pradesh	693.95	884.49	271.49	381.42	1972.70	159.34	156.00	4519.39
West Bengal	0.00	28.90	49.63	0.48	165.77	52.24	15.81	312.84
Total	**1988.38**	**1219.67**	**823.88**	**2020.33**	**26514.56**	**5572.09**	**6251.41**	**44390.32**

Source: NRSA, 1988-89

Table-5 : Percentage Distribution of Various Categories of Wastelands by State

State	Salt Affected Area	Water Logged Area	Marshy/Swampy Area	Gullied/ Ravinous Area	Land with or without Scrubs	Sandy Area	Barren/Stony/Sheet/Rock Area
Andhra Pradesh	2.35	0.01	2.14	0.21	82.75	1.75	10.78
Arunachal Pradesh	0.00	0.00	14.54	0.00	0.87	000	84.60
Assam	0.00	2.98	10.06	0.20	86.77	0.00	0.00
Bihar	0.00	11.29	3.38	4.01	60.46	11.06	9.80
Goa	0.00	0.00	36.32	0.00	52.68	7.81	3.19
Gujarat	19.06	1.51	3.74	4.53	58.41	1.60	11.15
Haryana	11.74	7.17	0.00	0.00	57.88	20.29	2.92
Himachal Pradesh	0.00	0.36	0.00	13.10	35.65	0.00	50.89
Jammu & Kashmir	0.00	0.00	0.40	0.11	19.39	2.34	77.76
Karnataka	1.67	0.00	0.08	1.77	81.69	0.48	14.31
Kerala	0.00	5.88	0.00	0.00	72.49	1.88	19.75
Madhya Pradesh	0.02	0.00	0.00	11.43	77.24	0.05	11.26
Maharashtra	0.89	0.10	0.84	1.04	92.01	0.30	4.82
Manipur	0.00	0.00	100.00	0.00 .	0.00	0.00	0.00
Meghalaya	0.00	54.90	0.00	0.00	45.10	0.00	0.00
Mizoram	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nagaland	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orissa	0.00	0.41	3.30	1.13	90.36	1.38	3.42
Punjab	17.14	8.78	0.01	0.92	15.95	57.20	0.00
Rajasthan	2.99	0.07	0.00	4.74	32.68	54.48	5.04
Sikkim	0.00	0.00	0.00	0.00	61.66	0.00	38.34
Tamil Nadu	4.19	2.07	1.65	0.79	75.88	10.03	5.40
Tripura	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Union Territory	2.63	3.36	4.98	0.40	58.07	30.26	0.30
Uttar Pradesh	15.35	19.57	6.01	8.44	43.65	3.53	3.45
West Bengal	0.00	9.24	15.87	0.15	52.99	16.70	5.05
Total	**4.48**	**2.75**	**1.86**	**4.55**	**59.73**	**12.55**	**14.08**

Source: Based On NRSA, 1988-89

Table-6 : Different Categories Of Forest Land And Their Percentage Share In Total Forest Area

(Area In '000 Hectares)

State	Degraded Forest	Forest Blanks Area	Total Forest Total	%Degraded Forest To Forest	Forest Blank To Total Forest
Andhra Pradesh	2295.69	2.65	6037.32	38.02	0.04
Arunachal Pradesh	1093.72	3.58	6935.09	15.77	0.05
Assam	213.78	0.00	1726.39	12.38	0.00
Bihar	1370.01	67.40	2667.88	51.35	2.53
Goa	1.99	2.46	210.89	0.94	1.17
Gujarat	367.99	161.70	1121.77	32.80	14.41
Haryana	26.59	16.76	68.23	38.97	24.57
Himachal Pradesh	178.67	0.50	1464.49	12.20	0.03
Jammu & Kashmir	277.45	62.56	1306.46	21.24	4.79
Karnataka	851.37	2.44	3327.73	25.58	0.07
Kerala	91.46	0.06	949.68	9.63	0.01
Madhya Pradesh	2071.31	134.75	14254.03	14.53	0.95
Maharashtra	1094.06	1155.29	5296.20	20.66	21.81
Manipur	260.84	0.00	1414.08	18.45	0.00
Meghalaya	240.49	0.00	1424.98	16.88	0.00
Mizoram	1588.05	0.00	2007.96	79.09	0.00
Nagaland	558.43	0.00	1142.18	48.89	0.00
Orissa	683.05	4.86	4595.30	14.86	0.11
Punjab	66.72	4.91	183.90	36.28	2.67
Rajasthan	1180.76	34.14	2253.72	52.39	1.51
Sikkim	52.41	10.90	280.46	18.69	3.89
Tamil Nadu	849.87	0.00	1613.83	52.66	0.00
Tripura	236.11	0.00	380.65	62.03	0.00
Union Territory	13.41	2.83	755.49	1.78	0.37
Uttar Pradesh	488.35	93.54	3484.01	14.02	2.68
West Bengal	121.69	52.52	808.11	15.06	6.50
Total	**16274.27**	**1813.85**	**65710.82**	**24.77**	**2.76**

Source: NRSA, 1988-89

Part II International Workshop on INSTITUTIONALISATION OF RESEARCH PRIORITISATION, MONITORING AND EVALUATION IN INDIAN NATIONAL AGRICULTURAL RESEARCH SYSTEM

(July 21-23, 1997)

2.1 Workshop Recommendations

General Assessment

1. Basic mechanisms for informal research priority-setting and monitoring are currently used which need improvement
2. Systematic application of innovative priority-setting approaches is lacking
3. Research evaluation and impact assessment is too weak.

Guiding Principles

1. Continuous commitment to improved priority-setting, monitoring and evaluation (PME) needed at the highest policy level
2. Where appropriate, improve design and implementation of existing PME mechanisms
3. Successful PME has to be linked to decentralised project-based funding and personnel performance evaluation
4. Initially institutionalisation should be implemented in phases at selected research centres
5. PME must be fully integrated with research decision making (e.g., mechanisms to drop unproductive/unsatisfactory projects)
6. PME methods should be simple, transparent and allow timely results
7. Institutionalisation should avoid bureaucratic structure
8. Continuous communication is needed with key stakeholders in PME activities
9. PME need to be integrated into project proposal formulation.

Priority-Setting Methods

1. Basic approach should combine participatory methods involving beneficiaries including farmers' organisations, and scoring/check list methods at project level
2. Should pilot benefit-cost analysis at selected applied research institutions
3. Finalise and provide guidelines on research priority-setting methods at regional and micro-levels
4. Develop a network of practitioners in PME activity.

Monitoring and Evaluation

1. Revise Research Project Files (RPF) which should integrate performance evaluation, ex ante evaluation and research funding decisions
2. Develop simple management information system (MIS; with key variables and indicators to be implemented for funded projects based on improved RPFs.

Institutionalisation

1. Policy advisory group should meet regularly and be proactive
2. Need simultaneous reforms in administrative procedures including financing system (project-based funding) and personnel performance evaluation
3. Need for multidisciplinary PME unit (preferably headed by economist) at the ICAR, SAU and Institute level
4. Representation of stakeholders in technical divisions and outside bodies as appropriate
5. Manualisation of guidelines for PME as part of project cycle (project formulation, screening, monitoring evaluation and ex post impact analysis)
6. Pilot implementation of improved PME at 5-10 programmes (institutes/SAUs) of diverse structures/mandates that are closely involved in NATP by integrating Subject Matter Divisions of the Council
7. Needs baseline information and performance indicators, which must be evaluated after 2-3 years
8. Ad hoc processing of proposals by NATP/PIU for funding under NATP using improved PME. NATP/PIU requires mechanism for screening proposals according to PME criteria
9. Simultaneously build awareness for replication throughout system through a series of workshops.

Training

1. Organise workshops and appreciation courses to sensitise top-level research managers
2. More in-depth training for selected scientists and economists in methods for research priority-setting and evaluation
3. Key role for NAARM in training in PME, assisted by NCAP, IARI, IASRI and other institutions with capability (including non-ICAR/SAU). Need specific courses, incorporation into orientation courses and materials for SAU curricula
4. Collaboration with international institutions in selected areas (ISNAR, IFPRI, ICRISAT, etc) for priority-setting methods and evaluation of natural resource management.

Action Plan

1. Constitute a working group at ICAR level to frame guidelines on research priority-setting methods at institute and project levels
2. Constitute a working group at ICAR level to (i) revise the RPF and (ii) develop manual, which provide guidelines for integrating improved PME approaches into project cycle
3. Identify few applied research institutions to pilot the improved PME before institutionalising in the entire NARS
4. Agricultural Research Information System (ARIS) should develop simple Management Information System (MIS) with measurable key variables and indicators while revising RPF
5. Organise workshops and appreciation courses to sensitize top-level research managers.

2.2 Workshop Proceedings

Workshop Background

National Agricultural Research System (NARS) in India is currently charting a proactive and futuristic role for agricultural technology management. Cost-effective agricultural technology generation requires rationalisation in research prioritisation, resource allocation and system organisation. Promoting complementarity and minimising overlapping research functions

within the NARS as well as international institutions are the guiding principles for reorganising agricultural research. Translating the vision of revitalising NARS for a responsive, efficient and futuristic role necessitates a systematic approach to institutionalise priority-setting, monitoring and evaluation (PME). The inherent strength of Indian NARS lies in its Capacity to draw lessons from past experiences and utilise the existing strong complementary linkages with several national and international institutions. Current focus on the institutionalisation of mechanism in Indian NARS is one such process being pursued under National Agricultural Technology Project (NATP) for keeping the system continuously responsive to external dynamism.

In order to prepare an action plan for institutionalising PME in Indian agricultural research system, a workshop was jointly sponsored by ICAR and World Bank during July 21-23, 1997. This workshop reviewed current PME mechanisms in the system and drew lessons from other NARSs and international agricultural research centres (IARCs) to strengthen these mechanisms.

Workshop Objectives

The workshop was designed to evolve the mechanisms for institutionalisation of improved capacity in PME. Specific outputs targeted from this workshop were as follows:

- The approach, including methodologies for PME
- Strategies for initiation, improving analytical capacity and information base for PME
- Needed resource scheduling and management and training support for sustaining PME.

Workshop Structure

Fifteen resource persons drawn from national and international agricultural research systems, shared their professional and institutional experiences. Three technical sessions, viz., research prioritization methods, institutionalisation aspects and national experiences and lessons, provided the focused presentation and discussion based on which another technical session was exclusively conducted for crafting recommendations. This session for formulating implementable strategies was organised through three parallel sessions of subgroups for specific discussions on priority-setting at national, institute and division levels; monitoring and evaluation (M&E) methods at scientist, programme and institute levels; and institutionalisation of PME at macro and micro-level including development of information system. The issues emerged during the three technical sessions were further iterated in these sub-group discussions for bringing out specific recommendations under each of the identified areas. These were once again presented, discussed, integrated and modified while finalising the medium-term and long-term recommendations.

Technical Session I: Research Prioritisation Methods Chairman: Dr H. K. Jain, Former DDG, ISNAR

The first technical session focused on analytical methods available and evolving continuously in the area of PME. Priority-setting methods used at the system, institute, research programme and project levels were discussed. The major issues for the institutionalisation which emerged during the discussions were:

- Target for simple and transparent priority-setting methods
- Methods should capture both demand and supply side considerations
- Make the trade-offs between research objectives transparent and explicit
- Aim for bottom-up approach with stakeholders participation
- Develop flexibility in priority-setting methods appropriate for different levels
- Provide feedback from ex post analysis to validate key parameters for ex ante priority-setting analysis
- Identify simple measurable indicators for M&E

- Match the needed research resources and project activities
- Define the periodicity for M&E
- M&E experiences should provide feedback to the planning process
- Link M&E outputs with the performance appraisal of the project team, and develop reward and incentive structure for better performance.

Technical Session II: Institutionalisation of PME: Case Studies Chairman: Dr Mruthyunjaya, ADG (ES&M), ICAR

This session deliberated on the institutionalisation of capacity in the system at all levels. Recent experiences of PCAARD and ICRISAT were analysed in great detail. The purpose was to identify strengths, weaknesses and adaptability of these models for replicab ility in Indian NARS. International experiences (ICRISAT model) have potentials for institute level adaptation while safeguarding against individuals and leaders based institutionalisation process (PCAARD model). Institutionalisation related specific issues which emerged from the international experience were:

- Develop a comprehensive view of the organisational behaviour to recognise the existing complexity .
- Attempt for organisational changes through institutionalisation that can be sustained
- Decentralisation does not end with multiplying budget making centres
- PME, MIS and budgeting are not to be treated as technical issues but as socio-technical and management issues
- Form a powerful guiding coalition with assured and sustained commitment from the top-level management. Create and communicate a vision for institutionalisation and empower others (scientists) to act on that vision
- Identify programme leaders for priority research areas in an interactive mode ensuring the overall confidence of project team members
- Allocate budget specifically to projects, and percolate down to activities and project team members
- Timely information about availability of funds to identified research priority areas
- Flexibility of converting non-plan and plan research funds.

Technical Session III: Indian Experiences and Lessons Chairman: Dr Dayanatha Jha, Director, NCAP

The third technical session focused on the available Indian case studies, covering institute and zonal research station level decentralised priority-setting activities. These experiences highlighted the felt need among the scientists to adapt for improved PME methods. Empowerment of scientists at all levels to pursue this vision will have positive and sustained impact within the system. Along with this, other activities like management information system, budgeting and incentive system should be treated as a single package and not in isolation while scheduling the process of institutionalisation. Issues emerged from the Indian experiences were:

- Integrate PME with research planning process
- Develop in-house capacity and specialised units for PME
- Committed resources for PME institutionalisation process
- Assess training needs of analysts, PME team/units and research managers
- Concentrate more on PME institutionalisation process and not the analytical methods
- Create information base on economic and technology related variables

Technical Session IV: Issues for Formulating Recommendations Chairman: Dr S. S. Johl, Former Chairman, CACP

Three sub-groups were constituted for synthesising the recommendations based on the issues generated during the first three technical sessions. The workshop was designed in such a way to provide about half of the time for such group discussions covering research

priority-setting at macro and micro levels, monitoring and evaluation methods, and institutionalisation of capacity and information systems. Guidelines were provided to the sub-groups to facilitate structured discussion and outputs.

General guidelines for discussion groups

- Identify the principles for improving PME in agricultural research in India
- Propose concrete action for the next 2-4 years under NATP for phased institutionalisation and resource needs for installing PME as an integral part of research planning and management in Indian NARS
- Suggest steps for prioritising research proposals for support under NATP at programme and project level
- Indicate the modalities of integrating PME into project cycle for the production systems research supported under NATP
- Highlight the linkage for feedback from production systems research to mission mode research and teams of excellence under NATP.

Plenary Session Chairman: Dr R. S. Paroda, Secretary, DARE and DG, ICAR

The recommendations of sub-groups were placed before the full house for more refinement. After one more iterative exercise, based on me feedback from the participants, final recommendations were modified and integrated and presented in the plenary session. While stressing the need for ensuring efficient agricultural technology management at all levels within NARS, the chairman flagged the following areas as a starting point for the group's consideration :

- Identifying easily quantifiable indicators of monitoring the performance of project, scientists and management personnel for improving efficiency of agricultural research
- Revising the RPFs and framing appropriate guidelines for integrating PME into project cycle and research management process at all levels within the NARS
- Planning for continuous human resource development through appropriately structured training modules to match the changing needs of research administrators in ICAR and SAU system
- Strengthening the internal review system within NARS by orienting the existing mechanisms like Research Advisory Committee and Quinquennial Review Team, etc. in a proactive and interactive mode by drawing from other national and international institutes' experiences like CGIAR Centres.

The chairman, in his concluding remarks, strongly suggested for a concrete action plan to initiate and install a permanent mechanism for identifying research priorities, programming resource allocations, monitoring the progress and evaluating the ex ante and ex post impacts of research projects for the NARS as a whole in an integrated and phased manner. The remarks of the chairman and the final recommendations of the workshop were synthesised for the Council's consideration and implementation.

2.3 Institutionalisation of Research Prioritisation, Monitoring and Evaluation in Indian NARS (Base paper for the workshop on 'Institutionalisation of Research Prioritisation, Monitoring and Evaluation in Indian NARS').

Suresh Pal and Dayanatha Jha National Centre for Agricultural Economics and Policy Research New Delhi

1. Introduction

Accelerating food production was the main challenge for agricultural scientists for the first three decades after Independence. This evolution was driven by area expansion in the first phase and by productivity growth in the second. Research managers had a relatively simple

task of research resource allocation in the context of this 'major' objective. Experience and judgement of scientists led to fairly efficient research resource allocation decisions and reasonable realisation of the objective.

The last decade, particularly these last few years, has added complexities. Regional balance, sustainability, trade-technology links, demand shifts towards non-food grains, income growth for the poor, are a few of the many new challenges confronting agricultural scientists today. With time, this complexity will grow further. On the other hand, availability of public funds for agricultural research is declining. Research managers find it difficult to address all the challenges and pursue all scientific options to tackle them.

These factors necessitate more analysis and use of some sort of decision rules along with technical information. Research planning and prioritisation has thus become a complex and specialised task. Institutionalisation of this process is, therefore, much more challenging in Indian NARS which is large in size and complex in research mandates. This brief paper outlines the methodological and operational aspects of such institutionalisation.

2. Levels of Analysis

Prioritisation is required at different levels. The ICAR lays out broad national priorities taking into account national needs and objectives. It identifies commodities and regions which are likely to face stress or which offer opportunities in the context of national objectives. It also has to take a long-term view of natural resource conservation and sustainability issues. Such ex ante judgements require analysis of expected costs and benefits.

Once the broad areas are flagged, a similar exercise has to be done for each of them. For example, if maize is identified as a priority crop, decisions have to be taken regarding where and what major research strategies should be adopted. There invariably are several feasible strategies, each with varying technological opportunities and varying degree of needed resources (costs). An essential input in this decision process is a scientific analysis of various constraints, corresponding (specific) options to tackle them, and judgement regarding the possibilities of alleviating these constraints. Once again some sort of optimising decision rules have to be applied to rank various options.

State Agricultural Universities and Zonal Research Stations which have research mandates for a state, region or zone, have to follow a similar approach to decide their research agenda. As one goes down the line, all parameters (constraints, options, costs, benefits) become somewhat more objectively measurable and research programmes/projects become sharply defined. Ideally, one would sum up the disaggregated profiles of priorities to arrive at the aggregate (national) agenda in a 'bottom up' planning approach. This should be the long-term planning approach.

Indeed this framework has been intuitively followed in the NARS. As mentioned earlier, subjective and intuitive judgements are inadequate in the context of contemporary complexity, formal analysis is the need of the day. Such capacity has to be built and, what is more important, institutionalised at all levels in the NARS.

This requires (a) access to information (data) on production structure and resources, (b) socio-economic factors driving these, (c) strong (scientific and technical) knowledge base, (d) analytical capacity combining agro-biological sciences and socio-economic expertise, and (e) an institutional mechanism close to top management at each level in the NARS. These are currently lacking. The purpose of this workshop is to suggest how to achieve this capacity and integrate it with management units at each level in the research hierarchy.

3. Methodological Issues

From the point of view of analysis, there are two main issues to be discussed. First, we briefly describe the choice criteria relevant for priority-setting and research resource allocation. Then the analytical approaches are indicated.

3.1 Choice parameters

Choice of research strategies is compounded by multiple criteria of evaluation. These are derived from broad national and agricultural sector goals. It is important to note at the outset that there are many instruments and policies to address these goals. Research is one of them. In many cases, other instruments are more effective. Without this understanding, choices are likely to be distorted as research managers, in their bid to garner greater political support, promise too much and then allocate scarce research resources to solve problems which are best tackled by non-research instruments.

With this caveat in mind, the important criteria or objectives which need to be considered are briefly indicated below :

a. **Growth:** To attain an overall economic growth of more than 7 per cent, the agricultural sector must grow at 4-5 per cent. This can come only through technology-based productivity growth. Agricultural research has a central role in achieving this.
b. **Efficiency:** To be globally relevant, this growth must be cost-efficient. Research options need to be assessed for economic efficiency in terms of real prices of factors and products.
c. **Sustainability:** Adverse environmental and ecological consequences of modern growth processes and trade-offs between short and long-term benefits are now better understood. This is demanding increasing attention all around.
d. **Trade issues:** In the wake of the new world trade climate, new trade opportunities and challenges are emerging. In addition, there are issues of technology gaps, technological dependence and intellectual property. The research system must remain vigilant and responsive to these considerations.
e. **Equity:** Accent on poverty alleviation requires that research contributions to this cause be also assessed. Equity in all three dimensions- regional, personal and gender, is important and research (technology) may influence this in positive or negative way.

It is obvious that these parameters interact among themselves. Intuition and subjective judgements fail to capture these complexities. Research managers need more information and analysis in order to make decisions about priorities and research allocation. In specific cases, other criteria (e.g., health, nutrition, energy, etc.) may be relevant depending upon the mandate of the institution.

3.2 Analytical approaches (This section Ls taken from Jha ct ill. (1995))

Methods reported for agricultural research priority-setting can be grouped into five categories: (1) scoring approach, (2) benefit-cost analysis, (3) programming model, (4) simulation model, and (5) econometric model. A brief description of each method is presented below.

Scoring/weighted criteria model

It is a commonly used method which involves identification of objectives for research system and choosing a set of criteria of measures of the contribution of commodities or types of research to the objectives. Criteria may be qualitative or quantitative in nature. Information on the commodities or research areas according to their overall contribution to research objectives are assessed for prioritisation.

Scoring models have the advantages that they can be administered in a relatively short period of time and are transparent, which facilitates their understanding particularly by administrators. They can be used to rank a long list of commodities as well as research areas, including non-production-oriented research. Qualitative as well as quantitative information can be used and perhaps most importantly, they facilitate the consideration of multiple goals and objectives. These models are often criticised because of their subjective weighting of multiple goals and objectives. Applications of these models are found in several studies like in the United States (Mahlstede, 1971), Argentina (Moscardi, 1987), Gambia (Sompo, 1989) and TAG (1992) review of priority and strategy for CGIAR.

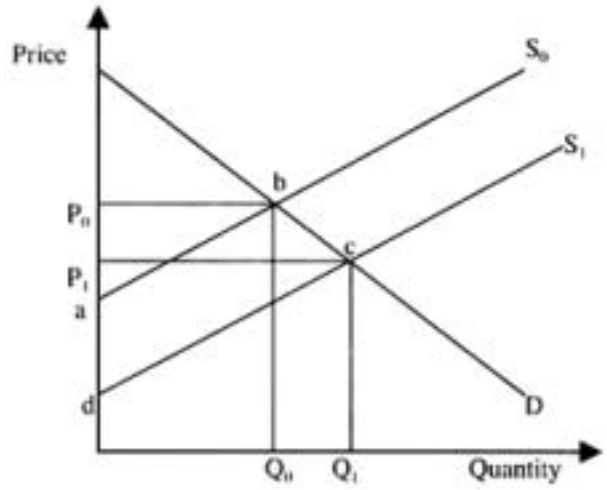
Benefit-cost (economic surplus) approach

The-economic surplus approach estimates returns to investment (generally, an average rate of return) by estimating the benefits from research in terms of the change in consumer and producer surpluses that result from technological change. Ex ante analysis usually incorporates expert opinion to determine projected research impacts, adoption rates and probabilities of research success, and provide estimates of the economic efficiency and distributional implications of agricultural research resource allocation.

Figure 2.1 illustrates the effect of technological change on economic surplus. The supply curve with the original technology is S_0 and the demand curve is D. The resulting equilibrium price and quantity are Po and Q_0, respectively.

Adoption of new technology, which reduces the unit cost of production (by raising yield) shifts the supply curve down from S_0 to S_1. This results in a new equilibrium price and quantity P_1 and Q_1 Consumers gain from the adoption of new technology because they can consume more at a lower price, and producers gain because their unit production costs fall. Net social benefit is the sum of consumer and producer surplus and is given by the area abed. The size of this benefit depends on the nature and size of supply shift.

Figure 2.1 Economic surplus model



The benefit-cost approach has the major advantage of incorporating several criteria related to economic efficiency and distribution into one or two measures. It can also be used to examine the general equilibrium effects of research; to assess the spillover of research benefits among different technologies, commodities, regions or countries; and to estimate the effects of agricultural policies on benefits arising from research. This method can be difficult to apply to a large number of commodities or research areas because types of data necessary for the analysis often do not exist for all commodities, li is also not well suited to rank non-commodity research areas. Applications of this method are found in studies in Peru (Norton et al, 1987), in eastern Caribbean (Norton and Douglas, 1989) and Australian Centre for International Agricultural Research (Davis et al., 1987).

Programming and simulation models

Programming models rely on mathematical optimisation to choose a research portfolio through maximising a multiple goal objective function given the resource constraints of the system. They have the advantage of explicitly incorporating the budget, human resource and other constraints in the system. Like scoring models, they facilitate the inclusion of multiple objectives. If constructed in a multi-period format, they can identify how the research portfolio should change over time. However, they require a great deal of analytical ability, data and time. An example of the use of this method is a study by Russel (1977) in the U.K.

In simulation models, mathematical relationships among variables are exposed 10 different scenarios to assess the best outcome. They can incorporate many factors that affect research priorities, such as multiple goals, research constraints, socio-economic variables, risk and uncertainty.

The advantage of simulation models is their flexibility. They can be constructed as relatively simple or complex tools, can incorporate optimizing or ranking procedures and can readily include probabilistic information. Their major disadvantage is that, to be useful they must be relatively complex and typically require extensive amounts of both data and time of skilled analysts. Anderson and Franklin (1977) and Lu et al. (1978) have used this method.

Econometric methods

The results of ex post analysis can also provide useful guidance for research resource allocation decisions if appropriately incorporated into systematic ex ante procedure. The most common ex post approach, in addition to the ex post benefit-cost analysis, is the econometric estimation of production or supply functions incorporating research variables. These econometric models assess the contribution of research to changes in production of different agricultural commodities. To be useful in ex ante analysis, econometric approaches must be applied with a high degree of disaggregation and good historical data on production, farm inputs and research expenditures.

Numerous studies have estimated these models (production functions, supply functions, profit functions, etc.) for ex post evaluation of agricultural research. While the results of these studies have been used to justify additional research funds for particular commodity; no research system has systematically used the results of a comprehensive econometric analysis for all its major commodities to help in setting research priorities.

There is no single approach that is suited for every situation. Each has advantages and disadvantages that affect its suitability for specific evaluation purpose, and in fact, it may be appropriate to combine different methods. The scoring and economic surplus approaches have been used more than the others.

Table 2.1. Comparison among major research priority-setting methods

	Characteristics	Scoring model	Economic surplus	Simulation method	Mathematical programming
1.	Requires explicit elicitation of goals	Yes	No	No	Yes
2.	Determines distributional effect on consumers and producers at various income levels	No	Yes	Yes	No
3.	Considers trade-off among goals	Yes	Sometimes	Yes	Yes
4.	Evaluates benefits to "aggregate" research	No	Yes	Yes	Yes
5.	Evaluates benefits to commodity research	Yes	Yes	Yes	Yes
6.	Evaluates benefits to non-production or non-commodity oriented research	Yes	Difficult	Sometimes	Yes
7.	Provides ranking of research projects based on multiple goals	Yes	No	No	Yes
.8.	Quantifies spillovers	No	Yes	Yes	No
9.	Relative ease of comprehension by decision makers	High	Medium	Low	Low

Source : Based on Norton and Davis (1981)

4. Information needs

The analysis requires considerable amount of information and data, covering both scientific (technical) and socio-economic aspects. These data should pertain to the level (national, state, zone) at which the exercise is intended. The following is an indicative list of such data.

Scientific information

- current, status of research
- constraints (technical and socio-economic)
- research approaches/options
- research resource needs
- probability of research success
- research and adoption lag

Socio-economic information

- supply, demand parameters
- farming system characteristics
- adoption possibilities, constraints
- yields, incomes, production, prices, inputs use
- externalities environment, gender, etc.
- market, policy environment

This is illustrative. As we deal with specifics, more and other kinds of information will be required.

5. Monitoring and Evaluation

An attempt was made under National Agricultural Research Project (NARP) to develop a system of monitoring research at participating SAUs. In the ICAR system too, an Agricultural Research Information System (ARIS) type system was introduced at the institute level. These have generally become defunct. Neither the scientists nor the management consider it important or useful.

Yet some kind of project information system is absolutely essential, not only for monitoring on-going research but also for research planning, prioritisation and resource allocation. It would not be an exaggeration to say that at present we don't have a very good idea of the disposition of research resources by commodities, resources, or problem areas. This must change. A simple, effective research project information system must be developed and adopted across the board in the NARS. In addition to our own Research Project File (RPF) and ARIS format, there are others which need to be looked into.

There are two reasons for 'no start' of earlier efforts. The more obvious one is that the project information system is not integrated with evaluation, either of individual scientist or of institution, or with any research planning. As such, it serves no purpose and is naturally neglected. The second reason is perhaps complexity of the format. The questionnaire is too cumbersome, it tries to cover a lot of information.

It is obvious that unless a workable research project information is set, systematic planning cannot be undertaken. What is needed is a two-fold strategy- a simple information system and the wherewithals to implement it, and secondly, an effective administrative mechanism linking this with evaluation of scientists and institutions. So long as such evaluations don't have teeth, the mechanism will not be taken seriously.

Other closely related aspects are the technology information system and research impact assessment. Institutionalisation of technology information system and impact assessment will help evaluation of achievements against targets. This will also provide feedback to research planning by looking at the extent and causes of deviations between targets and actual achievements. In addition, this will demonstrate research benefits, which are essential to justify enhanced research funding.

6. Institutionalising the Capacity

It is obvious that current capacity at various levels (national, regional, zonal) is inadequate to address the information and analytical needs of systematic research prioritisation work. An attempt was made under NARP to create some capacity at the Directorates of Research in various SAUs, but its focus was on monitoring and not prioritisation. Almost all constituent units of the NARS recognise the need for a planning unit; some of them have this unit, most address this through ad hoc processes (as and when five year plan is formulated). But, as mentioned above, such exercises are usually driven by a supply-side orientation, emphasising technical/scientific parameters and there is no analysis of socio-economic justification, impacts, or trade-offs-the main determinants of a demand-driven research

agenda. Now that there is a consensus on the new paradigm, these deficiencies must be addressed.

Three issues are crucial. First, there must be a realisation at the decision-making level in each institution that (a) this is important, and (b) this requires rigorous socio-economic analysis. The inertia of convention has to be overcome. Second, this work must be (a) positioned right next to the research manager and draw directly from his authority, (b) be mandatory for all research institutes, (c) done by a standing team of scientists including economists, and (d) adequately backed by analytical and infrastructure support. Finally, existing capacity in this area in different research institutions is weak.

In order to address these issues, it is proposed to:

1. Create a small, permanent planning, monitoring and evaluation cell in the office of the research manager at different levels (headquarters, institutes, SAU, etc.). This cell must have access to data base, computers, networks, etc.
2. Make explicit mandatory provision for priority analysis for research plans/ projects screening.
3. Developing research project information system under the cell.
4. Linking project information system and analysis with Staff Research Council and other research approval mechanism.
5. Linking individual (scientist) and institution assessment and reward system with the project information system.
6. Arrange for training of planning cell staff in relevant economic analysis.
7. Provide overall orientation to scientists through in-house training, training programmes at NAARM.
8. Provide training materials, manuals.

7 Summing Up

The institutionalisation process aims to promote resource allocation and use efficiency in Indian NARS. Central to this process is the creation of well structured decision support system. No doubt, entire process of the institutionalisation should be objective and based on scientific principles. At the same time, one should see that the process is simple and easy to operationalise. The following guiding principles may help attain these goals.

1. The process should be objective and transparent so that research managers (and non-economists) can easily comprehend it. If not the analysis, at least end results should be understood by research managers.
2. It should establish links between policy makers, research managers, scientists and farmers.
3. The process should be an ongoing activity and provide decision support structure for research management.
4. The process should be iterative with participation of scientists and research managers in discussion of the results and their implementation.
5. The process should ensure strong links between basic, applied and adaptive research.

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2.4 Programme

July 21, 1997

Inaugural Session

Chief Guest:	**Dr. M.L. Madan, DDG (AS), ICAR**	
Chairman:	**Dr. R.B. Singh, Director, IARI**	
0930 hours	Welcome and workshop objectives Overview of research priority setting, monitoring and evaluation in ICAR and SAUs	Dr Dayanatha Jha Dr Mruthyunjaya
	Address by the Chief Guest Remarks by the Chairman Vote of thanks	Dr M. L. Madan Dr R. B. Singh Dr N. N. Singh

Technical Session I : Research Prioritisation Methods

Chairman: Dr H. K. Jain, Former DDG, ISNAR

1030 hours	Paper presentation by the resource persons*	Dr Derek Byerlee World Bank
1100 hours	Tea break	
1130 hours	Session contd.	Dr (Ms) M.C.S. Bantilan** ICRISAT
1300 hours	Lunch Break	Dr K.P.C. Rao, MANAGE

*Each presentation was followed by a brief discussion.
**Presented by Dr (Ms). M.C.S. Bantilan

Technical Session II : Institutionalisation of PME: Case Studies

Chairman: Dr Mruthyunjaya, ADG (ES&M), ICAR

1400 hours	Institutionalisation of the capacity Case studies - ICRISAT Philippines	Dr Paul Perrault, ISNAR Dr P. K. Joshi, ICRISAT Dr R. M. Juanillo
1530 hours	Tea break	PCARRD6

Technical Session III : Lessons from the Indian Experience

Chairman: Dr Dayanatha Jha, Director, NCAP

1600 hours	Paper presentation by the resource persons	
		Dr H. K. Jain Former DDG, ISNAR Dr D. R. Bhumbla Former VC, HAU Dr R. B. Singh Director, IAR
	Open discussion	
1730 hours	Poster presentation -Methodological: aspects and data requirements	Dr Stanley Wood, IFPRI

July 22, 1997

Technical Session III (Contd.)

Chairman: Dr K. P. C. Rao, Director, MANAGE

0930 hours	Paper presentation by the resource persons	
		Dr J. C. Katyal, NAARM Dr C. Ramasamy, TNAU Dr J. Thakur, RAUV(B) Dr Stanley Wood, IFPRI
	Open discussion	
11 30 hours	Tea break	

Technical Session IV : Issues for Formulating Recommendations

Chairman: Dr S. S. Johl, Former Chairman, CACP

1200 hours	ARIS Issues for formulating the recommendations	Dr Gajendfa Singh, ICAR Dr Suresh Pal, NCAP
1300 hours	Lunch Break	
1400 hours	Parallel sessions of sub-groups	

1. Priority-setting at the macro (i.e. national) and micro (i.e. institute/ division) levels
   Chairperson: Dr (Ms) M. C. S. Bantilan, ICRISAT
   Rapporteur: Dr Suresh Pal, NCAP
2. Monitoring and evaluation methods (individual, programme, institute level)
   Chairman: Dr Derek Bayerlee, World Bank
   Rapporteur: Dr P. K. Joshi, ICRISAT
3. Institutionalisation of priority setting at macro and micro level, including training and monitoring & evaluation
   Chairman: Dr Mruthyunjaya, ICAR
   Rapporteur: Dr (Ms) Alka Singh, IARI
4. Development of information system
   Chairman: Dr Gajendra Singh, ICAR
   Rapporteur: Dr S. Selvarajan, NCAP

1530 hours	Tea break	
1600 hours	Parallel sessions (contd.)	
1630 hours	Tea break	
1700 hours	Demo on the use of DREAM software for priority setting	Dr Stanley Wood, IFPRI
1930 hours	Workshop dinner	

July 23, 1997

Technical Session V: Finalisation of the Recommendations

Chairman: Dr Dayanatha Jha, Director, NCAP

0900 hours	Presentation of preliminary recommendations by the chairpersons of sub-groups Open discussion	
1130 hours	Tea break	
1200 hours	Finalisation and integration of the recommendations by subgroups	
1330 hours	Lunch break	

Plenary Session

Chairman: Dr R. S. Paroda, Secretary, DARE and DG, ICAR

1500 hours	Welcome Presentation of the recommendations Summing up (brief sum up as closure to the workshop) Remarks by the chairman Vote of thanks	Dr N. N. Singh Dr Mruthyunjaya Dr Derek Byerlee Dr R. S. Paroda Dr Dayanatha Jha

List of Participants

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3 CRITICAL ISSUES IN LAND - USE PLANNING IN INDIA

Sulabha Brahme
Pune

India today is facing a critical situation in relation to land - use planning. Even though the foodgrain production recorded almost a fourfold increase in the post-independence decades, shortage of rice, pulses and oilseeds is growing. Shortages of pasturelands, firewood and fast depletion of the forest wealth are assuming serious proportions. As a consequence of various development endeavours ecological imbalances e.g. soil erosion, rapid situation of dams, shortage of ground water, land and water pollution, water logging etc. are growing adversely effecting the agricultural productivity. Unless special efforts are made towards preservation of the land, water and vegetative resources of the country and its long term sustainable use is planned, the foodgrains and other basic needs of the country's population cannot be met, food security and self-reliance cannot be assured and enhanced livelihood security to the oiling millions in India cannot be ensured.

A review of the five decades of development and the new measures that are being adopted under the Structural Adjustment programme since 1991 would help identify the critical issues in relation to land - use in India in coming decades.

Green Revolution

Plagued with the problem of stagnant agriculture and shortage of foodgrains production in drought years, India accepted the green revolution technology under the advice of various foreign aid agencies. In the short-run, gains in productivity were achieved. However, this petrochemical-based technology is not sustainable because it is resulting in depletion and deterioration of land and water resources. Moreover, water-fertilizer - pesticide-intensive agriculture, crossbred animals and single species forest plantations - a technique borrowed from temperate countries is not suitable to India. The soil characteristics, the rainfall pattern, the wind pattern, the pollination pattern are different in temperate and tropical zones. The soils in the tropics are poor in organic matter because organic matter decomposes quickly under the impact of high temperature and humidity that induced high microbial activity. Because of the long dry spell in the tropics, soil becomes parched and tends to get eroded with high rain. In the humid tropics, nature has provided earthworms and termites and ferns and algae in great abundance as builders of the topsoil, and soil fertility. The use of chemical fertilizers and pesticides in tropics means decimation of soil building species. Unlike temperate countries where pollination is mostly windblown, in tropical countries the main agency is insects. The use of pesticides that kills beneficials is therefore more harmful in the tropics. In wet tropics, chemical fertilizers get washed down the canals and river more quickly and hence poisoning of surface and groundwater level is much higher. The pesticides break down into components and find an easy entry into the biological systems. Hence the accumulation of pesticides components is much greater in the animal and human bodies in the tropics, increasing the risk of cancer.

The non-sustainable nature of the green revolution, white revolution technology and the fast depletion of natural resource base led the Ministry of Agriculture and the Planning Commission to take serious cognisance of the problems of planning and management of country's natural resources. The Ministry of Agriculture initiated in 1987 an extensive research project " Perspective plan for Conservation, Management and Development of Land resources in the country" on a zonal basis. The Planning Commission set up in 1988 Agro-climatic Regional Planning Units. Before the recommendations of the various zonal studies were taken up for serious deliberations the NEP era set in. NEP is in obvious contradiction with the policy of Land use regulation.

Policy Measures Under NEP Affecting Land-Use

i. Relaxation of restrictions on acquisition of land and other immovable property in India by NRI'S and FERA companies. The NRIs and foreign companies with income levels hundred times (or more) as compared to the levels of income of the Indian nationals can capture the prime lands anywhere in India. The Multi-nationals are free to grab and mine, pollute, destroy land and water resources. The Government of India is powerless, the Government is not in a position to intervene and regulate the land-use, keeping in view the long term interest of conservation and sustainable use of land, water, forest and marine resources of the country, so long as it is governed by the IMF conditionalities and WTO.

ii. Removal of controls on location of industries and special concession to industry if located in backward districts. This means proliferation of industries in a haphazard manner in rural districts dislocating peasant agriculture, polluting land, water and air, leading to environmental damage over extensive areas.

iii. Relaxation of restrictions on conversion of agricultural lands to non-agricultural uses, and ceiling on agricultural land holdings. This is resulting in a large-scale transfer of lands for speculative purpose, distorting the land market and viability of agriculture.

iv. Promotion of export-oriented agriculture and concessions to agro-processing companies. This is leading to diversion of land peasant farming and exhaustion of soils, mining of water resources due to chemical-input intensive cultivation.

A special study was carried out in Maharashtra State during April- July 1996 to access the impact of NEP on land-use. The results of this study are briefly presented below to get an insight into the processes that are turning futile any regulation of land use attempted by the Government of India, in the national interest.

Conversion of Agriculture Land

The Government of Maharashtra has relaxed restrictions on conversion of agricultural lands to non-agricultural (N.A.) uses, bringing agricultural lands in the speculative market. According to Government Ordinance issued in 1994 permission for N.A. uses is not required in areas where (1) Regional Town Planning Act, 1966 is in operation, (2) legally declared Industrial zones exists or is finally accepted/proposed. In Maharashtra, about 1534 thousand hectares of Government land had been distributed to 773760 persons by the Government. Landless persons especially tribals, dalits, exservicemen, freedom fighters etc. had received land grants and these lands were inalienable. Now the restriction on alienation of these lands are also removed. The agricultural Land Ceiling Act has been amended to permit large holdings if the land is shown as under horticulture and these can be owned by any party. The land owned by scheduled tribes persons is subject to the provisions of sections 36 and 36A of the Maharashtra Land Revenue Code 1966. This means tribal land cannot be purchased without obtaining District Collector's permission. These provisions are being violated under the current 'free market' dispensation.

It is true that even when laws restricting land transfers were in force thousands of illegal transactions were taking place and these transfers were getting legalised in collusion with revenue officials. However, the SAP has opened the flood gates through amendments to land legislation and jacking up land prices through relaxing restrictions of NRIs and FERA companies.

Land Acquisition

The Maharashtra Government has an awry programme of land acquisition for industry, airports, expressways, ports, tourist resorts and offering extensive packages of concessions to multinational and Indian companies.

The Mumbai Metropolitan region is being extended to cover Thane, Kalyan, Bhiwandi, Ulhasnagar and Vasai tehsils of Thane and Uran and parts of Panvel, Karjat, Pen, Khalapur

and Alibag tehsils of Raigad district. Land under agriculture, plantation and forests are being taken over for urban and industrial development with disastrous consequences for agriculture and fisheries due to air pollution, water pollution, destruction of marine wealth and loss of rich rice and plantation lands.

The Maharashtra Industrial Development Act. 1961 provide for acquisition of private land anywhere in the state just by serving a notice to the landowner. MIDC has so far acquired 35000 hectares of land over 200 locations. It has planned land acquisition for 120 industrial areas/estates covering 30000 hectares of land. Nine large industrial townships with size ranging from 2000 to 7000 hectares are planned. The Irrigation Department will earmark necessary water for the townships. MIDC is also planning deluxe industrial estates for attracting NRIs and foreign companies. Air-links to Mumbai are planned to be provided through private sector. Exemption from landing fees, sales tax on aviation fuel is offered for a period of five years. Aquaparks, along the coast are planned through MIDC, equipped with ponds for pisciculture, warehousing, and cold storage facilities. Land is being acquired by the Government for private hotel industry and tourism development.

Large stretches of land are under acquisition for new expressways and airports. For example, 1828 hectares of land for a new Mumbai - Pune expressway and 2000 hectares for megacity projects that are being launched, international airport near Mumbai 2900 hectares of land are earmarked near Mandwa - Rewas in Raigad district, and 5000 hectares for a township near the airport.

Invasion of Coastal Lands

The MNCS and large industries are particularly interested in coastal locations in the Konkan districts of the state. The facilities of port are crucial for many MNCS who are import-export dependent. Seacoast provides ample water supply and free space for waste disposal. Besides, in coastal tracks of Konkan stretches of lands are still owned by Khots (absentee landlords) who sell off land dispossessing peasant cultivators.

In the ecologically sensitive coastal districts, chemical, copper smelting, steel, cement factories, thermal power stations, petroleum refinery and several other polluting industries are being invited. The Konkan Railway which is under construction linking Mumbai to Manglore will provide strong land link to the other part of the country. A new coastal highway is under execution. Maharashtra has over 720 Kms. of coastline with two major ports-Mumbai and Jawaharlal Nehru Port in Mumbai Metropolitan region and 48 minor ports. The State Government has announced privatization of all the 48 ports. Existing port facilities at these ports would be given on long lease and the Government would be acquiring additional land for the private companies.

In the coastal taluka of Guhagar (Ratnagiri district) MIDC forcibly acquired in 1994 about 650 hectares of land at Anjanwel-Veldur for Dabhol Power Company (DPC) set up by the ENRON Corporation of U.S.A. In 1995 acquisition process of 800 hectares of land for the Hindustan Oman Petroleum Corporation was begun near Devgarh- Marg Tahmane. These lands have a very rich horticultural potential - Alphanso mango, coconut, arecanut, cashewnut plantations, a variety of spices etc. and the coast is rich in marine wealth with good export potential. Hence horticultural and fisheries, the traditional vocation of the toilers of the region, were earlier encouraged by the Government. Now the orchards are being bull -dozed to hand over the lands and the ports to MNCs. MIDC is acquiring about 7200 hectares of land along the stretch from Dabhol creek and Guhagar town on the coast to Marg Tamhane along Guhagar-Chiplun Road. The peasants and fisher-folks are opposing this sell out to the multinationals and big industry and are demanding horticultural and fisheries development. In addition the industrial areas and aqua-parks, the coastal ecology is being disturbed by the development of beach resorts, tourist hotels and sports facilities, express-ways and air-strips. All coastal taluka are earmarked by the State Government for development as special tourism area.

All this development is proceeding inspite of the Government of India CRZ Notification of February 1991. The Notification prohibited within the Coastal Regulation Zone (CRZ)

specified activities such as construction, land reclamation, discharge of waste, mining of sand, rocks etc. However, the State Governments continued unabated industrial and urban developmental activities in the CRZ. In a significant order issued in December 1993, The Supreme Court directed all coastal state not to permit industrial units or allow any kind of construction in the area of 500 meters from the sea water at the maximum high tide. However, the Government of Maharashtra, in gross violation of the Notification is permitting a fast and uncontrolled growth of industries, including thermal power station, development of ports, beach resorts, coastal highway, marine park, acqua-farms etc. ignoring the CRZ regulations. Such a breach of land use regulations imposed within the coastal zones means increased coastal erosion, enhancing coastal flooding and salt-water intrusion, extinction of priceless and rare menine flow destruction of the marine fauna threatening the livelihood of thousands of fisherfolks.

Attack on Hills and Mountains

The Government of Maharashtra, by special notification dated 26th November 1996, threw open for development as Hill Station/ tourist/holiday homes etc. hill tops, hill slopes, forest areas in the state to private developers, violating the provisions of the MRTP Act and the Central Government directives for preservations of forest areas. Hundreds of hectares of forests in Chandrapur and Gadchiroli districts of Maharashtra are being given on long -lease to private companies for coal mining overlooking ecological hazards and the displacement of the tribals. Special tourism areas are being notified in hilly-forested tracts of Maharashtra e.g. Ajantha - Verul in Aurangabad, Chikhaldara in Amravati, Lake District project in Pune district. Hotels, resorts, health farms, motels, water sports facilities, golf courses, amusement parks are being promoted in all the talukas of the state. In the 'green zone' or no development zone' surrounding city area the government is now permitting golf courses, gliding facility, amusement parks, sports facilities etc. The land declared surplus under Land Ceiling Act is being diverted for construction of hotel/motel complexes. Sales tax, luxury tax, electricity duty exemptions for a period of ten years are offered by State Government.

Thus the hills, forest and green areas, the sensitive regions in the ecological balance that need to be preserved as no development zone except for the normal activity of the local people, are being invaded unscrupulously by the MNCs and builders. Exploitation of ground and surface water resources, discharges of untreated waste, alteration of hilly terrains through roads and building construction, destruction of flora and fauna zone, disturbing hydrological cycle and destroying biodiversity and rare flora and fauna.

Apart from the above disastrous ecological consequences of the NEP, the new policy has destabilizing economic effects that are distorting land-use.

Sky Rocketing Land Prices

With the removal of restrictions on land purchases by foreigners and NRI's and on land transfers and land use, the prices of land in Mumbai -the financial centre of India skyrocketed, recording a four or five times increase between 1992-1994. A parallel rise in land prices is experienced in the adjoining konkan districts, Mumbai-Pune conurbation and the major cities of Maharashtra. Black money is flowing even in the remote areas for speculative land hoarding by the land speculators, builders and politicians. Land sales are being forced through manipulation of land records and even by resorting to threats depriving peasant of their means of livelihood. Cultivation is turning non-viable because of the ingress of polluting industries, mining, and other non-agricultural activities. The sum available today from the sale of land appears attractive as its future income from cultivation. Changes in the land-use are thus being effected in a haphazard and ecologically disastrous manner, under the current unregulated market operations.

Changes in Land-Use

Apart from the diversion of lands from cultivation to industry, housing, tourism and other non-agricultural uses and the extensive damage to cultivation due to industrial waste, pollution, water extraction by the industries, townships etc., there is a diversion of lands to chemical-intensive cultivation due to the growth of agro-processing companies and export oriented cultivation by rich land owners. Flouting government regulations, monopoly is being established on ground water, and surface water resources by these developers. Inroads are being made even in the tribal areas of Pune, Thane and Nasik districts by agro-processing companies. Consequently, the tribals are being deprived of their means of livelihood and the land under cereals and pulses is declining, threatening food security.

Need for a Firm Land-Use Policy

The experience in Maharashtra noted above is repeated in Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and most other states of India. The states are removing special restrictions under 'no development zone' declared to protect agricultural lands, hill ranges and coasts, 'reverse forest areas' 'biodiversity conservation areas', tribal areas and regulatory measures in relation to land-use, contradicting the stipulations of the state TRP Acts, Forest Acts, CRZ and other regulations promulgated by the Ministry of Environment and Forests and even the provisions under the Indian Constitution. The states are competing to attract MNC's giving them special concessions and gifting away lands and forests. Unless the Central Ministry of Agriculture, Ministry of Environment and Forests and the Planning Commission intervene and halt this indiscriminate spread of industry, mining tourism and other urban encroachments into coastal lands, hilly tracts, forests, and tribal homes and the Indian Ocean, the natural resources of the country would be squandered and plundered by the MNCs and the toiling masses ruined. Two pronged strategy has to be planned to avert this disaster. On the one hand, the protective legislation in relation to land, forests and environment has to be strictly adhered to. Today the Ministry of environment is giving provisional clearances (which in fact, means final clearances) to MNCs and State Governments for several ecologically harmful projects even without insisting on submission of scientific environmental impact studies and its evaluation. On the other hand, policy measures have to be formulated and implemented for preservation, augmentation and proper utilization of the land, forest, water and other natural resources of the country. The judicious approach under tropical conditions would be to put stress on conservation and enrichment of the natural renewable resource base. For this it is necessary to deepen our understanding of how the biochemical systems exchange matters with the surroundings all the time, the process of recycling between land surfaces, water surface and the atmosphere, the process of recycling between soil, plant and animal life, the hydrological cycle and energy flows. Holistic understanding will give us clues to simple, inexpensive but efficient techniques beneficial in the long run. Holistic approach will show the way of nitrogen fixation through biological agents, soil enrichment by composting waste products, higher productivity through inter-cropping and crop rotation, pest control through diversity, maximization of food basket through multivarietal crops and multi-pronged culture - viz. forestry, agriculture, horticulture, animal husbandry, poultry, fishery, all interwoven and supporting one another. The variegated needs of the Indian society can be maximized through judicious use of processes of recycling and symbiosis.

A switch from chemical to ecological farming may give lower yield in the initial years i.e. till the damage done to soils is repaired. It also means greater care, labour and skills. However, it is sustainable in the long run, as it is based on the conventional use of the natural resources and not on their exploitative use. Improvement in production levels can be achieved through integrated approach to resources use rather that competitive approach. The basic elements of the new approach are : (i) All the land and water resources are to be treated as social resources and their use has to be planned on the scientific basis, (ii) The land and water use is to be planned on the basis of watershed planning with uplying portion being reserved for erosion control using graded bunds and suitable grasses and trees, so as to ensure stabilization of water supply and improvement in moisture regime that will base, (iii) The desert tract to be put under Silvipastoral treatment, (iv) The mountains and hilly tracts that regulate the hydrology of the country to be fully protected from urban and other

encroachment. Conservation and reforestation to be taken up in cooperation with the local population and the forest resources to be harvested on a sustainable basis, (v) Special protection to coastal regions and marine wealth. To check ingress of seawater and protecting the shore extensive plantation of mangroves and strict enforcement of CRZ regulations. (vi) Ban on clear felling of forests and special measures for regeneration of degenerated forest tracts.

The above measures have to be implemented in full cooperation of the toiling people in the respective regions in such a manner that the people should begin receiving real benefits in terms of a good life and meaningful work with human dignity.

4 AGRICULTURAL POLICY AND LAND USE PLANNING

N.V. Ratnam
Agricultural Management Consultant, Bangalore

Introduction

Agricultural development is a complex process of interaction between the physical input - output relations of the agricultural system and the social and economic milieu of the national economy in a dynamic equilibrium. Land use planning is a strategic planning exercise to assess the future potential of the agricultural sector and achieve accelerated growth through judicious management of land and water resources.

There are two misconceptions about the Land Use Planning (LUP). One is that the LUP is relevant for the developing countries only. Secondly, some opinion makers in the developing countries like India which are now experiencing liberalization of industrial sector, have the misconception that opening up agricultural sector to the free market forces at one go, even without any agreed agricultural policy, will bring about a significant boost in the growth rates of agriculture.

This paper, however argues that the sluggish growth rates during the post-green revolution scene are not the result of a technology gap alone but a more serious structural deficiency in the agricultural sector. The challenges of supporting an expanding economy has imposed complex demands on a traditional agricultural system which has essentially underdevelopment - both institutionally and socially. Agriculture itself has become increasingly complex and needs a new set of rules and institutions to bring about this structural readjustment. Now more than ever, the entire gamut of social, economic, institutional and legal dimensions of agriculture have become very relevant in addition to a reappraisal of the traditional technology. Only then, the market forces can be moulded to subserve:

- the interests of 60 per cent of the population still dependent on agriculture and
- align Indian agriculture to the impending globalization envisaged in the World Trade Agreement (WTA). In fact, this limited restructuring has now become necessary for the developed countries also to prepare them to fulfill their obligations for globalization under the WTA without jeopardizing the farm incomes and the flow of technology and capital into the system.

This paper attempts an analysis of agricultural development and the role of Land Use Planning (LUP) in three sections:

i. The historical perspective to agricultural development and role of technology and management in accelerating growth rates.
ii. Land Use Planning (LUP) as resource management tool; for formulating strategic agricultural policy initiatives for development.
iii. Land Use Management as a dynamic concept involving-

- Land-water relationship to assess production potentials in river basins/regions
- Land-people relationship to assess employment and income potentials in river basins/ regions; and
- Land-capital relationship in a micro-watershed plan for a local community level investment plan for developing countries.

What Land Use Planning?

According to the Agricultural Economists, the third stage of technology transfer for agricultural development is defined as "capacity transfer". Assuming that the green revolution had leveled of the 1970s, India had been waiting for the accelerated agricultural development across all the subsectors of the economy covering the food, feed, fibre, fodder and forest products, the technology initiatives such as the Lab-to-land programmes and the National Agricultural Research Project (NARP) from 1979 onwards have not been able to produce the desired results. The facts are:

i. The growth rates in agriculture has remained stagnant over the past twenty years around 2.5 per cent compared to the rest of the economy averaging between 5-7 per cent.
ii. The continuously favourable monsoon over the last ten years also have boosted the growth rates beyond the 'Hindu rate of growth", and
iii. Though the share of agriculture and allied sectors in the GNP fell to 26 per cent the population dependency upon agriculture still hovers around 60 per cent.

The above facts clearly indicate that the agricultural development has now become a complex process and that a system approach is called for to chart out the future growth path. We need fresh reevaluations of the strengths and weaknesses of the agricultural resources base, land and water, for each river basin and identify the impediments to the flow of technology and infrastructure investments at the macro level.

Land use planning (LUP) is a complex subject. This is a management process aimed at integrating the social, economic and legal aspects of agricultural economy in which the agricultural production system is operating. The LUP assesses the production potentials of various agro-ecologies at sustainable levels and matches them with the market forces. Quantitative assessment or simulation is attempted to superimpose these production potentials over the environmental constraints to delineate strategic plan for the regions or river basins. The external environment that facilitates this dynamic production system is codified into a forward looking Agricultural Policy. The cost of converting the potentials into achievable targets of production are worked out at the micro-watershed or community level.

The strength of LUP is in prioritizing all land use (in a zero-base budgeting context) according to its capability coupled with the renewable water resources availability. Our definition of agriculture and allied sectors include production of the 5Fs - food, feed, fodder, fibre and forest products. Besides the cropland, it includes assessment of suitable production capacities of forests and other land-based activities such as animal husbandry and inland and coast fisheries sectors.

LUP is not a subsectoral plan but is an integrated approach covering preparation of strategic plans at the national and regional levels as well as district community level investment / programme planning. This, essentially is a bottom -up planning process where the investment decisions are left to the stakeholders, the national priorities are codified in the strategic plans and the overall agricultural policy governing the linkages with the rest of the economy are worked out.

The process of planning is required to match with the dynamic process of growth in equilibrium. It is, therefore, necessarily an iterative and continuous process. This feature is important for annual monitoring and correction in management context. The dynamic equilibrium is in terms of managing the internal resources optimally and in harmony with the changes in the external factors such as social, legal, and economic changes in the national economy.

Objectives of Land Use Planning

The Objectives of Land Use Planning can be summarized as follows:

- to quantify the agro-ecology factors that defines the categories of land use and optimal cropping patterns
- to integrate the economic/ market relationships of the input- output matrix that governs the acreage and production relations under the particular crop regime identified for the category of land use identified
- as a tool for bench - marking farmers ' managerial index and his capacity to absorb capital and technology and charting out ways and means of enhancing it
- to identify the institutional infrastructure needs for promoting "brand equity" and usher in the commercial / industrial status to agriculture; and
- to help in reorienting the departmental perspective from present top-to-bottom departmental (compartmentalized) approach to a bottom- up management process with the participation of all stakeholders in agricultural development.

Suggested Plan of Action

Two conditions must be met if land use planning is to be useful:

- the need for changes in land use, action to prevent unwanted change, must be accepted by the people involved and backed by a proactive community
- there must be political will, ability and vision to manage the development of agriculture cutting across the departmental vested interests.

If the foregoing conditions are met, the bench-marking exercise in land use planning could be taken up by the individual states immediately. Once ready, these could be integrated to come up with perspective plans for the management of land and water resources in the major river basins. A national perspective plan for management of land and water resources can be put together by the National Landuse & Wasteland Development Council as a part of its agricultural policy formulation exercise.

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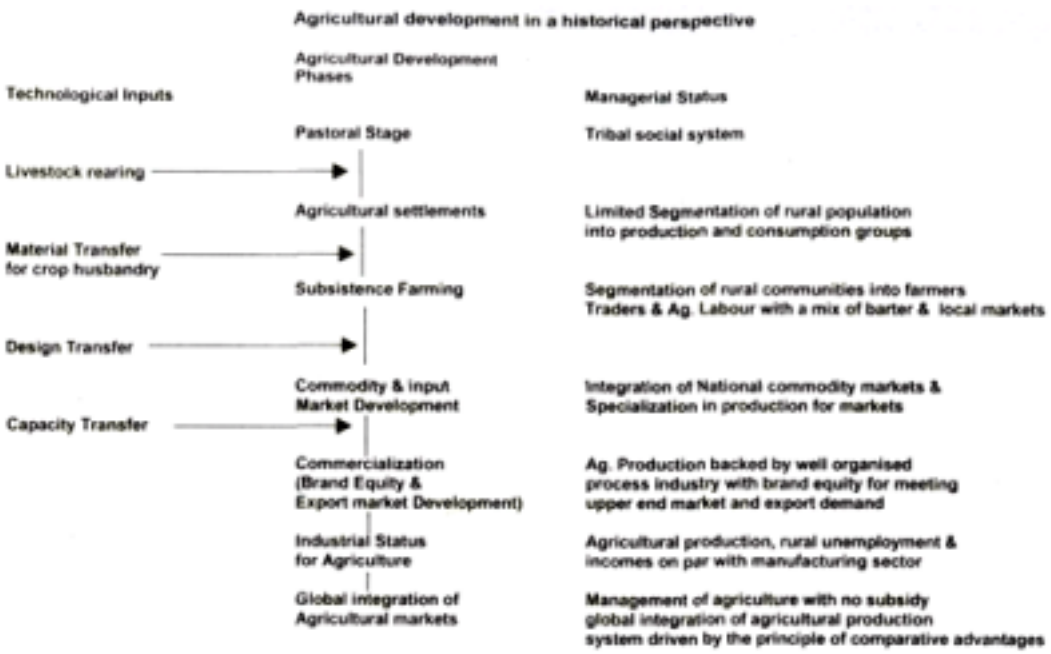

5 A PERSPECTIVE ON LAND USE PLANNING FOR EASTERN INDIA

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Section 1

Conceptually, perspective land use planning involves altering the land area allocations over alternative uses through suitable technological and institutional devices such that:

- the supplies of the various commodities and service which follow from the stipulated land use pattern broadly conforms to the projected demand for such items
- the uses are sustainable in the sense that the current uses by one group does not jeopardise the uses of another group or those of the future generation and
- the bio-mass production - i.e. the streams of output which follow from the stipulated land use pattern (and even income and employment following from the streams of output) are maximized.

The approach that has been followed to study the perspective land use planning for the three eastern states of W. Bengal, Bihar and Orissa is explained in Chart 1.1.

Of all the natural resources endowed upon mankind, soil cover on the mother earth has been one of the most important basic resource, which plays a strategic role in determining the living standards of human beings. Soil, in fact, is the base for all sorts of productive activities. Any type of transformation, be it quantitative, qualitative or spatial, requires soil in varying degrees. Historically, soil has been put to increasing number of varied uses. Given the fixed amount of land available on the mother earth and the simultaneous increase in population over time, the pressure on land has been increasing tremendously. In earlier days when economic activities were mainly concentrated around agricultural activities and the population of the world was not that high like what we have today, land was not considered to be scarce. Forests were felled to make land available for agriculture as well as for human settlement. In course of time man graduated into industrial production which necessitated further diversion of land from agriculture and/ or forests to meet the requirement of industries as well as that for urbanization. Simultaneously, the agricultural sector grabbed further forest land to make up for the loss caused by such diversion. Thus we have gradually shifted from slash and burn agriculture to multiple cropping on the one hand and on the other, land meant for agricultural .production are getting diverted to non-agricultural use at a very alarming rate. Under such circumstances it is necessary that a proper planning is undertaken in allocating the available land in an optimal manner among different possible uses to balance the requirements of all types of economic activities.

Chart-1.1 : Features of the Present Approach to Land Use Planning

- Minimize reliance on centralised decision-making bodies and their budgetary provisions.
- Do not leave everything to be decided by the unconstrained functioning of the existing market forces.
- Evolve self-governing and self-sustaining decentralized user group_ institutions at local level (e.g. at the level of villages and micro-watersheds) with appropriate higher-tire organisations, which would perform the land use planning exercise as part of their regular business.
- Evolve indigenous and less complex technologies which are consistent with the behavior of such decentralised organisations.
- Highlight interesting cases, in general, and success stories in particular, which can bring out the crucial role of institutions and technologies in land use planning exercise, for possible replication.

From an earth covered with only forests and rivers with patches of deserts here and there, even a few thousand years ago, we have arrived a level of 'development' where land is used for the following purpose:

- maintenance of forest cover upto a certain specific level for ensuring ecological stability
- production of cereals and other food crops for ensuring food security
- production of fodder for the live stock that ensures supply of other food stuffs necessary for human beings
- maintenance of water bodies for irrigation and supply of water for drinking and other purposes
- cultivation of commercial crops for use as input by other production activities
- provision of shelter to the world's population both in rural and urban area;
- extraction of minerals, and
- Establishing industrial enterprises.

Given these multitude of possible uses of land and the fact that very often there are possibilities of emergence of a new user competing the existing users, and consequent conflicts, land use planning per se is to be considered as an .important exercise facing the policy makers and planners of an economy. The present paper is an attempt at identifying the issues and suggesting possible remedial measures vis-a-vis the land use pattern in the three eastern states of India, namely, West Bengal, Bihar and Orissa.

As we talk of land, its most important use still is in terms of that for producing food grains as is necessary for the subsistence of human beings. As the per capita land available for such use is declining all over the world partly because of rapid increase in population and partly due to land being put to alternative uses. More and more intensive agricultural practices are becoming the order of the day. Table 1.1 provides an insight into the decline in per capita net sown area and per capita gross cropped area for the states under consideration over the years. Land use planning involves taking stock of the natural endowments - namely, soil, underground water and rainfall and then managing them properly for the purpose of maximizing the productive potentials of available land resources. The practice of intensive use obviously put pressure on the quality of soil as well as the ground water reserve.

Table-1 :
Decrease in Per Capita Net Sown Area and Gross Cropped Area in the Eastern States

(in hectares)

Year	West Bengal		Bihar		Orissa	
	NSA	GSA	NSA	GSA	NSA	GSA
1950-51	0.180	0.203	0.230	0.281	0.385	0.408
1980-81	0.102	0.140	0.119	0.160	0.232	0.332
2000 A.D. (Projected)	0.066	0.100	0.079	0.104	0.160	0.273
% decline in 50 years	63.33	50.74	65.65	62.99	58.44	33.09

Status of Soil

Soil, the upper veneer of the earth's surface, is the medium of plant growth. Almost all plant nutrients come from soil. The following features deserve special mention for better management of the soils of this region:

i. Poor Progress of Soil Survey in the Eastern States.
ii. Accelerated Oxidation of the Soil Organic Matter,
iii. Problems with the Moisture Regimes of the Soils.

Status of Ground Water

Regarding ground water availability and utilization status of the three eastern states of Bihar, Orissa and West Bengal, it is seen that, in general, the groundwater availability position is quite promising while the extent of its utilization so far seems low in most of the districts. Chart 1.2 identifies the districts where the balance stock of groundwater is relatively low, irrespective of the extent of utilization and where the extent of utilization is low irrespective of availability of huge stock of ground water.

The Status of Rainfall

The distribution of normal and actual rainfall with seasonal break-up for the eastern states of the country reveals the following features:

i. Not a single district of this region falls within the low rainfall category - whether one considers the average annual rainfall or the average kharif rainfall.
ii. Since the proportion of rainfall received during) the monsoon months (July-September) constitutes about 75 to 80 per cent of the total annual rainfall of these states, irrigation becomes extremely important.
iii. Over the last 20-30 years, the average actual rainfall seems to have fallen short of the normal annual rainfall for all the three states. This is also true season wise, at least in the cases of West Bengal and Orissa.
iv. Instability of rainfall (inspite of high/medium average rainfall) is a serious problem for those districts for which the coefficient of variation of average annual rainfall is at least 20 per cent.
v. But interestingly and quite contrary to expectations, the years in which rainfall received was less than 25 percent of the normal level, the states have been able to produce more kharif paddy. But the years in which flood visited the region (e.g., in 1978-79 and 1981-82), there was fall in the production of kharif paddy. Thus, flood damages kharif production more than drought in this part of the country.

Chart-1.2 : Classification of Districts in Terms of Ground Water Availability and Its Use

	Low Utilisation < 20%	**High Utilisation > 20%**
Low availability >2cm/year/ha	Banka, Bhagalpur, Bokaro, Buxar, Chatra, Garhwa, Jamui, Madhepura, Supoul, Godda, Ranchi, Sahebganj, Deogarh, Gumla, Santhal, Parganas, (Dumka), Kalahandi, Purulia, 24.Parganas (S)	Haora, Medinipur(E), Dinajpur, Maldah, Nadia, 24 Parganas (N)
High Availability <2cm/year/ha	Paschimi Singhbum, Giridih, Palamu, Dhanbad, Hazaribagh, Purbi Singhbum, Lohardaga, Kishanganj, Bhabhua, Pashim Champaran, Aurangabad, Purnia, Araria, Rohtas, Madhubani, Munger, Koraput, Phulabani, Puri, Mayurbhanj, Sundargarh, Kendujhar, Sambalpur, Dhenkanal, Bolangir, Cuttack, Ganjam, Jalpaigrui, Darjiling, Cooch Bihar, Birbhum, Bankura	Darbhanga, Nalanda, Gaya, Gopalganj, Saran, Purbi Champaran, Khagaria, Katihar, Nawada, Saharsa, Siwan, Jehanabad, Sitamarhi, Samastipur, Muzaffarpur, Vaishali, Patna, Begusarai, Balasore, Bardhaman, Hugli, Murshidabad

Problem of Drought

On the problem of drought, the following observations are in order:

i. Very few countries of the world and even other states of the Indian union can boast of such an average of rainfall as is enjoyed by the eastern states. But uncertainty and uneven distribution - especially a long dry spell in the middle or late September results in too low crop yield or large scale crop failure. So, the failure or limitation of crop output is more frequently

due to "agricultural drought" rather than "due to "meteorological" or "hydrological" droughts which are only occasional.

ii. The Barind land in the Maldah district of West Bengal and the Black Cotton Soils in the Kalahandi district of Orissa often suffer from agricultural drought due to adverse edaphic conditions of the soil and not for inadequate rainfall.

iii. The state governments seem to be inflating their figures for drought affected areas. What is, therefore, needed is to determine acute drought conditions with a fair degree of accuracy using remote sensing techniques.

Problem of Flood

Regarding flood-proneness of this region, the following findings deserve special mention:

i. The eastern states constitute a major part of the flood prone area of India, the most probable time of flood being July to September, the crucial period of kharif paddy which is the main crop of this region.

ii. The common view that the figures of flood damage are often inflated in order to tap more central assistance for flood relief cannot be ruled out. It appears there is some lacuna in flood damage assessments (ISRO, 1983).

iii. The role of collective action and leadership - namely, how a perennial problem of flood-proneness can be converted into an asset for initiating a diversified set of developmental activities is quite important in this context.

Management of Waste Lands

Management of waste lands, which implies reclamation of such lands and putting them back to productive and efficient use on a sustainable basis - all at a reasonable cost - is beset with three general and interrelated problems: first, definitional, second, informational and third, diagnostic.

Based on a conservative estimate capturing only barren land, cultivable waste and fallows other than current fallows - most of which are lying vacant, Chart-1.3 lists the districts within these three states, where the area under the category of barren, other fallow and cultivable waste land has increased consistently between 1986 and 1994.

Chart-1.3 : Districts showing Unfavourable Movements of Area Under Waste Lands

States	Area increasing between 1986 and 1994
West Bengal	Cooch Behar (between 1972-86)
Bihar	Purbi Champaran, Darbhanga, Sitamarhi, Madhubani, Vaisali, Siwan, Aurangabad, Gumla, Lohardaga, Ranch!
Orissa	Baleswar, Bolangir, Dhenkanal, Mayurbhanj, Phulbani, Keonjhar

Source: Based on data collected from ARPU, Ahmedabad

The scope for waste land development through a ranking of the districts in terms of the extent of waste land available (i.e., the extent of waste lands being measured by the estimate given above as proportion of total geographic area) is displayed in Chart 1.4. The locations as well as estimates of the area under each category of wasteland are given in Charts 1.5 to 1.8.

No estimate is available for the different categories of strip land - namely, those along public roads, railway tracts, canal banks etc. The amount of strip land available along the roadside across states is of the order of 139, 80 and 116 thousand hectares in the states of West Bengal, Bihar and Orissa respectively.

Stylized Features Regarding Management of Forests in the Eastern States

There are certain special features of the eastern states, which make the issue of forestry management in these states both qualitatively and quantitatively distinct:

i. Implications of the broad socio-economic features - namely, high population pressure on land and the high incidence of scheduled caste and scheduled tribe population.
ii. High Incidence of shifting cultivation.
iii. Strong demand from industries (e.g. paper-making) and the communication sector.
iv. High order of deforestation due to socio-economic reasons as well as implementation of developmental projects.
v. Poor yield rate of forests, and
vi. Growing importance of participatory mode of forest management with increasing importance being attached to development of minor forest products.

A list of minor forest products of this region together with their potential for industrial use is given in Chart 1.10.

Cropping Pattern and Management of Arable Land

An analysis of crop-yield, its instability (i.e., c.v.) and land area allocation (namely, percentages of GCA) for the four major crops of this region -namely, paddy, wheat, pulses and oilseeds has been done in Charts 1.11 to 1.14. For each crop, the districts have been classified into eight categories depending upon whether the yield rate is relatively high or low, whether the coefficient of variation of average yield is high or low and whether a proportionately high or low percentage of GCA has been allotted to this crop - each category highlighting the need for different policy measures. For example, the districts belonging to cell number 1B in any of these charts, even if they cannot augment productivity and reduce c.v. further, should attempt to allocate a large land area under such crops. Districts belonging to cell 2A need to reduce high c.v of yield in crops and if successful, those in cell 2B should allocate a larger land area under those crops. Districts falling in cell 3A require measures at augmenting the poor yield of crops and once such measures are successful, those belonging to cell 3B can allocate a large land area to such crops. The districts belonging to row 4 need measures for both augmenting yield and reducing C.V. If such measures are costly to enforce, each district should try to look for crops where it has high yields with low C.V.

Chart-1.4 : Extent of Wastelands Available in the Eastern States

Wastelands as proportion of total geographical area	States		
	West Bengal	Bihar	Orissa
Less than 5 percent	Burdwan, Birbhum, Midnapur, Howrah, Hoogly, 24 Parganas, Nadia, Murshidabad, W.Dinajpur, Darjeeling, Jalpaiguri, Malda	Nalanda, Buxar	Kalahandi, Ganjam
5 to less than 10 percent	Bankura, Purulia	Bhojpur, Jahanabad, Samastipur, Patna, . Rohtas, Muzaffarpur, Madhepura, Darbhanga, Siwan, Aurangabad, Nawada, Bhabhua, Sitamarhi, Pashimi Champaran, Madhubani, Gopalganj, Purnia, Araria, Purbi Champaran	Mayurbhanj, Dhenkanal
10 to less than 20 percent		Saran, Bhagalpur Supoul, Chatra, Khagaria, Begusarai, Vaishali, Munger, Saharsha, Kishanganj, Katihar, Palamau, Gaya	Puri, Balasore, Cuttack
20 to less than 30 percent		Godda, Deogarh, Gumla, Bokaro, Giridih, Banka, Jamui, Singhbhum, Ranchi, Sahebganj.Hazaribagh, Lohardaga	Sambalpur, Sundargarh, Phulbani, Keonjhar, Balangir
More than 30 percent	Cooch Behar	Santhal Parganas, Dhanbad	Koraput

Source: Based on data collected from ARPU, Ahmedabad
Note: Data for West Bengal refers to the year 1986, for the rest of the states the information pertain to 1994

Chart-1.5 : Saline Land in the Eastern States

State	Exact Locations	Estimated Area (in ha)
West Bengal	Coastal tracts of Midnapur and 24 Pargnas, and Northern & Southern Salt lake near Calcutta	80, 50, 202 (Source: Planning Commission, 1963)
Bihar	Muzaffarpur, Saran, Darbhanga (specially north-western side, north to the Ganges in the alluvial tract having impeded drainage)	4,50,000 (Source: Soil Conservation Directorate, Bihar)
Orissa	Coastal tracts of Ganjam, Puri, Cuttack and Balasore	2.55.721 (Source: ORSAC, Orissa)

Chart-1.6 : Waterlogged Lands in the Eastern States

State	Exact Locations	Estimated Area (in ha)
West Bengal	North and South 24 Parganas, Midnapur and some alluvial zones	18,50,000
Bihar	South Bihar Plains	3,34,401
Orissa	Spread over all districts	74,760

Chart-1.7 : Mine Spoils in the Eastern States

State	Exact Locations	Estimated Area (in ha)
West Bengal	Mostly Raniganj, Asansol, Barakar and Jamuria Areas in the district of Burdwan and partly in the districts of Birbhum, Bankura and Purulia	4555
Bihar	Mostly prominently in the districts Dhanbad, Hazaribagh, Palamau and Ranchi	NA
Orissa	Bolangir, Cuttack, Dhenkanal, Ganjam, Kalahandi, Keonjhar and Balasore	96930

Chart-1.8 : Shifting Sand Dunes in the Eastern States

State	Exact Locations	Estimated Area (in ha)
West Bengal	NA	NA
Bihar	Ganges plain due to ecolian action during summer	17,000
Orissa	Balasore, Cuttack, Puri and Ganjam	56,299

Chart-1.9 : Acid Soils in the Eastern States

State	Exact Locations	Estimated Area (in ha)
West Bengal	Laterite soils of Birbhum, Bankura & part of Midnapur having pH 5.5-6.5; red gravelly soils of Purulia and red soils of Malda and West Dinajpur; intense and partly decomposed organic matter also responsible for soil acidity in the Terai region in Darjeeling and Jalpaiguri	NA
Bihar	Red laterite soils of the Chhotanagpur Plateau (i.e. Palamau, Hazaribagh, Santhal Parganas, Dhanbad, Ranchi) with pH 4.5 to 6.5; mixed red and black soils of Singhbhum with pH 5-6.8.	6.7 lakh ha. (**Source**: Soil Conservation Directorate, Bihar)
Orissa	Intense and partly decomposed oiyanic matter also responsible for soil acidity in the districts of Cuttack, Puri, part of Balasore, Gangam and Dhenkanal with pH 4-6.5.	48 lakh ha. (**Source**: Soil Conservation Directorate, Orissa)

Chart-1.10 : Some Minor Forest Products of Eastern India

Name of Minor Forest Produce	Potentials for Use
Sarpagandha (*Rauvulfia Serpentina*) Kochila (*Nuxvomica*) *Kurnchi Holanbena Artidysenterica*)	Used in modern herbal medicinal industries
Myrobolans i.e., Haritaki (*Terminalia Chebula*), Baheda (*Terminalia Bellerica*), Amala (*Emblice Officinalis*)	Raw materials for medicinal preparations and for pickles and soft drink industries, besides being used as tanin for tannery industry.
Lac	Varnish and Polish preparations
Seeds of Sal (*Shoria Robusta*), Neem, Karanja ({*Pongamia Slabrai*) Poonag (*Calophylm Inophyllum*)	As non-edible oils and paints
Kendu (*Diospyros Melanoxilon*) Sal leaves	For 'bidis' (indigenous cigarette), making disposable leaf plates and cups
Sabai Grass (*Eiolopsis Binata*)	For paper mills, rope and broom stick making
Kumkum seeds (*Anatto - Bixa Orellena*)	Edible colour with potentiality for colouring food stuff, sweatmeats, squash and for use in preparation of lipsticks, face powder and other cosmetics as source of colour.
Lemon grass (*Cymbopogon Martinal*) which can be grown for purpose of soil conservation along the steam banks and guilies for stabilization of banks	Steam distillation of its leaf yields lemon grass oil which is of great demand in the preparation of perfumes, soaps, cosmetics, mosquito repellent cream and vitamin A.
Ipecac (*Ipecacuanaha*), a plant of Brazilian origin, grown in Darjeeling district of West Bengal	Roots of this plant are used for extraction of alkaloid.

Chart-1.11 : Categorisation of Districts in the Eastern States in terms of Yield, Instability of Yield and Allocation of GCA on Paddy

Districts with % of GCA Allotted		
	A. High	**B. Low**
High yield, low C.V.	Bihar: Nalanda, Nawada	Bihar: Bhojpur, Patna, Rohtas, Saran, Siwan
	Orissa: -	
	Bengal: Bankura, Birbhum, Burdwan, Malda, Midnapur, Murshidabad, 24 Pargnas	Orissa: -
		Bengal: -
High yield, high C.V.	Bihar: Darbhanga, W.Champaran	Bihar:-
	Orissa:-	Orissa:-
	Bengal: Howrah, Hoogly, Purulia	Bengal: Nadia
Low yield, low C.V	Bihar: E.Champaran, Purnia, S.Parganas	Bihar: Katihar, Mungyr, Saharsa
	Orissa: Balasore, Keionjhar, Mayurbhanj, Puri, Sambalpur	Orissa: Cuttack, Korapur
		Bengal: Darjeeling
	Bengal: Cooch Behar, W.Dinajpur	
Low yield, high C.V.	Bihar: Aurangabad, Dhanbad, Gaya, Giridih, Hazarihagh, Madhubani, Ranchi, Sitamarhi	Bihar: Begusarai, Bhagalpur, Gopalganj, Muzaffarpur, Samastipur, Vaishali
	Orissa:-	Orissa: Balangir, Dhenkanal,Ganjam, Kalahandi, Pulbani
	Bengal:-	Bengal:

Note: Yield >= 13.75 qt/ha (mid-value of range is high, low otherwise
C.V. >= 20 is high, low otherwise
Land allocation >= 50 percent of GCA is high, low otherwise

Chart-1.12 : Categorisation of Districts in the Eastern Sates in terms of Yield, Instability of Yield and Allocation of GCA on Wheat

Districts with % of GCA Allotted		
	A. High	**B. Low**
High yield, low C.V.	Bihar:-	Bihar:-
	Orissa:-	Orissa: Balasore, Cuttack, Mayurbhanj
	Bengal: Murshidabad, Nadia	Bengal: Birbhum, Howrah, Hooghly, Cooch Behar, Midnapur
High yield, high C.V.	Bihar: Gopalganj, Nalanda, Patna, Samastipur, Sarn, Siwan	Bihar: S.Parganas,
	Orissa:-	Orissa: Dhenkanal, Keonjhar
	Bengal: -	Bengal: Bankura, Burdwan, Malda, Purulia, W.Dinajpur
Low yield, low C.V.	Bihar:-	
	Orissa:-	Bihar:-
	Bengal:-	Orissa: Balangir, Sambalpur
		Bengal: Jalpaiguri
Low yield, high C.V.	Bihar:Aurangabad, Begusari, Bhagalpur, Bhojpur, Darbhanga, Gaya, Katihar, Madhubani, Mungyr, Muzzafarpur, Nawada, Palamau, W. Champaran, E.Champaran, Purnia, Rohtas, Saharsa, Sitamarhi, Vaishali	Bihar: Dhanbad, Giridih, Hazaribagh, Ranchi
		Orissa: Ganjam, Kalahandi, Korapur, Phulbani, Puri, Sundergarh
		Bengal: Darjeeling
	Orissa:	
	Bengal:	

Note: Yield >= 18.5 qt/ha (mid-value of range) is high, low otherwise
C.V. >= 20 is high, low otherwise
Land allocation >= 10 percent of GCA is high, low otherwise

Chart-1.13 : Categorisation of Districts in the Eastern States in terms of Yield, Instability of Yield and Allocation of GCA on Pulses

Districts with % of GCA Allotted		
	A. High	**B. Low**
High yield, low C.V.	Bihar: -	Bihar:
	Orissa: -	
	Bengal: -	
High yield, high C.V.	Bihar: Aurangabad, Muzaffarpur Palamau, Patna, Vaishali	Bihar: Begusarai, Bhagalpur, Madhubani, Nalanda, Nawada, W.Champaran
	Orissa: Keonjhar, Koraput	
	Bengal	Orissa:
		Bengal: -
Low yield, low C.V.	Bihar: -	Bihar: Rohtas
	Orissa: Balasore, Dhenkanal	Orissa: -
	Bengal: -	Bengal: -
Low yield, high C.V.	Bihar: Saharsa, Singbhum	Bihar: Bhojpur, Darbhanga, Dhanbad, Gaya, Giridih, Gopalganj, Hazaribagh, Katihar, Mungyr, E.Champaran, Purnia, Ranchi, S.Parganas
	Orissa: Balangir, Cuttack, Ganjam, Kalahandi, Mayurbhanj, Phulbani, Puri, Sambalpur, Sundergarh	
	Bengal: -	Orissa: -
		Bengal: -

Note: Yield >= 6.8 qt/ha (mid-value of range) is nigh, low otherwise
C.V. >= 20 is high, low otherwise
Land allocation >= 10 percent of GCA is high, low otherwise Bengal has hardly any area under pulses

Chart-1.14 : Categorisation of Districts in the Eastern States in terms of Yield, Instability of Yield and Allocation of GCA on Oilseeds

Districts with % of GCA Allotted		
A. High		**B. Low**
High yield,low C.V.	Bihar: -	Bihar: Vaishali
	Orissa: -	Orissa: -
	Bengal: -	Bengal: -
High yield, high C.V.	Bihar: -	Bihar: Begusarai, Patna, Samastipur
	Orissa: Dhenkanal, Sambalpur	Orissa: Balasore, Cuttack
		Bengal: Bankura, Nadia
	Bengal: -	
Low yield, low C.V.	Bihar: -	Bihar: -
	Orissa: -	Orissa: -
	Bengal: -	Bengal: -
Low yield, high C.V.	Bihar: Palamau, Singhbhum	Bihar: Aurangabad, Bhagalpur, Bhojpur, Darbhanga, Dhanbad, Gaya, Giridih, Hazaribagh, Katihar, Madhubani, Mungyr, Muzaffarpur, Nalanda, Nawada, W.Champaran, E.Champaran, Purnia, Ranchi, Rohtas, Saharsa, S.Parganas, Saran, Sitamarhi, Siwan
	Orissa: Balangir, Ganjam, Kalahandi, Keonjhar, Koraput Phulbani	
	Bengal: W.Dinajpur	
		Orissa: Mayurbhanj, Puri, Sundergarh
		Bengal: Birbhum, Burdwan, Darjeeling, Hooghly, Jalpaiguri, Cooch Behar, Malda, Midnapur, Murshidabad, Purulia

Note: Yield >= 8.5 qt/ha is high, low otherwise
C.V. >= 20 is high else low
Land area allocation >= 10 percent of GCA is high, low otherwis

Stylized Facts with respect to Management of Irrigation in Eastern States

Based on the district wise data on percent gross cropped area irrigated, ground water availability together with level of groundwater utilization and source wise irrigation status, Chart-1.15 identifies the following districts in the states where the position of irrigation is very grim (net irrigated area less than 25% of the net cropped area). The stylized facts with respect to development of irrigation and watershed in this region are as follows:

i. In the eastern states, mostly the alluvial plains having a flat topography and growing mainly rice during all the three seasons, are under irrigation by the major river valley projects which has caused alarmingly high water-logged conditions in the absence of proper drainage arrangements.

Chart-1.15 : Districts Having Critically Low Levels of Irrigation

District	% GCA Irrig.	Level GW Util.	Major Source of Irrigation
Jalpaiguri	11.93	1.10	Canals
Cooch Behar	8.64	4.30	Underground
West Dinajpur	23.13	23.70	Underground
Deogarh	8.61	7.90	Minor Surface
Dhanbad	2.50	1.50	Minor Surface
Giridih	10.47	1.20	Underground
Godda	9.90	5.30	Minor Surface
Gumla	2.81	2.00	Other Sources
Hazaribagh	12.57	1.50	Underground
Lohardaga	9.72	7.30	Underground &
			Other Sources
Bokaro	6.12	18.25	Underground
Purnia	18.30	10.10	Canal &
			Underground
Ranchi	8.25	2.0	Canal
Sahebganj	5.17	11.60	Other Sources
Santhal Parganas	5.69	1.60	Underground
Singhbhum	4.60	0.96	Canal
Kishanganj	18.97	8.90	Underground

Source: ARPU, Anmedabad

ii. About 20-30 percent of available ground water potential has been utilized in Bihar and West Bengal whereas in Orissa only 4.74 percent has been utilized against 70-80 percent in Haryana and Punjab (Ministry of Irrigation, 1982).

iii. Two types of factors have been identified for the failure of Deep Tube Wells and River Lift Irrigation: (i) The internal factors which include mechanical inefficiency, lead to gradual decline in water discharge rate over time, and the lack of timely maintenance and repair which reduces the life span of the machine, (ii) The external factors include (a) erratic supply of electricity, (b) theft of transformer and machine parts, and (c) political influence on the operator to irregularise the distribution of water.

iv. Given the imbalance between demand and supply of irrigation water, there exists a scope for making enormous profit by water sellers through selling excess water to the small and marginal farmers and even to share croppers.

v. The incidence of use of diesel pumpset is large enough inspite of relatively higher efficiency and lower private cost of operation in case of electric pumpset. It is observed that erratic power supply is responsible for the unpopularity of electric pumpset.

vi. Under the existing property relations, unrestricted use of submersible pumpset has not only restricted the efficiency of STWs but also has threatened the prospect of the agrarian economy through depletion and continuous going down of ground water potentials.

vii. The impact of irrigation in the eastern states is comparatively lower since kharif paddy is the major crop of these states where there is no absolute necessity of irrigation, given the high rainfall, except in the years of drought. Moreover, the consumption of fertilizer and HYV seeds is quite low in the eastern states, which further bring down the impact of irrigation on crop yield.

viii. Integrated watershed development (IWD) requires coordination and integration among three groups

- Departments of Agriculture, Revenue, Irrigation, Forestry and Animal Husbandry,
- Scientists and planners, and
- Farmers & voluntary agencies

ix. In the eastern states different types of land treatment work on watersheds basis are being implemented under different programmes like

- National Watershed Development Project for Rainfed Areas (NWDPRA)
- Watershed Management Programme in the priority watersheds of the interstate River Valley Projects.
- Watershed Management under Drought Prone Area Programme (DPAP)

But all these are being undertaken at government initiative and expenses.

Role of Land Reforms in Land Use Planning

Till today, the equity of objects of land reforms seems to have played a much bigger role than the objective of growth in shaping the nature and details of land reforms in these states. The major trends are as follows:

i. With respect to the behavior the size redistribution of operational land holdings in all the three states are tending towards more equal pattern of land distribution of operational holdings.

ii. All the three eastern states have achieved very little success in land consolidation as the number of parcels per holding is quite high in these states (5.38, 6.27 and 5.02 for Bengal, Bihar and . Orissa, respectively).

iii. On the issue of distribution of surplus and vested land in the eastern states, the position is as follows. Contrary to the fact that pressure of population on land is high and hence the pressure for distribution of surplus and vested land would also be high, the performance of these states is not specially encouraging.

iv. As regards tenancy arrangements, share-cropping is the dominant form of tenancy contract in all the three states, although in Bihar, leased-in land under infrastructural contract constitutes a significant proportion of total leased in land. While legislation for protecting the rights of tenants and regulating land rent are also there in Bihar and Orissa, West Bengal has by far made the most elaborate arrangements for enforcing tenancy legislation's - namely, to record the names of sharecroppers, so that they cannot be unlawfully evicted and also to ensure that the lawful share of the produce goes to them.

Major Issues on Land Reforms

When land reforms are being seriously pursued over a fairly long period of time as for example is the case in West Bengal, however, one would expect its consequences to get reflected in certain macro-level development indicators. Unfortunately, this has not been the case. So, keeping the example of West Bengal in the forefront, one can legitimately raise the following questions in order to pinpoint the strengths and weaknesses of the existing approach to land reforms. Similarly, if not the same questions, can also be legitimately raised in the context of Bihar and Orissa, though these states are not so well known for their record of land reforms:

The Nature of the Urban Land Use Problem & Critique of the Traditional Approach

The implications of urbanisation for policy-makers are broadly three-fold. The first and the positive aspect of urbanisation is that it can play the role of a growth centre and can induce growth through backward and forward linkages with the rural hinterlands. In the context of the eastern states, however, this concept does not seem to have played any significant role. One strong negative effect of the rapid urbanisation process is encroachment of agricultural and forest land and misuse of fringe areas in brick kiln, sand digging, small factories and residential construction in an unplanned manner.

Q-1 Why does not the poverty situation look better in West Bengal as compared to the other states and why is not poverty showing a downward trend in West Bengal?

Q-2 Why is not the "Gini" coefficient of ownership and operational holdings for West Bengal one of the lowest in country and why has not it gone down over time?

Q-3 Why is not the proportion of landless and/or landless plus semi-landless rural households going down in West Bengal?

Q-4 Why are the real wages declining in West Bengal? It is due to declining labour productivity, then the question would be - why is labour productivity falling? If declining labour productivity is not the reason (or the only reason), then why does real wage rate fall ! (and more than labour productivity) in a ruled state like West Bengal?

Q-5 Why is the performance of foodgrains yield no better in West Bengal than in Bihar, though better performance is expected of the former in view of its better overall natural endowments and considerably better record of land reforms?

Q-6 Are not land reforms in West Bengal then adding fuel to the already existing process of marginalisation of agricultural holdings and making agricultural farms even more non-viable?

The second negative effect of urbanisation is the rapid rural-urban migration it generates, resulting in two-fold congestion - congestion of people in houses and of houses on land, and causing both environmental and mental pollution. The four major problems which arise out of the excessive pressure of population on urban conglomerates are: (a) exposure of the urban population to increasing risks of disaster, (b) pollution of air, water and noise, (c) scarcity of basic amenities like supply of water, sanitation etc, (d) decline in the economic standard of living of urban population, in general and of the urban poor, in particular.

The whole problem of urban land use finally boils down to evolution of organisations and institutional mechanisms which can generate urban land use patterns such that the growth and development through rural-urban linkages are maximized, while at the same time encroachment of productive agricultural land and the multifarious environmental problems associated with rural-urban irrigation are kept at the minimum.

Broadly speaking, there have been three types of responses to the urban land use problem in the eastern states: first, preparation of master plans; second, evolution of rules and regulations to control land use and the problems associated with undesirable uses; and third, evolution of special development plans, rules and regulations and also to provide further guidance in this regard.

The stylized facts which are brought out by the master plans studied in this context, however reveals absence of explicit mechanisms and institutional devices by which failure to achieve targets in terms of desired land area allocations can be prevented. It appears that exclusive reliance has been placed on statutory rules and regulations for avoiding sub-optimal allocation without regard to the high transaction costs that may be involved in enforcing such statutory provisions. Moreover, not enough attention seems to have been paid either to augment the productivity of organised open space, agricultural and allied activities and water bodies and/or wet land around urban fringes, nor to create a public awareness about their environmental utilities and benefits.

In order to promote optimal urban land use and also to strengthen rural-urban ties, all the state governments have been pursuing the growth center concept through promotion of special area

development authorities, but often to the utter neglect of the financial viability of such organisation and at the cost of unnecessary messing up of activities between those of the pre-existing organisations and those of the new ones.

The growth of urban population in the three eastern states of West Bengal, Bihar and Orissa shows that the growth has been particularly phenomenal in recent times in the two states of Bihar and Orissa, which not only started from a lower urban base but also continued to remain so as compared to West Bengal. However, there has been a slackening in the growth rate of urban population in the last decade in all three states and especially in Bihar and Orissa. Urban land as a percentage of the land put to non-agricultural uses, though still lower in Bengal and Bihar as compared to the all-India situation, has increased steadily during 1971-91 in this region, the current percentage figures being 20.5, 18.6, 36.2 and 27.4 for West Bengal, Bihar, Orissa and the country as a whole, respectively.

Status of Fisheries in the Eastern States

The three eastern states under the study, namely - Bihar, Orissa and West Bengal contribute about 25 per cent of the total fish production in India. The percentage annual increase in production of fish between 1980-81 and 1988-89 is recorded maximum in the state of Haryana (25.1), followed by Punjab (14.9) and Uttar Pradesh (12.90). In comparison to this, the corresponding figures for West Bengal, Bihar and Orissa are 4.4, 8.1 and 5.9, respectively. In Bihar, inland is the only source of fish production, while in Orissa and West Bengal which have coastal lines, the shares of inland production to the total production of fish are 53.81 and 87.87 per cent, respectively.

However, the average production of fish per hectare of water area is very low (600 kg) in tnese states. Introduction of improved technologies is confronted with problems which are both technological and institutional in nature. Some of the problems which deserve careful attention by the policy-makers are mentioned below:

i. A major constraint to the development of pisciculture is the prevalence of a large number of multiple owners, which results problems associated with common property resources.
ii. A significant area under tanks and ponds is in a derelict and semi-derelict condition.
iii. Another important constraint is non-availability of seeds.
iv. In all three states, leasing policy favours allotting the water area to fishermen's cooperative societies and not to individuals. In Bihar, most of the societies are not functioning well and are riddled with factions and dominated by a few influential persons.
v. One of the most crucial constraints in the development of fishery in these states is the non-availability of appropriate technology of production and processing and its effective absorption and adaptation by fish farmers. At present there is no organised fish marketing. The entire large scale and wholesale marketing and transport of fish for both inside and outside of the states is done by private traders.
vi. One of the constraints faced in the development of marine fisheries is the rising operational costs faced by the owners of small and medium-sized mechanized fishery boats.

Role of Livestock in the Context of Land Use Planning

The dominance of small holdings in three eastern states, namely, Bihar, Orissa and West Bengal, where development of animal husbandry has a high potential in improving socio-economic conditions of the rural people, on the one hand, and strong linkages with land use and, therefore, with agriculture, forestry and environment, on the other, highlights the need for evolving fresh policies and strategies to tap the full potentials of this sector in this region. The stylized features are as follows:

i. The eastern zone has about one-fourth of the country's cattle and one-tenth of the buffalo population. Bihar, Orissa and West Bengal constitute 8.4. 6.7 and 7.7 percent of the country's cattle and 6.6, 2.2 and 1.6 percent of the country's buffalo population, respectively.
ii. This region has mainly non-descript indigenous breeds of cattle and buffaloes with poor quality of conception and low growth rate of milk production. The number of animals in this region is very large as compared to total milk production. The region accounted for about 20.7 percent of the country's livestock as well as 20.0 per cent of bovine population in 1982 but produced less than 12.3 per cent of the country's milk production in 1986-87.

iii. In this region, the population of poultry and its egg production is very low. When compared to the overall Indian scenario, obviously, the situation is alarmingly dismal for the region as a whole, and for the state of Orissa, in particular.
iv. The sheep population in the eastern states has shown a steady upward trend over 1972-82, at the rate of 3.07 per cent for Bihar, 5.39 per cent for West Bengal and 2.36 per cent for Orissa against 8 per cent in case of the country as a whole. Comparatively, the goat population has risen at a much faster rate over 1972-82, the rates being 5.12 per cent in Bihar 7.46 per cent in West Bengal and 5.36 per cent in Orissa.
v. Among farm animals, cattle and buffaloes occupy an important place in the rural economy of Bihar as well as in other eastern states.
vi. Acute shortage of fodder and disproportionate livestock population, in general, and of goat population, in particular is a serious problem for management of pasture in the eastern states. The amount of pastureland in the eastern states is very meager. West Bengal has only a meager 0.06 per cent of the geographical area under permanent pasture, whereas Bihar has 0.86, and Orissa has 3.62 per cent of the geographical area under permanent pastures. It is also observed that these pastures are all overgrazed and in a neglected state. They have been degraded and have become devoid of any grass or fodder trees.
vii. Idle working bovine (working cattle and buffaloes) is another serious problem in the eastern region. The working (draught) animals in farm houses are often idle, due to the fact that only 26.88, 36.47 and 26.4 per cent of the total cropped area are irrigated in West Bengal, Bihar and Orissa respectively and majority of the area are single-cropped.

Section 2 : Recommendation and Issues for Future Research

Handling of Land Use Planning Data and Administration of Land Use Planning Exercise

Regarding handling of the relevant data and administration of the land use planning exercise, the following suggestions emanate from the understanding of the information given in section 1.

i. The land use planning exercise by the National Land Use and Conservation Board and the State Land Use Boards, on the one hand, and the agro-climatic regional planning exercise by the Planning Commission, on the other, ought to have a point of convergence.
ii. Given the data availability position, land use planning exercise ought to be performed at a more desegregated taluka level. It is high time that the State Land Use Boards (SLUB) be instructed to maintain on a continuing basis updated information at taluka level on all aspects of land use planning.
iii. Now that the Panchayat system has been functioning at the grass-root level, land use planning exercise ought to be performed even at level of the lowest administrative unit - namely, villages. However, in order to get the maximum mileage out of this exercise, geographic jurisdiction of villages, of that blocks and even districts may have to be reorganised and redefined so that they can correspond to the definitions of micro and macro-watersheds.
iv. Ideally, SLUBs ought to be a crucial part of the Planning and Development Department, having liaison with the planning and development activities of each and every Department. Moreover, they must be given an appropriate status in terms of decision-making and law-making powers so that they can effectively coordinate their task with the relevant governmental and nongovernmental bodies.

Stylized Facts about Land Category Movements and Policy Issues

Based on the existing (latest) pattern of land use across districts, Chart 2.1 identifies the districts which need special care i.e., interventions of one kind or another, to improve (or halt deterioration in) existing land use.

Chart-2.1 : Districts Requiring Special Attention in Terms of Land Use

Categories	Districts	Relevant Issues
Disproportionately low % of NSA (<30)	Bihar: -	1 (a) Whether and how cropping intensity can be augmented.
	Orissa: Koraput, Phulbani	
	Bengal: -	
Proportionately high % of C+CF+OC (>5)	Bihar: Aurangabad, Begusarai, Bhagalpur, Bhojpur, Darbhanga, Dhanbad, Gaya, Giridih, Gopalganj, Hazaribagh, Katihar, Madhubani, Mungyr, Muzzafarpur, Nalanda, Nawada, Palamau, E.Champaran, Patna, W.Champaran, Purnia, Ranchi, Rohtas, saharsa, Samatipur, Santhal Parganas, Sarn, Singhbhum, Sitamarhi, Siwan	2(a) Whether this is induced by land legislation or other government policy or a real phenomenon. 2(b) Scientific and economic devices to bring down the area under this category.
	Orissa: Balasore, Balangir, Cuttack, Keonjhar, Koraput, Puri, Phulbani, Sambalpur.Sundergarh	
	Bengal: Birbhum, Bankura, Howrah, Purulia	
Proportionately high % of Barren land (>3)	Bihar: Auragabad, Bhagalpur, Gaya, Giridih, Hazaribagh, Munger, Nawada, Palamau, Patna, Purnia, Rohtas, Samastipur, Santhal Parganas, Saran, Singhbhum, Siwan, Vaishali	3(a) Identification of locations and reasons. 3(b) Technological and institutional devices to bring down area under this category.
	Orissa: Balasore, Balangir, Keonjhar, Puri, Sambalpur	
	Bengal: Cooch Behar	
Proportionately low % of Pasture & Miscellaneous Trees (<5)	Bihar: Aurangabad, Begusarai, Bhagalpur, Bhojpur, Dhanbad, Gaya, Giridih, Gopalganj, Hazaribagh, Katihar, Madhubani, Mungyr, Muzaffarpur, Nalanda, Nawada, Palamau, W.Champaran, Patna, Purnia, Ranchi, Rohtas, Saharsa, Samastipur, Santhal Parganas, Saran, Singhbhum, Sitamarhi, Siwan, Vaishali.	4(a) Whether consistent with the role of the animal husbandry sector. 4(b) Measures to improve management of common property type pastures. 4(c) Measures to improve cultivation of tree crops.
	Orissa: Kalahandi, Mayurbhanj	
	Bengal: AII districts	
Proportionately low % of Forests (<10)	Bihar: Aurangabad, Begusarai, Bhagalpur, Bhojpur, Darbhanga, Dhanbad, Giridih, Gopalganj, Hazaribagh, Katihar, Madhubani, Muzaffarpur, Nalanda, Palamau, Patna, E.Champaran, Purnia, Ranchi, Saharsa, Samastipur, Santhal Parganas, Saran, Singhbhum, Sitamarhi, Siwan, Vaishali.	5(a) Measures to improve management of existing forests. 5(b) Extension of social forestry outside of regular forests.
	Orissa: Balasore	
	Bengal: Burdwan, Birbhum, Hoogly, Howrah, Nadia, Murshidabad, W.Dinajpur, Darjeeling.	
Proportionately high % of Non-Agricultural Area(>5)	Bihar: Aurangabad, Begusarai, Bhagalpur, Bhojpur, Darbhanga, Dhanbad, Gaya, Giridih, Gopalganj, Hazaribagh, Katihar, Madhubani, Mungyr, Muzaffarpur, Nalanda, W.Champaran, Patana, Purnia, Ranchi, Rohtas, Saharsa, Samatipur, Santhal Parganas, Saran, Singhbhum, Sitamarhi, Siwan, Vaishali.	6(a) Measures to check urbanisation. 6(b) Measures to improve management of existing non-agricultural land use.
	Orissa: Balasore, Cuttack, Koraput, Puri.	
	Bengal: All districts except Cooch Behar	
Proportionately low % of Non-Agricultural Area (>3)	Bihar: Nil	7(a) Measures to induce non-agricultural land use for benefit of both agricultural and non-agricultural sectors.
	Orissa: Kalahandi, Phulbani.	
	Bengal: Cooch Behar.	

Management of Soil Resources

For properly managing the soil resources of the eastern states, the following suggestive measures may be taken:

i. Special drive for soil correlation and classification may be done according to Comprehensive Soil Series Classification (CCSC) system ought to be made to up-date and rationalise the soil information available with the National Bureau of Soil Survey & Land Use Planning (NBSSLUP, ICAR) and All India Soil & Land Use Survey Organisation (AISLUSO) as well as the relevant state-level organisations in order to facilitate meaningful use of the data for macro as well as micro level planning.
ii. For handling accelerated oxidation of the soil organic matter of this region, Glyricidia maculeta and Leucaena leucocephala plants are suggested to be grown under farm forestry on field bunds.
iii. Soils having "aquic" formative element in sub-order level, require immediate drainage programmes.
iv. By and large, the alluvial tracts of the eastern states having an alluvium classified as "Udifluvents" play a vital role in determining the productivity of these states. It seems, however, that most of the alluvial tracts in eastern states have been given flow irrigation and as such the impact of irrigation on productivity been comparatively poor. It is, therefore, recommended that the eastern states, especially the irrigated commands of the alluvial tracts, should give more attention to "water management" programmes rather than to simply extending irrigation. It is to be spearheaded by massive provision of tube wells and pump sets, with improvement of drainage etc.
v. Moisture conservation programme such as bunding, terracing, gully plugging and such other conservation measures like watershed development, besides provision of irrigation, whenever feasible, are recommended for 'Ustic' soils for optimum production.

Policy Perspectives for Eastern States in View of Available Recommendation for Accurate Assessment of Drought and Flood Damages

A quick assessment of drought conditions, which can be done using remote sensing techniques, should be attempted to provide qualitative as well as quantitative data on droughts before releasing central aid to states. The National Commission on Floods (Rashtriya Barh Ayog) have also recommended use of remote sensing techniques to assess crop loss due to flood damages etc. (RBI, 1984).

Suggestive Policy Measures for Flood Prone Area

i. In order not to deprive of the fertile silt to the delta area and the flood plains, it is recommended that "flood escapes" should be designed with suitable sluices to allow floods to take place in a controlled manner. This will help the flood plains and the delta to buildup gradually every year with rising of the bed of the river and ultimately save the area from heavy flood damages or water logging and drainage congestion etc.
ii. In case the flood prone area is already under irrigation, distribution of irrigation may be done from nearest main canal through underground pipe distributions, which will not be affected during floods.
iii. The strategy of the flood prone areas should be to utilize the flood-free period for crops. In order to have irrigation facilities, more emphasis on tubewell/river lift etc. should be encouraged. Easily detachable pumpsets, with either electric motor or diesel engines should be such as to enable to do multipurpose job of pumping out water and/or performing other agro-processing jobs.
iv. Flood-prone areas having sand casting problem of agricultural land during peak floods should be demarcated and suitable species like casurina, bamboos, sisso etc. can be grown to act as a screen to keep the sand filtered and to save the adjoining land from further sand casting.
v. Another "live saving" land use to save human, cattle and stored grain during peak flood after getting flood warnings is to build large 'mounds' in every flood prone village and build on it community building (School/Library/Hospital) to accommodate cattle/human beings and their stored grains during flood. The mound may be protected by bamboo and other plantations to save the area from cyclonic weather, which usually accompanies floods.

Suggestive Policy Measures for Cyclone-prone areas

i. It is recommended to raise suitable shelter belt cum wind breaks to protect crop lands from the disaster of cyclones.
ii. Besides protection, scientific management of the mangrove vegetation to act as a buffer zone between the sea and the farm lands is recommended.
iii. Raising plantation of casurina, cashew, etc. along the seacoast, as is being attempted in the coastal areas of Orissa by the State Deptt. of Agriculture/Soil Conservation in Orissa and West Bengal, will be also a successful venture for coastal cyclone-prone areas.

Issues for Management of Waste land

Chart 2.2 lists some of the technological solutions for saline land, waterlogged areas and acid soils of the eastern states:

Chart-2.2 : Corrective Technological Solutions for Certain Types of Waste Lands (namely saline, acid and waterlogged lands)

Technical Correctives	Institutional Requirements
1 . For acid and saline soils:	**For both 1 & 2:**
1.1 Paper mill sludge's to be used as liming material to neutralise acid soils; applicable to non-calcareous saline coastal areas of Orissa and Bengal.	(i) Since for most of these solutions, the benefits are divisible across individual beneficiaries and the costs do not outstrip the private benefits, government ought to strengthen the market system by: (a) Arranging extension and dissemination of knowledge through various government and semi-government local bodies, (b) Arranging proper monitoring through participation of local people so that the statutory provisions for the thermal power stations and cement factories not to leave the 'fly ash' directly to sky through chimnies but to have electrostatic/magnetic precipitators to arrest them are being enforced. (c) Since industrial waste and effluents are so useful in amending and treating problems lands and soils, a committee ought to be formed at the initiative of the State Land use Boards and inclusive of the Chairman of the State Pollution Prevention and Control Board, the Agricultural/Soil Chemists of the State and other relevant people, to work out the details for adaptive research cum pilot projects following this approach. (ii) When there are economies of scale and scope in arrangement, a collective body at local level - whether a local cooperative or a voluntary agency even a decentralised local body like panchayats may generate better results than given the market system in the purchase and sale of the necessary ingredients. (iii) When costs and/or benefits are, indivisible, a 'free rider's problem' is certain to arise and development of a collective body to share the costs and benefits is a must, as we shall see shortly in the context of management of vast saline and waterlogged areas along the coasts.
1 .2 'Fly ash' from cement factories and thermal power plants available in colloidal forms (as observed in Talcher Thermal Plant in Orissa by Sahu (1987) to be used for liming soils.	
1 .3 Dolomite, lime stone waste and coal cinder of railways after pulverising to be used for treatment of acid soils; coal cinder will also add potash to the soil.	
1 .4 Rock phosphate, besides treating acid soils, in particular, will add phosphate to the plants.	
1 .5 Pyrites and gypsum for treating saline and alkaline soils.	
1 .6 Liquid effluents from paper mills after minor treatment can be used to irrigate acid soils under plantation forests.	
2. For waterlogged areas:	
2.1 Rice bran and sawdust can be applied to improve soil tilth and also the organic matter of the heavy soil in mildly / moderately waterlogged areas.	
2.2 Vermiculite (hydrous silicate minerals with tiny flakes of mica) may be used to aid better soil erosion against water logged heavy soils.	
2.3 Low grade lignite's and graphite's having low commercial value or their wastes near benefaction plants can be diverted to agricultural fields to improve both soil tilth and organic matter content of soils.	

When the direct and indirect (organisational) costs of applying corrective solutions are too high, the following adaptive solutions to problems of salinity and/or waterlogging are suggested (Chart 2.3):

Chart-2.3 : Adaptive Solution to Problems of Salinity and/or Waterlogging in the Eastern States

1. Adaptive Flood-resistant	
Varieties of Rice	**Remarks**
Chakra Kanda Belandi	(a tall and local variety used in Orissa) (short duration early maturing variety used in Orissa, which stands allows planting as late as September)
FR 44 A and FR 44 B	(Isolated by pure line selection among the surviving plants after floods hours)
FR 43 A and FR 43 B	(released by the Department of Agriculture, Government of Orissa and locally known as Chin 41 and Chin 43, respectively in West Bengal)
CR 1009, CR 1010, CR 1018; BR 14 and BR 46	(for water depth 15 to 50 cms)
CR 1030, SURESH, BIRAJ, JANKI RD 19, JALMAGNA, JALADHI 1, PANIDHAN (for water depth above 1 metre)	(for water depth 50-100 cms) (varieties 1.5 to 1.7 are recommended by the Central Rice Research Institute and quoted by RBI (1984), these varieties are to be seeded before onset of monsoons with recommended dose of fertilizers so that they establish themselves to resist flooding.
2. Adaptive Solutions for Coastal Saline Areas	
Methods	**Remarks**
'Ridge and furrow' method can be applied to grow superior varieties of date palm and coconut	The plantations may be raised in the leeward side of the sea after raising a suitable belt over anti-saline embankments, which would protect the plantation from "cyclic salt". While the ridges can be put under plantation crops, the furrows may be used for pisciculture purposes.
Salt resistant varieties of paddy like SR 268, Patani 43, Nonabokara	Difficulties, however, arise as salinity increases with advancement of dry season and heavy flooding during the monsoons. In such areas, prospect of a rabi crop is very high, provided creeks, rivers and surface ditches accumulating sweet water can be used through lift or surface irrigation devices.
Coarse varieties of paddy seeds (which stand better to environmental stress than finer ones) can be soaked prior to sowing in 0.1 per cent solution of sodium chloride to increase their salt tolerance level upto 0.33 per cent salt in the soil.	
When no other solution is applicable, salt bushes (portu/aca eleraces) can be grown in the field to pump salt out of the soil.	These bushes known as Luna Giria in coastal areas of Orissa have an economic use as Dajii (an impure washing soda) is being prepared out of these. The local washermen burn it and wash clothes by using the ash in a crude form. It may be worth-while to investigate the agronomy of this plant and the manufacturing process for getting washing soda out of these bushes.

Handling Sand Dunes Problem

The sand dunes problem encountered in the eastern states is observed mostly in the coastal areas of West Bengal and Orissa, where dryness is not the major problem. Besides growing coconut and on a relatively smaller scale, date palm on such lands, Kajurina is being extensively grown in the coastal sand dunes of Orissa. Although such incidences are low in these states, shrubs, which come up fairly quickly, have stronger chances of survival, and, therefore, these species ought to be tried.

Afforestation of Strip Land

Afforestation of strip lands is more an organisational problem than a technical problem, except in those difficult terrains where growth of vegetation requires special knowledge and huge resources. In this situation, the optimum solution seems to be lying in encouraging local level organisations like Panchayats, clubs, schools and voluntary organisation to plant suitable species of trees, to protect them and also to enjoy a major part of the benefits from harvesting of such plants on short-term basis.

Issues on Management of Mining Land

While the three eastern states are fortunate in having a rich endowment of mineral resources, they also have the misfortune of inheriting a number of complicated problems due to these mining activities. In view of the gravity of the problem, the state governments have made it mandatory on the part of the potential lease to prepare land use plans encompassing pre-operational, operational and post-operational phases of a mine, along with the project report for exploitation of a particular mineral deposit in a given area, which would be approved and also monitored by suitable authorities.

The current approach, which seems to be full of wishful thinking and is devoid of strong economic reasoning, have laid too much of reliance on the benevolent disposition of the leaseholders of mining land and the effectiveness of government regulatory mechanism, to the utter neglect of the recent advancements in the participatory modes of management and the sustainability properties of the existing system of arrangement.

In the present context, given the whole spectrum of technologies available from the technologists, the question is: How should one go about resolving the following issues: *

i. Should one emphasize only reclamation of mined lands, as done in the past, or look at the environmental problems arising from the very beginning of mining operations?
ii. How far can one depend upon afforestation as a solution to the multiple environmental problems arising out of mining operations?
iii. If afforestation is a solution, what are the optimal combinations of species which ought to be encouraged in a given situation?
iv. What are the best ways of handling old and defunct mines which are still generating environmental problems because of their inappropriate handling in the past by their leaseholders?
v. Given the long-run and invisible nature of the environmental problems, how should contracts on mining rights be devised?
vi. Whether, how, how far and to what extent the involvement through a participatory approach of local residents and employees, who seem to be having the largest stake in environmental control, would improve upon environmental enforcement?
vii. What would be the future role of the area as well as the local residents/employees when the mining activities will be over? How should one incorporate the life of a mining area in land use planning?
viii. Who will incur the expenses on R & D for environmental control and how should these costs be distributed over time and space? Should there be a federation of mining companies which should undertake these R & D activities and disseminate the findings?
ix. What should be the future role in this context of National Afforestation and Eco-Development Board vis-a-vis other government departments / agencies? How should the functions of various government R & D agencies / institutions relating to mining activities be integrated and coordinated? '

Issues for Future Management of Forests: Handling of Forestry Data, Identification of Critical Area for Action

For developing an appropriate management perspective, discrepancies in forestry data across sources should be convincingly reconciled as the very first step. It is recommended that maps based on remote-sensing data be used for location of area for plantation, and inside the forests, for location of forest blanks and degraded forests.

It is not wise to fully depend upon only exotic species and monoculture programme. At the same time, however, the experience gained on exotic species and its success should not be lost sight of. Some successful exotics, which have proved the test of time, especially in these eastern states, like Eucalyptus (hybrid), Accacia Auriculoformis and Casuarina Equisetifolia (for sandy coastal belts) should not be discarded on the basis of mere prejudice and presumptions.

Trees that yield well on desert conditions are likely to yield well on saline soils also. It is, therefore, wise to try promising varieties of mangrove vegetation in the desert, and desert suitable species in the coastal as well as in other saline areas, where there is physiological aridity. Prosopis juliflora, a plant of the desert has already established itself in coastal saline areas. Prosopis cineraria needs experiment.

Considerable forest area has been lost in the reservoirs of irrigation projects. As a compensatory measure, an equivalent area in the command may be earmarked to be put under "ideal production: site" for practicing intensive forestry including commercial production of wildlife such as deer, rabbits etc.

Regarding management of the social forestry programme, the following observations/recommendations are now in order:

- training and orientation for the staff
- involving local bodies like panchayats and cooperatives and even granting 'tree pattas' to individuals seems to be the crying need of the hour
- this programme ought to be put on media (Newspapers, TVs, radios) and the pros and cons of the project as well as the economics of the farm forestry as worked out by NABARD ought to be propagated, including big industrial houses, paper mills etc. under the purview of farm forestry to facilitate growth of forests on long term leased out forest land
- long term leasing rights ought to be generated in favour of private individuals in case of non-strategic and non-priority lands, whereas for strategic and priority lands, government should alter property rights in favour of the community and their organsiation, which ought to be run in a spirit of partnership with the government.

Shifting Cultivation

There are two types of technical solutions for tackling shifting cultivation; first, hard-core basic land treatment and second, soft-core agronomical and agro-forestry practices.

Bench terracing (the most costly item of soil conservation measures) can only be adopted on hill slopes, where there is soil depth of more than 5-8 ft. and where the intention is to go in for an intensive cultivation, say monsoon potatoes, off-season vegetables like cauliflowers, tomatoes, beans, raddish and taping some irrigation source from a nearby hill spring, if possible.

An alternative to avoid costly earthwork is to take up Puerto Rican or Californian type of terraces on hill slopes where two rows of grass or bush having some stiff stem are recommended. The grass or hedge plant should be a perennial plant requiring little effort for maintenance, but at the same time should not be aggressive enough to become a weed for the agricultural field. Vetiver grass (Vertivera Zizanioiders) locally know as Bena in Orissa and recommended by the Agriculture Division of the World Bank, New Delhi can be tried as a planting material for developing the Puerto Rican type of terrace. The other hedge plant recommended is Vitex Vigando, (Begunia), Jatropha Carass (Baigaba) etc. Even intermittent planting of Leucaena (Leucaena Leucocaphala) variety K-28 may be tried. Instead of Leucaena, Calliandra Calothyrsus may also be used with success.

Harvest & Post-harvest Technology

Bow saws may be used for felling trees up to 30 cm in diameters and raker cutting saws for higher grithed trees (NCA, 1976). There will be considerable saving of wood if these basic equipments are used in logging operations. Many inferior secondary timbers after treatment with a chemical known as ASCU can be used, replacing the conventional durable timbers. Even sap wood sleepers out of soft wood species like pine can be used under rails after being treated with ASCU (Sagreiya, 1976).

A concurrent measure to minimize pressure on forests would be replacement of timber by metal and plastic equipments wherever possible. It is also suggested that CSIR and other material research institutions in India should orient themselves and give importance to production of better synthetics, capable of replacing wood or timber for use in the household.

Joint Forest Management

While there should be tenurial security and clarity about the nature of the contract between the FD and the FPC, performance of each and every party should be subjected to some competitive forces through periodic evaluations (the implication of the first two Johnson conditions), while considerable care ought to be taken in the selection of beneficiaries as well as of sites, on the one hand, and innovative devices ought to be applied by the government to the sharing of various direct and indirect inputs, on the other.

In a dynamic context, in order to keep the interests of the members always alive, it is necessry to continuously diversify the portfolio of business activities in favour of new peripheral activities with suitable system of cost-sharing.

While there should be free entry, only genuinely interested people should be given membership based on actual performance and not based on judgement of a smaller and outside body like Bon-O-Bhumi Sanskar Sthayee Samiti (BOBSSS) of West Bengal. As timing and amount of benefit flows are extremely important for the beneficiaries, in general, and especially for poor participants, greater scope for innovative thinking in business diversification is required. JFM as a voluntary organisation of the relevant beneficiary group ought to be allowed to derive sustenance from the panchayat system (e.g. the representation of panchayat should facilitate growth and coordination), but this should by no means be at the cost of not allowing them to grow as an independent self-sustaining organisation. Both the macro and micro-level management aspects which need to be taken into account for efficient functioning of FPCs are summarized in Chart 2.4 below.

Chart-2.4 : Micro & Macro Level Management Aspects of JFM

A: Macro Aspects		
Target	**Purpose**	**Action Needed**
Development of suitable multi-tier federal structure of FPCs and like bodies	1. Internalize externalities across like bodies, 2. Achieve economies of scale/scope in promotion/ procurement of R & D and other inputs, and in agro-processing and marketing of products, 3. Effectively bargain with the government (and the FD) for a more positive role leading to further value-addition, whether through intensive / extensive methods, and 4. Effectively monitor the functions of the government including the FD	Awareness building and collective action across the relevant bodies
B: Micro Aspects		
Target	**Purpose**	**Action Needed**
1 . Business Development in the spirit of an enterprise	To control timing and flow of economic benefits so as to keep the interests of the members always alive and thus to facilitate the collective action across members.	a) Flexible cost sharing and output sharing rules across agro-climatic regions, across members and also between the FPC and the FD. b) Micro-planning to be used as a continuous process and merely as a routine periodic and unilateral exercise.
2. Promotion of welfare activities in the spirit of applying paternalistic welfare goods & services	To further expand and strengthen the base for collective action.	a) Members of PFCs should gradually but increasingly fund these activities out of their incomes.
3. User-controlled and patronage-cohesive governance structure.	To get rid of opportunistic behaviour by individuals and freerider's problems at collective level	a) Free entry but continuation of membership contingent upon fulfillment of minimum patronage service, as may be decided by the group from time to time, b) No artificial representation by special groups through statutory provisions, c) Other stake-holders like the FD, the financial institutions may be represented in the Ecs, but they may not be given voting rights, d) The benefits flowing to participants should be proportional to the patronage, so that the share going to the FD should also have strong justification, e) The individual beneficiaries may be given voting rights proportional to patronage, but subject to a minimum of tone voting right for each legitimate member, and f) If there is strong basis for stratifying the members based on their patronage service, different types of members with differential voting rights may be created.

Management of Arable Land:

The following districts have been identified where there is enormous scope for bringing more land under cultivation (as the per cent of net sown area to cultivable area is less than 80)

Bihar: Aurangabad, Bhagalpur, Deogarh, Dhanbad, Gaya, Giridih, Godda, Gumla, Hazaribagh, Katihar, Khagaria, Lohardagga, Mungyr, Palamau, Ranchi, Saharsa,Sahebganj and Singhbhum.
Orissa: Phulbani, Keonjahr and Koraput
West Bengal: Purulia.

In rest of the districts of these states, improvement in agricultural production has, therefore, to be brought about through a more intensive use of cultivated land as the scope for bringing more land under cultivation has been practically exhausted.

However, the various types of land which can be brought under cultivation are generally cultivable waste and fallow lands, barren and uncultivable lands and vested lands which are badly degraded and denuded of any vegetative cover and their productivity is almost negligible or far below the potential, here is need for a shift in favour of tree plantations from that of regular agricultural crops.

Another way of improving the productivity of land and thus income of the farmers is to achieve inter-crop transfer of area which requires strong infrastructural support in the form of marketing, processing and input supply in favour of those crops for which the land is most suited. In this context, cooperatives, if formed on principles of sound planning and managed by local leadership as in cases of Gujarat and Maharashtra, are most suitable organisations to provide the necessary forward and backward linkages required to induce the farmers to shift their cropping pattern in favour of the most profitable crops of that area.

Extending the facilities of regulated markets and all weather roads can also go a long way in strengthening the forces of the competitive market system and inducing a more optimal allocation of arable land area across crops.

Management of Irrigation & Watershed

i. Land leveling should not be encouraged in the irrigated alluvial zone of eastern states. Instead, pumping sets for lifting water from nearby canals should be encouraged.
ii. The problem of waterlogging can somewhat be avoided if conjunctive use of tank water is encouraged to grow seedlings for transplanting paddy without charging the whole irrigation system during the nursery stage. Renovation of old tanks lying in the command area and digging up more to store water is desirable to avoid waterlogging.
iii. The state governments should undertake legislation of water rights in tanks, jheels and lakes and their maintenance should be vested with Panchayats (RBI, 1984). However, some precautions are necessary here. The Panchayats may be dominated by those people who do not demand water for irrigation from these sources leading to their inefficient management. Therefore, management of tanks, jheels and lakes and even irrigation equipments (e.g. mini deep tubewells currently being installed under World Bank support in West Bengal) should be entrusted to the group of farmers who are mainly dependent on these sources for irrigation water.
iv. There is need to change the design of the cross drainage works in alluvial plains to an alternative one of feeding small drainage channels to the canals and distributors themselves. The conventional system should be replaced by sluice gates both in the up-stream and down-stream side of the drainage channel while crossing the canal.
v. Given the very low exploitation of ground water resources in the eastern states, the main thrust of irrigation development strategy has to be tapping the large ground water resources of these states.
vi. Regarding the management of pumpset the successful experience of Pani Panchayat operation in Gujarat can be operationalised in eastern states too. Recovery of institutional finance for minor irrigation would also improve under cooperative loan scheme rather than when loans are given to individual farmers.

vii. The following measures can be implemented to prevent possible over exploitation of ground water resources (i) the abandonment of the government policy of low-cost highly subsidised irrigation from government owned irrigation works; (ii) linking water rates to volume of water actually used by the farmers, (iii) giving up the flat power tariff for electric pumpsets, and (iv) undertaking massive extension work to educate the farmers both about efficient irrigation and the harmful effects of over-irrigation.

viii. It is clear from the analysis that all the watershed development programmes in the eastern states are totally dependent on government support. Watersheds managed either by local people or by some NGO's are virtually absent in this part of the country. In order to avoid scattered work on watershed management that are being done at the state level under various programmes, a state level authority say, watershed area development authority (WADA) may be created in the same lines as command area development authority (CADA). This authority would be vested with power to co-ordinate different items of work on watershed basis (for which master plans are being prepared by the districts) and utilize funds of Agriculture, Pisciculture, Animal Husbandry, and Soil Conservation Departments to work as per watershed plans prepared for the district.

Future Perspectives with respect to Land Reforms

In the context of land reforms and land use planning we strongly feel that one needs to take a fresh and proper perspective on the issue. Given production technology at any given point of time, any attempt at overcoming unevenness in the existing distribution of land and other complementary resources across households and/or over space to facilitate production and exchange, generates a series of alternatives to the society - redistribution of land and related assets across households and space, elimination intermediary rights in land to pave the way for self-cultivation and use of a variety of contractual forms to facilitate leasing in/out (purchase/sale) of the services of land, labour and other complementary assets (inputs). In a dynamic context, the society has a further option of devising and adopting new technologies in order to overcome the twin problems of unevenness in distribution of the ownership and control of resources and of limited substitutability across factor inputs. In a liberalised and globalised framework, therefore, the options are far greater than mere physical redistribution of only land assets. The essence of the present approach is therefore to create an overall environment and property rights over all resources and not merely on land so as to provide the strongest possible motivation for acquisition and disposition of entrepreneurial skills. The major hypothesis of this study is that land reforms in the narrow sense is only a component of the whole package of agrarian reforms, which alone can release enough entrepreneurial skill to promote the necessary technological and institutional innovations for achieving the goal of growth with equity.

Urban Land Use

In the light of the past trend on urban land use, as described earlier, and the experiences of Sweden's eco-municipalities, the following policy prescriptions are suggested to improve urban land use:

i. A systematic and comprehensive survey of urban land for ail cities and towns which should synchronize with decennial population census. Use of satellite pictures, as recent studies reveal , may provide useful data in this regard.

ii. Another important area where planned actions are called for is land under mixed use. The concept of 'Building Center' with emphasis on mixed land use, is being applied by these state governments to provide cheap housing to low and middle income groups in urban fringes. Ideally, the state governments should play the role of facilitators encouraging and inducing private and cooperative initiatives often in collaboration with industries to undertake these tasks and manage them, rather than themselves going in for such ventures.

iii. In case of places like C.M.D. area which has nearly stopped growing, development of core areas which have deteriorated in recent times and lack the facilities of open space and do not have adequate roads or street for speedy movement of traffic, renewal or redevelopment seems to be the only strategy. It may even be useful to "undo" to some extent big metropolis like the CMD area, by shifting the major activities (even the state capital in case of Calcutta) to far-off places. In order to facilitate this process, subsidies on urban life should be removed and the urban-dwellers ought to be made to pay fully for the service they receive. The government should facilitate the role and growth of secondary cities more and more in the coming years.

iv. There is considerable scope for achieving a balanced distribution of urban population within towns through development of certain wards and areas within wards.
v. One major step in avoiding/minimizing environmental hazards, especially in large urban conglomerates is to recognize the communities "right to know" and facilitate smoother information flows.
vi. Decentralized and perfectly comprehensible small projects, having "graceful failures", are suggested as a viable strategy to combat growing urban vulnerability to disaster.
vii. Based on the experiences of the past, the current trend is to move towards participatory approach to management from application of intimidatory law and regulations.
viii. The various regulatory instruments available in this country for handling urban land use deserve a fresh and critical look not only in view of the potentials of the participatory approach at the local level, highlighted above but also in view of the fact that, as in the U.S., a number, of regulatory instruments can allow urban strategies to move further into market mechanisms.
ix. There is a need for business to keep local government informed, and also a need for local governments to work with industry in promoting safe, beautiful and risk-free urban life.
x. Poor assessment of land and landed property very often leads to poor tax collection and the resulting violation of equity. The current tax base is either capital value or annual value. What is suggested is that a tax based on some physical properties of land should be followed.

Fisheries Development

There exists a vast potential for the development of marine and inland fisheries in these states. In order to tap this potential, development efforts should focus on the following activities:

i. Improvement of traditional and small mechanised crafts and fishing gear and adoption of new and modern technology,
ii. Provision of infrastructural facilities, particularly strengthening of existing harbours and constructing new harbours and providing required service including cold storages and ice plants.
iii. To take up all necessary steps to supply good quality feed. Adequate fiscal and non-fiscal incentives should be given to the entrepreneurs who want to set up feed milts in accordance with the estimated requirement of feed in the light of expected growth of the brackish-water area.
iv. A work plan to control the quality of water and release of fish fry and fingerlings of the commercial species need careful consideration.
v. Rapid development of brackish-water fishery would generate high levels of demand for prawn seed. This in turn would require strategic action on the part of the state governments to encourage establishment of commercial hatcheries capable of sustaining large scale supply of seed on a regular basis.
vi. Considerable support in the form of financial incentives, subsidies etc., and also the required infrastructure should be provided to the small fish farmers, socially water sections and cooperatives as the land lease policy for brackish-water agriculture is generally in favour of these target groups.
vii. Fallow and derelict water bodies, waterlogged areas etc., should be developed for culture of air-culture or air-breathing fishes, catfish etc., which have high value and good consumer demand.
viii. Development of culture fisheries through Fish Farmer Development Agency (FFDA) should be expanded to areas so far not covered.
ix. At present, the main reason for low production reservoir fisheries is inadequate stocking. Therefore, the main development thrust will have to be regular stocking of the water bodies with carp fingerlings.
x. To sustain the yield from riverine fisheries, strict measures are to be enforced to restrict the flow of industrial effluents.
xi. Marketing of fish should be handled by Regional Marketing Federations comprising of all primary fish cooperative-societies in the region. Accordingly, the bye-laws of the fishermen's cooperative societies have to be amended on the pattern of Amul Cooperatives in Gujrat.

Livestock Sector Management

i. There are vast areas under the category of waste lands of various type, which can not be put under field crops but can be fit enough to grow fodders and ought to be put under grasses with proper management. Some of these can be put under tree-based fodders like Subabul. This will help not only in augmenting the availability of green fodders but also help in checking soil erosion.
ii. It is necessary to stabilise the livestock population at a certain level so that it can be sustained. This calls for culling out gradually the unproductive population of the livestock considering not only with the feeding resources position but also the low productivity levels of such animals.
iii. The State Sewage Board and Animal Husbandry Department can interact with each other in order to utilise city sewage water after treatment for growing suitable crops for animals.
iv. For the introduction of fodder based mixed farming and for the improvement of the grazing resources of the state, it is essential to raise seeds of improved and high-yielding fodder crops, legumes and grasses in the state.
v. A number of animal feed mixing plants may be set up during the coming plans, which will utilise agro-industrial by-products, slaughter house wastes, feed grade urea, minerals, vitamins and other feed additives for manufacturing animal feeds for different species of livestock (ruminants and non-ruminants).
vi. As weather aberrations play havoc in the eastern states, it will be desirable to set up fodder banks in chronically drought and flood-affected areas.
vii. Low cost, bullock-driven water lifting devices like Persian wheel, Archimedes's screw etc. may be introduced to supplement irrigation and to keep the bullocks engaged.
viii. Idle bullock power may also be utilised for bunding, terracing, land leveling and land shaping works utilising simple bullock-drawn implements like keni, wooden scrappers etc.
ix. Massive programmes for improving the reproductive efficiency of cattle and buffaloes should be undertaken.
x. Low producing stock is to be eliminated progressively.
xi. Emphasis is to be given on increasing milk production and improving the working efficiency of bullocks.
xii. Breeding for milk production should be concentrated in milk-shed areas so that they can be easily linked up with the existing and the proposed dairy projects.
xiii. Milk production should be on commercial basis to attract the small farmers. Financial loans to small farmers through banks should be offered. While the small producers ought to be organised under the cooperative sector with the necessary multi-tier approach, one needs to be cautious about their spurious growth under government patronage. The cooperative sector need to be freed from the clutches of the government and similar high-powered bodies, allowing them to run like private companies but with the spirit of self-governance and self-control.

The present paper has been an attempt to provide a perspective on the multitude of uses land is put to in the Eastern states of India, namely West Bengal, Bihar and Orissa. The available information and subsequent suggestive policy makers to devise an optimal land use pattern necessary for this region. However difficult the task may look to be, we are of the view that institutional changes if brought about to involve people's participation in the truest sense of the term, may make the task easier.

6 IMPACT OF STRUCTURA1 ADJUSTMENT PROGRAMME ON LAND AND WATER RESOURCES OF GUJARAT

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Introduction

Gujarat, the fourth richest state of India, is poised to take a big leap in industrialising it's economy, however on a poor, unevenly distributed critical natural resource base. Ignoring the fact that there are perpetual drinking water shortages in most parts of the state - now even in the southern parts which receives high rainfall - the Government of Gujarat (GOG) has gone aggressively for attracting large investments in the industrial sector. Since the onset of the Structural Adjustment Programme (SAP), the state has topped the list in terms of new investments (Industries and Mines Department (1995), Industrial Policy, Government of Gujarat, July). At the same time, the agricultural activity in the state has declined. In any case, only a quarter of the state's cultivated lands have been irrigated, the rest of the agriculture being rainfed and land exposed to erosion. The Gujarat High Court, passing judgement on Public Interest Litigation (PIL) filed for water pollution observed that "the State Government has lent support to the submission (By the petitioners.)that it has regarded the anti-pollution laws as hindrance to the industrialisation of the State. "(Judgement passed by Chief Justice B.N.Kirpal and Justice H.LGokhale, Gujarat High Court on August 5, 1995, pp. 52.) In the blind rush of industrialising the economy, the state, which was poorly endowed with natural resources, has mismanaged it's land and water resources.

The development in the state has been on a dichotomous path. Although, the secondary (specially the registered manufacturing) sector has grown rapidly and consistently, more so after 1981, the decline in poverty has not been so consistent. According to the official estimates, the poverty declined sharply between 1877-78 and 1983 (From 43.1 per cent in 1977-78 to 27.6 per cent in 1983 an d2.2 per cent in 987-88.) and at lower rate thereafter (Hirway, I. (1995), "Selective Development and Widening Disparities in Gujarat", Economic and Political Weekly, 30(41/42), pp.2603-18.) Minhas et al (Minhas, B.S., L.R.Jain and S.D.Tendulkar(1991), "Declining Incidence of Poverty in 1980s: Evidence versus Artifacts", Economic and Political Weekly, 26(27/28),pp. 1673-82.) and Mahendra Dev et al (Dev S.M., M.H.Suryanarayana and K.Parikh (1992), "Rural Poverty in India: Incidence, Issues and Policies", Asian Development Review, 10(1), pp.35-66.)have shown after that 1983 (Ibid [6].), the poverty has increased in Gujarat. Since incidence of poverty is measured in terms of calorie intake, the poverty statistics also indicates extent of food security of the population. Thus, with the increase in registered manufacturing sector, which has been capital intensive, the food security has increased. The state does not fare well in the area of the social development either (i) Hirway, I. And D.Mahadevia (1996), "Critique of Human Development Index: Towards an Alternative", a paper circulated as a background paper at Technical Workshop on Building a Framework for ensuring Gender Equity, May 15-17, Bangalore.(ii) Parikh, K. (1996), "Equitable Sustainable Development of Gujarat", Economic and Political Weekly, 31(19), pp. 1151-67.). Gujarat has been a net importer of food grains.

Not only the agriculture has declined but, within it, the food grain production has declined and crop production, specially groundnut and other oilseeds has increased. The oil seeds are salinity and drought resistant, and hence their increase, where as the coarse grains (bajra and jowar) have sharply declined. On the natural resource front, the forest cover has

declined. Part of the remaining forests are degraded. Wastelands have increased significantly. The extent of area covered under Desert Development Programme (DDP) and Drought Prone Area Programme (DPAP) has also increased significantly.

In the post-SAP phase, the GOG has introduced new ordinance and amended legislation to obtain or facilitate access to land for industrial purposes. In certain locations, agricultural lands have been diverted for mining and industrial activities. Projects amounting to staggering Rs. 150,000 crores have been sanctioned (Based on the data from the Industrial Extension Bureau (Indextb) of the GOG.). It is mindboggling pace of industrialization pursued by the state government, blind to other aspects of development, that has worried us. Will the ordinary people of the state be a part of such development process? After being displaced from the agriculture sector, will they be absorbed in upcoming mega projects so that their livelihoods are protected? Or will the self-reliant people be forced to depend on water supplied through tankers, as is the case now in many parts? Finally, what will be the environmental and human impacts of such capital-intensive development that creates islands of affluence amidst poverty and environmental degradation?

This paper raises some of these questions using statistics of the government departments and information gathered through discussions with the local people affected by the mega projects. It is a part of the larger ongoing study on five districts of Gujarat, but the findings from only two districts are discussed here against the macro background of the state. It is an indicative study because many of the recent changes on environment and people have not been registered in the village landrecords. Long term, village level cropping pattern trends are not available because of the poor records at the taluka level for making pre and post comparisons possible in the affected villages. Such information can be collected with lot of perseverance over time, which was not possible under this quick study. This study is also a response and commitment to many of the local resistance groups involved in the activity of saving their land and water resources for protecting their livelihood security. These groups felt a need for comparative information to strengthen their collective resistance. We hope that the output will be useful for their purpose.

Impact of SAP on land and water resources in Gujarat is expected to be felt through large scale industrialisation pushed after 1991. Thus, it was decided to follow the local impacts of some mega projects in the state. Two districts, Surat and Kachchh were selected and within them, one taluka which received the highest investment was selected to observe the ongoing process of change with respect to land and water resources. To authenticate the observations with respect to the land, we have collected the village cropping pattern and landuse data, for last seven to eight years, wherever available. Changes in quantum of agricultural produce by the local marketing yard was collected as an indicator of agricultural production changes in the region.

Gujarat's Economy - Pre and Post Sap

Gujarat is the fourth richest state in India in terms of Per Capita State Net Domestic Product (NSDP), however, lagging far behind Punjab, Haryana and Maharashtra. In 1993-94, the Per Capita SNDP at constant (1980-81) prices was Rs.2351, which was lower than that of the previous year (Rs.2585). Infact, since 1988-89, there has been a decline in the PCNSDP (Annexure I) (Directorate of Economics and Statistics (1995), Socio-Economic Review Gujarat State, 1994-95, Government of Gujarat, Gandhinagar.). This is explained by severe decline in the income from agriculture. The total income from agriculture declined not only in the drought years (1985-89), but in the good monsoon years as well, for example the early nineties. The share of agriculture in the total income has also gone down. This is inspite of high level of commercialisation of agriculture in Gujarat. Thus, not only, there is a shift away from the agriculture sector, there is overall decline in the agricultural activities in the state. This process is expected to exacerbate because of large-scale land transfers for industrial activities, expected pollution of land resources due to mining leases granted on a large scale and decline in availability of irrigation water.

The manufacturing sector's performance was spectacular in the eighties, inspite of the textile crisis. During the sixties, it grew at 3.04 per cent per annum, in the seventies at 5.55 per cent and in the eighties at/8.11 per cent (Ibid [6]). But in the first few years of SAP, the growth of this sector is slow. In 1991-92, the income from this sector declined, followed by only 2.0 per cent to 2.5 per cent growth in the subsequent years. However, once the new mega projects, which are under implementation now, are commissioned, there will be a jump of income in this sector. It is tertiary sector, the transport and communications sector, the banking and the insurance sector and the real estate sector that has grown rapidly in the first phase of SAP. This is quite obvious because of construction of mega industrial projects, increased transport as a result and increase in the activity of the financial markets after the one set of SAP.

Industrial Development

The state has diversified from the traditional textile base to chemicals, petrochemicals, dyes and dye intermediates, pharmaceutical, engineering, food processing and agro-based industries, mainly during the eighties. Of late, mining and mineral based industries have been sanctioned. The chemicals and petrochemicals sector has grown rapidly during the eighties, having it's own consequences on water resources of the state. The group of chemical industries (industry group 30) has grown it's share in the gross fixed capital from 16.41 per cent in 1980-81 to 36.93 per cent in 1990-91(Based on Annual Survey of Industries, 1980, 190.). This trend is likely to continue because of upcoming large capacities in this group (For example Reliance Industries Limited's (RIL's) plant in Hazira area where Rs.23,629 crores of investment has come. One such large plant is coming up in Jamnagar district. Indian Petrochemical Limited (IPCL), besides large existing capacity in Bharuch district, is investing Rs.1500 crores more (Based on the data for Indextb).).

The small scale sector has grown consistently at about 10 per cent during the seventies as well as eighties in terms of number of units (Industries Commissionerate (1995, 1992), Industries in Gujarat (Some Statistics), Government of Gujarat.). From 1988 onwards, it has grown at about eight to nine per cent per annum (Table 1). But the large and medium scale industries have increased at a much higher pace than the small scale sector (Table 1). Total 3767 projects worth Rs. 148278 crores have been sanctioned in the large and medium sector after 1991. In the first year of the SAP, this sector jumped in terms of number of units as well as investment sanctioned. Therefore, in terms of units, it has registered an annual growth of around 30 per cent and in terms of investment of about 40 per cent.

The capital intensity in the medium and large scale sector has increased after 1991. For example, till 1990, investment of Rs.15 lakhs generated one direct job. For projects sanctioned in 1991, the investment per job was Rs.9 lakhs. Thereafter the investment per job was: Rs.16.6 lakhs in 1992, Rs.23.7 lakhs in 1993, Rs.22.5 lakhs in 1994, Rs.23 lakhs in 1995 and Rs.31.2 lakhs upto April 1996. The highest capital intensity is for the cement plants sanctioned in Kachchh district, Rs.63.3 lakhs per job in 1994 and Rs.258 lakhs per job in 1995 and Rs.258 lakhs per job in 1996 (All estimates of investment per job are based on data from the Indextb). There is no estimate, as of now, as to how much indirect jobs will be generated because of such industrialisation. But one thing is certain, that in 'all villages where such industries have come up, agriculture has stopped or significantly declined reducing labour participation rates.

One impact of SAP on industrialisation pattern in Gujarat has been that Saurashtra and Kachchh region, which had very little industrial investment before 1991, has attracted large investment (Annexure IV). Mining leases have been granted to private sector in this region which has large deposits of mineral such as limestone and lignite. These two are the main inputs for the cement and power industries respectively.

Table-1 :
Year Wise Number of Units Sanctioned/Registered in Small Scale (Ibid [16]) and Large and Medium-Scale (Based on data from Indextb) Sectors

	1988	1989	1990	1991	1992	1993	1994	1995
Small Scale*	9743	10568	11538	12684	13852	15258	16359	17020
% Change***		8.4	9.1	9.9	9.2	10.1	7.2	4.0
	Upto 1990 from 1983			199	199	199	199	199
Large & Medium			88	129	227	299	385	506
Scale* % change***				45.6	75.9	31.	28.7	31.3
Large & Medium			2137	3186	6056	8752	12190	18014
Scale** % change***				49.0	90.0	44.1	39.2	47.7

- Numoer or unit
** Investment in Rs.Crore
*** Over previous year

Both industries are highly capital intensive. Most large industrial plants, such as RIL In Hazira area near Surat or Sanghi Cements in Kachchh have their captive power plants, permitted under the SAP policy of reservation of some industries from the public sector, one of these being the power sector. Development of private ports has been permitted by the new industrial policy for export promotion. The mega industries have set up or are setting up their own port facilities. Thus, we observe this dispersal of industrial development in Gujarat, along the coastal belt while continuing the concentration along the golden corridor, Vapi, Valsad, Surat, Bharuch, Vadodara, Ahemadabad and Mehasana districts of the pre-SAP phase. Land along the whole of Gujarat coast, all the way upto Kachchh will be effected as a result.

Agricultural Sector

Agriculture in Gujarat, even before the onset of SAP, was highly commercialized. In 1991-92, when SAP was introduced, 56.5 per cent of the total gross cropped area of 105 lakh hectares was under non-food crops, mainly the groundnut (in 19 per cent area) (Centre for Monitoring of Indian Economy (1995), India's Agricultural Sector: A Compendium of Statistics, CMIE, Bombay, July, Table-9.). In India, only one-third of the gross cropped area is under cash crops. Further, only 27.4 per cent of the gross cropped area was irrigated in 1991-92 (Ibid [20], Table-14), the rest of the agriculture being rainfed and therefore unstable because of cyclical droughts. One of the reason for large areas to be under groundnut cultivation is, that this is a drought resistant crop and has replaced bajra in many parts of the state. In fact, during the worst drought period, 1985-88, in some districts such as Kachchh area under groundnut production increased, as against sharp decline in the area under bajra, the traditional food grain (Crop and Season Reports, Gujarat). Overall, in India, contribution of Gujarat State to food grain production has declined from 3.49 per cent in 1970-73 period to 2.37 pen cent in 1991-94 period (Ibid [20], Table-48). As a result, the per capita food grain production also came down sharply (Ibid [20]).

Table-2 :
Area Under Select Crops (Source of data is Ibid [12])

(in '000 ha)

	1989-90	1990-91	1991-92	1992-93	1993-94
Food grains	4734	4621	3912	4312	4001
Jowar	873	853	509	449	376
Bajra t	1332	1152	1150	1273	1212
Wheat	619	717	409	611	487
Tuvar	382	402	397	408	426
Groundnut	2072	1702	1942	1884	2053
Castor	242	345	278	306	312
Cotton	1187	921	1135	1151	1126
Sugarcane	106	118	120	127	128

In the post -SAP phase, area under food grains has continued to decline (Table 2). Area allocated to bajra has declined somewhat but that under jowar has drastically declined. Surprise reduction is in the area under wheat, which declined even though the farmers have preferred this crop instead of the traditional coarse grains during much of the earlier two decades because of the support price given by the government. All through the decade of seventies, area under wheat increased rapidly (Pathak, M. and H.F. Patel (1983), "Agricultural Development in Gujarat: Problems and Prospects", in D.T. Lakdawala (ed.) Gujarat Economy: Problems and Prospects, Sardar Patel Institute of Economic and Social Research, Ahmedabad and Allied, New Delhi, pp 211-24) and then remained almost stable during the eighties. It may be improper to conclude this as a definitive trend and link it with SAP at this juncture.

From our field visits we could discern that the farmers have given up cultivation of bajra and even wheat now, because of non-availability of irrigation facilities. For example, in Kachchh, near Panandharo Thermal Power Plant of the Gujarat Electricity Board (GEB), due to pollution of local water resources by the plant, wheat and bajra cultivation was not possible. In Hazira area near Surat, the irrigation canal from Kakrapar dam, was diverted for the industrial use, making cultivation of any cereals difficult. Instead of cereals, in many places, the farmers were cultivating groundnut. Trend with respect to non-food crops, however is continuation of the trend of the eighties. As we shall see later in the case studies, near the sites of large industrial projects, cultivation of food grains has almost stopped. It is likely, that in some pockets, food grain production will considerably decline in the coming years.

Natural Resources

Water

Gujarat has very poor endowment of natural resources. The rainfall varies from 1800 mm in Dangs to 340 mm in Kachchh. The average for the state is 800 mm. Two in every five years are drought years. Except Narmada, Tapi, Mahi and Purna in South Gujarat, all other rivers of the state are seasonal and generally dry throughout the year (That was not so about forty years ago, as evident from the descriptions of the rivers of north Gujarat by Ramprasad Shukla in Saritao na Sanidhyama, Gujar Sahitya, Ahmedabad). For both, drinking water and

irrigation, therefore there is heavy dependence on ground water. As high as 78 per cent of irrigation was through wells, including deep tubewells in 1991-92 (Ibid [20], Table-16). Even 77 per cent of the drinking water and industrial water need was met by the ground water in 1991(Based on, Narmada and Water Resource Development (1992), Report of the Committee on Estimation of Ground Water Resources and Irrigation Potential in Gujarat, Government of Gujarat, Gandhinagar) Due to overexploitation of ground water, the water table has gone down and many ground water sources dried up. Thus, even in good monsoon year, drinking water scarcities in large parts of the state is common. In 1963-64, as per a state government survey, there were 1043 villages with no facility. According to the Eight Plan document, 11815 villages were declared as no source (Hirway, I. and P.P. Patel (1994), Dynamics of Drinking Water in Gujarat, Centre for Water Resources, Utthan, Ahmedabad, pp. 54). In 1992-95 period, about 82 per cent villages were declared as having no source (Annexure II). Ground water table in north Gujarat has gone down to as low as 400m to 450m. In Mehsana it is dropping at the annual rate of five to eight meters (Ibid [31]).

Hirway and Patel (Ibid [32]) attribute increase in drinking water problem to development of water resources for irrigation purposes. Initially, that was for short term gains in increasing food production. But later on, the vested interests of the rich farmer lobby governed irrigation policy. The farmers lobby specially those engaged in the production of water intensive cash crops, became so powerful that it was difficult to control over drafting of the ground water and over use of canal water in some regions. It is not only the coastal belt, from Gulf of Khambhat to Saurashtra that is saline but also in some of the inner districts, such as Ahmedabad (10 per cent of the total area) and Surendranagar (7 per cent of the area) the lands are saline (National Remote Sensing Agency (1993), Wasteland Atlas of India (Volume I), NRSA, Hyderabad and Department of Wasteland Development, Government of India) A special feature of irrigation in Gujarat is that, the budget allocations to this sector have gone up but the area irrigated has remained constant. The investment in the irrigation has been to improve the existing sources, for example for making deeper tubewells. The massive industrial development in the post-SAP phase, many of these industries such as power and petrochemical are water intensive. They have come in the water deficient regions as our case studies show. They have taken the command of the available water resources, rendering agriculture infructious.

It is not only the availability but the quality of drinking water, which has been a problem. In many parts, ground water is naturallysaline or contaminated by fluorides and nitrates from agriculture. For example, in and around Ahmedabad, the TDS levels were as high as 3000-4000ppm (Matzger, H. and M. Moench (2994), "Ground Water Availability for Drinking Water in Gujarat: Quantity, Quality and Health Dimensions", Economic and Political Weekly, 29(13), pp. A-31 to A-41). In Kachchh, 62 per cent of the wells monitored by the Institutes of Desert Ecology has TDS level above 2000ppm, the permissible level (Ibid [2])

Fluoride content is beyond acceptable limits in 11.2 per cent villages of the state (Ibid [36], based on Gujarat Water Supply and Sanitation Boards' draft copy on The State of Gujarat's Environment) Most districts of north Gujarat and Saurashtra have high proportion of villages with excessive fluoride content. Pollution from chemical industries has become a menace during the eighties. Water sources in Ahmedabad, Vadodara, Bharuch and Surat district have been highly polluted by the chemical and petrochemical industries belonging to both, the public and private sectors. In Ahmedabad City alone, 756 small scale units were notified by the Gujarat High Court to take care of their effluent (Indian Express, 8-8-95, Ahmedabad). On non-compliance of this order, the high court ordered all these units to close down till the effluent treatment facility was made functional. Similarly, about 250 units in Ankleshvar, Bharuch district and 11 public sector undertakings such as Gujarat State Fertilizer Company, IPCL, Gujarat Refinery (of IOC), etc. were also notified (Indian Express, 26-8-95, Ahmedabad). The pollution problems created by the small and large industries in the eighties have not yet been taken care of and new massive capacities have been sanctioned in the chemical and petrochemical sector after 1991. On field visit to the site of upcoming industries, we realized that water pollution problem has not been seriously tackled and whatever efforts have been made have created it's own serious impact. For example, at Panandharo, GEB is operating reverse osmosis plant, primarily to increase their water supply, concentrated brine, the product is being dumped in the local water bodies. The TDS level in the surrounding water

bodies have therefore increased. Non-comprehensive approach and strategy to concentrate chemical industries in specific industrial estates may aggravate the problem in the conning years.

Land

As with water, the land resource has also been mismanaged in the pre-SPA era. Of the total 18.82 million hectare of land in the state, about 51 per cent was cultivated in 1993-94 (Annexure III). Among the rest, 10 per cent lands were under forest. More than half the forests are degraded that leave state with very low (5 per cent (As per National Remote Sensing Agency data. See Ibid [32])) forest cover. About 24 per cent (4.6 million ha) of land area is barren and waste land. Decline in the agriculture activity in the state is corroborated by significant and consistent increase in area as current fallow, from 0.5 million ha in 1980-81 to 1 million ha in 1991-92. Considering that only a quarter of the total 9.4 million ha cultivated land is irrigated, for rest part of the year 7 million ha of agricultural land requires protection. This brings the total of about 14 million ha (75 per cent) that is degraded in the state and requires some protection (Ibid [6]).

Recent Changes in Land Legislation

To facilitate rapid industrialisation, the state government has amended some of the land legislation, which were introduced earlier as a part of the land reforms process. The state government and the industrial houses have always felt that the land reform laws have been a constraint in the industry's access to rapid growth. These amendments are briefly discussed here.

The first to be amended was a restriction on the purchase of agricultural lands by those living beyond eight km limit. As per the Land Acquisition Act, those possessing or intending to possess agricultural land, should be staying within eight km limit of the land. This restriction was introduced to check the concentration of agricultural lands in the hands of few and those not engaged in agriculture. Possession of land is not only an asset but a survival strategy and social status for rural population in semi-feudal economy. In practice, many interested persons circumvented this law to purchase of agricultural lands which was introduced on March 31", 1995 (Based on an article in Naya Marg, April 16, 1995).

The second amendment introduced was also related to law pertaining to land tenancy. In all, there are 34 different land legislation under which tenancy rights are given. After independence, under the tenancy laws, about 21.31 lakh landlords received 25.90 lakh acres of land in Gujarat. Even wastelands distributed are covered under the tenancy laws. All such recipients got what was called 'New Tenure' land, which came with a restriction of sale in the land market. Only 'Old Tenure' land was saleable or transferable (The Times of India, Feb. 27, 1996, Ahmedabad; Indian Express, Feb.27, 1996, Ahmedabad; The Times of India, March 1, 1996). So lands distributed under land distribution policy could not be sold in the market. Again the purpose was to ensure that the livelihoods of the poor were protected. New tenure lands in the villages were not available to the industries, even if the farmers, which are mostly small and marginal farmers, were interested in selling them.

In many places, where industries have come recently, prices of agricultural lands have shot up. Many farmers are interested in and have started selling off lands to the incoming industries. For example, in Ahmedabad rural, where we have taken a case study (not presented here today), the current price of agricultural lands is Rs.300,000 to Rs.350,000 per acre ($21,500 to $ 25,000 per hectare). In Hazira village near Surat, another case study area, the Essar industry paid Rs.350,000 per acre ($ 25, 000 per hectare) to the farmers. The deal, was struck before the amendment was introduced on Feb 26, 1996. Hence, lands have been thus sold. The government, while introducing this legislation stated that, in any case, lands were illegally transferred to the advantage of the middleman and to the disadvantage of the farmer (This indeed is true as told to us by the President of Bavla Marketing Yard, near Ahmedabad, who himself is a land agent and has assisted industries purchase lands in the region).

The third amendment proposed is with respect to Bombay Land Revenue Code and Bombay Tenancy and Agricultural Land Act, under which, No Objection Certificate (NOC) is required for converting agricultural lands to Non-Agricultural (NA) use from either the District Collectorate (DC) or District or Taluka Development Officers (DDO and TOO) or the Revenue Secretary. This is a cumbersome procedure and involves corruption. To facilitate industries to buy lands, an ordinance is proposed that, any person purchasing land upto 10 hectares for 'bonafide' industrial use, will not have to take NOC for land transfer but will only have to notify the DC within 30 days of the commencement of it's use. For purchase of land above 10 hectares, permission from only State Industries Commissioner is required. If the purchaser fails to put up infrastructure for the industrial activity on such lands within three years, the seller has the right to repurchase the land at the original price. If the seller fails to do so, then within three months the government will purchase the land (Indian Express, Jan.4, 1996, Ahmedabad).

The question is, after selling the land, will the seller have money to buy back the land, when in reality it is observed that on getting the money the seller indulges in conspicuous consumption, renovating a house or buying a motorcycle or other consumer durables. If the seller does not purchase back such lands then, the government will be forced to buy such lands at the market rates prevalent five years ago (which are many times higher than the land acquisition price paid by the government). In most instance, when the industries start coming into a region, at one point of time, the prices shoot up many times. The government will end up paying for some people to get NA for industrial activity and declare a very high price for the same and later on force the government to purchase the land.

I Box 1: Case of HADA

I Hazira Area Development Authority (HADA) was constituted in 1985 under Gujarat Town Planning and Area Development Act of 1963 for planned industrial development of area under it's jurisdiction. Nine villages Hazira, Sunvali, Rajgari, Mora, Bhatali, Dmaka, Vansva, Kavas and Limla spread over 86 sq. km. come under HADA's jurisdiction. HADA region comprises 14.5 per cent area of Choryasi taluka of Surat district and 17.2 per cent of the total rural area of the taluka. The area is mainly Khar (saline) and marshy land. The terrain is undulating, with chain of sanddunes and drifting sands, making agriculture less productive. After the finding of natural gas at Bombay High decision to pass the gas pipeline from Ubharat on the mainland south of Surat City, industrial development in this region started. The Krishak Bharti Co-operative (KRIBHCO), a gas cracker fertilizer plant was first to come up in the region on the site of Mora and Limla. Oil and Natural Gas Commission (ONGC) establishment came up in Bhatpore village, in adjoining Surat Urban Development Authority (SUDA) area. Thereafter, NTPC's gas -based power plant came at Kavas village. Then came the private sector units, Larsen and Tubro followed by RIL in Mora Village and Essar Gujarat in Hazira village. When the first draft development plan of HADA region was prepared, lands of all the villages were declared as reserved for the use of Gujarat Industrial Development Corporation (GIDC). By this, all I agricultural lands of the eight villages were marked for industrial use, making agriculture an illegal use in the region. The lands would then have been acquired for the use of GIDC at very low rates. To this proposal of HADA, the Sarpanch's for all the Gram Panchayats in the region and individuals raised objections, using the provision in the development plan. HANDA had to revise it's development plan as a result, taking away the reservations for the GIDC. Only lands already under the possession of various industries were put under the possession of various industries leaving all other lands for agricultural use.

The industries are liable to pay the taxes, Octroi and house tax to the Gram Panchayats. To escape paying the taxes, the industries forced the government to issue another notification in 1989, to declare the area under the eight villages as notified, to be administered by a notified Area Committee (NAC). The NAC can be controlled by the industrial houses and by that, they can ward off the tax liability. To this also, under the leadership of HVAS, the residents have objected. Till date, 1100 objections, some individually and some collectively have been raised. The residents and the local politicians are ready to fight till the end.

Though these events took place before the onset of SAP, it indicates that the state government, of any political party, has been quite amenable to the demand raised by the industrial development, is a state government subject and under the 'Eminent Domain' of the State. Using this constitutionally given powers, the state government has overridden all other powers given to the authority and ignored the rights of the local inhabitants over their own land, to make this critical input cheaply available to the industries. In the post -SAP phase, such conflicts of the people with State, if the latter intervenes on the life-space of people, are expected to increase.

The state government has also declared a policy, vide Government Resolution dated August 9, 1994, that, the government owned wastelands will be leased out for horticulture, plantations and other agricultural proposes to the NRI owned companies, individuals, co-operatives, Indian companies and corporate houses. The wastelands will be leased out if they undertake to develop the same using some modern technology. Minimum of 100 acres and maximum of 2000 acres will be leased, for a period of initially 20 years to be extended by another 20 years. For the first two years of the first 20 years, no lease money will be charged but thereafter, per acre lease rent per acre are Rs.25 per in the third year and which will increase by Rs.2.5 per acre every year till the tenth year. Thereafter, the basic rate will be revised. The lease rent rates fixed are ridiculously low. This policy of involving co-operative and private sector development can be productive and useful if these are sustainable. This policy should be so implemented as not to transform this scarce natural resource into a means of primitive accumulation by the private sector.

It can thus be seen that the GOG has taken strong policy measures and made legislative changes to facilitate industrialization and promote corporate agriculture, as required under the SAP. Even before these amendments, the GOG was always amenable to provide land for the industries using other legislative tools, one of that being land acquisition act. Lands have been acquired for the public sector undertakings, such as GEB's Thermal Plants, National thermal Power Corporation's (NTPC's) plants, KRIBHCO plant, etc. government paying meager compensation to the farmers. Even for the private sector, lands have been acquired, for example for Ambuja Cement in Amreli taluka, RIL in Hazira area and so on. By introducing an amendment in the Land Acquisition Act in 1984, industrial use was brought under the public purpose, thereby making it possible for the industries to get lands at cheap rates. It is yet another study of the impact of land acquisition of people's livelihoods, not presented here. The government has also granted revenue lands to the industries at nominal rates. For example, RIL in Hazira got 245 hectares of land in 1990 and 96 hectares in 1994 and Essar industries got 38 hectares in 1991 from the Surat district collectorate (Data from the DC's Office, Surat). Granting of land was there even in the pre-SAP phase. Other legislation used for transferring land to the industries is Gujarat Town Planning and Urban Development Act (For case of HADA see Box 1). Because of all these, it is expected that there will be large scale diversion of agricultural lands for NA purposes. These have yet not reflected in the overall landuse pattern of the state, but in few years time, that will be visible at the macro level as well. Box-2 shows how Sanghi Cement Industry in Kachchh was granted land lease through legislative action.

Box 2: Denotification of Narayan Sarovar Wildlife Sanctuary

Whereas in case of HADA, the state government notified the villages to bring i them under a new authority, in Kachchh part of Narayan Sarovar Wildlife Sanctuary was denotified to make lands for industrial use. Prior to that, the 1981, using The Wildlife (Protection) Act, without the consent of the local people (again because land is under the 'Eminent Domain' of the state), the Department of Agriculture, Forest and Co-operation of Government of Gujarat declared lands of 56(out of 99) villages of Lakhpat Taluka as reserved for Chinkara Sanctuary. The sanctuary area was 765.79 sq. kms, that is 39.4 per cent of the total area of the taluka. Total area of 21 villages were notified and the local population, which are pastoralists or semi-pastoralists, lost control over their lands.

The GOG has argued that large mineral deposits, bauxite, benotinite, lignite and limestone, are located in the sanctuary. The development of Kachchh depends on the exploitation of these resources and developing mineral based industries. Further, such development will bring employment and income in the region, relieving people of permanent scarcity and dependence on relief works. The GOG also argued that this is not a great agricultural region and hence any other economic activity in the region is always welcomed. That will stop the large scale out migration from the region. For the industrial development of Gujarat, large amount of power is required. At Panandharo, already, 210 MW GEB plant is there and another 235 MW plant is to be commissioned in Akrimota near by. If lignite is not made available, all this will fail, affecting the development of Gujarat, Finally, for the current population of Chinkaras, such a large reserved area is not required. In the last decade, after reservation, nothing was done to systematically develop the sanctuary because the area was too large and the GOG could not manage it. By reducing the area, the government will be better able to manage the sanctuary. The last two arguments, to say the least are ridiculous and all others have been, by now, proved superfluous.

With these arguments, the GOG denotified 321.56 sq. km. (16.5 per cent of taluka's) area from the sanctuary in 1993. Out of 56 villages notified in 1981, part or all area of 26 villages are denotified.

After denotification, the GOG issued a lease order to Sanghi Cement for mining limestone in 10,000 hectares (5 per cent of taluka's area). This affects six villages, Rodsar, Lakshmi, Rani, Jadva, Harudi, Naredi and Baranda. Among this, 2000 hectares of Jadva village alone has been leased out. The total area of Jadva is 3015 hectares, that is two-thirds of the village lands will go for mining. This will mean uprooting of the whole village inhabited by Rabaris, who are pastoralists. Five per cent of taluka's lands is mined by only one company. Other five companies have filed Letter of Intent (LOI) for setting up cement plants in the adjoining region. Those too will seek limestone mining rights in the regions. Identified limestone reserve are in 216.64 sq. km. (11 per cent of taluka's area). This means that Sanghi alone has been granted mining lease over almost half the limestone reserve in the taluka.

Here too, the local population have organised under Jan Jagran Manch to resist the type of development coming in their region and to establish land and water rights over their village lands.

Case Studies of Post-SAP Impacts

Two case studies are presented here to discuss the impact of industrial development in the post -SAP era. The case of villages in Hazira area of Surat district and villages near the site of Sanghi Cement in Lakhpat taluka, Kachchh district are presented. The development of HADA is not strictly related to SAP because RIL, a private sector venture was set up even before SAP. But Essar Gujarat is post-SAP. Nonetheless, the development speeded up after SAP and Essar could purchase private lands without any hindrance from the administration. This

area is nevertheless taken to observe what happens when large scale industrial development of capital intensive type comes in any region. We had problems in identifying regions which were strictly post-SAP influences because much of the investment after 1991 has come in the industrial regions developed during the decades of eighties. Sanghi cement industry, however, is directly related to SAP as already discussed earlier.

Hazira Industrial Area

Popularly known as Hazira area, named after Hazira village on the peninsula formed by Tapi river on one side and Arabian sea on the other, is located about 30 kms from Surat city. It appears as a suburb of Surat City because of continuous development along the road going to Hazira from Surat City. Surat is among the most industralised districts of Gujarat. After 1991, the district has attracted highest (34 per cent of the total) investment sanctioned in the medium and large scale industries. In the pre-SAP phase also, the district along with Bharuch, topped in Gujarat in terms of investment sanctioned (Annexure-IV). Within Surat district, Hazira falls in Choryasi taluka, the largest, the most populous and most industrialised of all the talukas. Besides medium and large industries, Surat also has large number of small-scale units in textile sector and diamond cutting and polishing. Surat district came second after Ahmedabad in terms of total number of SSIs, comprising 14.5 per cent of total SSI units in the state (Based on Ibid [12]).

In 1981, population of Surat district was 34 lakhs. Surat City with a population of 15 lakhs in 1991 was the second largest city of the state. The population of the city increased fourfold during 1971 to 1991 period because of rapid development in and around Surat City, one of that being the HADA area. In the first phase of HADA's growth, government wastelands and some acquired agricultural lands were allotted to the public sector companies such as NTPC, ONGC, and KRIBHCO. The RIL was also granted public lands by the District Collectorate. But Essar, the last to come, got only some lands from the government. It had to purchase the private lands from the farmers paying Rs.350,000 per acre (Rs.291, 000 for the land and the rest for the standing crops).

The district is divided into three broad regions; a) the eastern hilly tribal ' belt, b) the central belt, which is the most agriculturally fertile and through ' which passes the main railway line and hence has an industrialised ; corridor and c) the coastal zone which is saline. Hazira falls in the third region and hence never had very good agriculture. But vegetables have been grown in a big way (A study of Damka village located in Hazira area, in 1979 by Dipankar Gupta, also observed that because of terrain and poor irrigation, vegetables were the main produce. Also, good soil was rare and that there were mainly small and marginal farmers. See Gupta, D. (197), Scarcity and Market Dependence in Damka: Portrayal of Kisans in an Atypical Village, Centre for Social Studies, Surat).. Nearness to Surat City made vegetable growing an attractive proposition. Because of the undulating terrain, rain water collected in the troughs recharged the underground aquifers. For many years, well water catered to the drinking water and irrigation needs of the population. Later on the canal coming from Kakrapar met the irrigation and drinking water need. However, after the coming of the industries in the region, this canal has been diverted for the use of the industries.

In the near Hazira area, we have observed impact of industrialisation on eleven villages, Ichchhapur, Bhatpur, Damka, Vansva, Bhatlai, Rajgari, Limla, Kavas, Mora, Sunvali and Hazira. Land and cropping data of three 'nearby villages, not directly affected by Hazira's development is also observed from comparative picture. People of all these villages are in a stage of transition. They were producing their own food till 1981, as majority were engaged in agriculture sector. The picture changed in 1991 census when, in most of the villages mentioned above, the male workers were engaged in non-agricultural activities. Now, the population is partly producing food and partly purchasing the food. This situation is reflected in area devoted to food-grains, which has declined (Table-3) and that under non-agricultural areas have increased (Annexure-V). In Pisad, which is not in Hazira area, practically, there is very little agriculture. But in Bhesan, village not affected by industries, the cropping pattern is fluctuating as is normally the case. In all villages where industries have come, except Hazaria village, in 1990-91, practically no land was devoted to cereal production, which has

depressed the averages of first two periods (1989-92 and 1990-93) in Table-3. The whole of Limla village is under KRIBHCO and hence has no agricultural production.

The vegetables cultivated are; Brinjal, Bhaji (fenugreek leaves and spinach), okra, gaurd, guvar and other green vegetables. Only bhaji is grown regularly and large area devoted to it's cultivation. Vegetables cultivation has also declined in the recent years, due to, one, decline in land available and two, youth seeking employment outside agriculture. In expectation of getting a job in the industries as was promised by some industries - almost all youth went for technical education. Hence, agriculture has been abandoned as an occupation by the younger generation.

Table-3 :
Villagewise Area Under Wheat, Rice, Jowar and Bajra, Choryasi Taluka

Village	Av. of 1989-92	Av. of 1990-93	Av. of 1991-94	Av. Of 1992-95
Pisad	4.8	6.2	7.6	8.3
Bhesan	208.9	263.7	307.2	231.2
Malgama	59.5	68.5	43.3	42.3
Ichchhapur	101.4	90.0	56.0	44.6
Damka	343.0	343.9	356.9	341.2
Vansva	21.0	12.2	1.9	2.3
Bhatlai	56.2	45.6	40.0	41.3
Rajgari	125.2	201.2	198.9	169.6
Bhatpore	37.7	18.3	13.6	16.1
Kavas	44.8	30.6	21.6	11.9
Mora	60.9	46.8	39.9	33.9
Sunvali	181.5	281	247.3	219.0
Hazira	138.9	137.9	194.6	171.0

Source: Based on village land records

These landuse changes and decline in agriculture activity in the Hazira region, is likely to have caused decline in the purchase of vegetables by the Surat Agricultural Produce Marketing Yard. Choryasi taluka does not have a grain marketing yard. Instead, the marketing yard purchased only vegetables produced. There is only one grain marketing yard for the whole of district located at Vyara. In the study villages, the food grain were traditionally cultivated for self-consumption. The surplus grains were sold to the local population, the food grains were available to every one at low price. Only vegetables were marketed. Local people told us that half the quantity of vegetables produced were normally sold to the marketing yard and other half in retail in Surat City. We have data from the Surat Marketing Yard from 1988 onwards, which shows that till 1991, there was a mixed trend in the purchase of the vegetables, after which, the quantity of vegetables purchased has consistently declined (Annexure VI).

With the coming of industries in the region, as mentioned earlier, the canal coming from Kakrapar dam has been diverted for the use of the industries. This canal runs parallel to the

main road from Surat to Hazira. While travelling on this road we could observe that till Ichchhapur village, the canal water was being utilized by the households for domestic purposes, a familiar site of women washing clothes on canal bank and going towards the canal with a basket of clothes on head. In villages after that, we observed women washing clothes in the water collected in ditches along the road side. It had rained the previous day and hence the collection of water in ditches along the road. We are describing this to indicate the water shortage in Hazira region even in monsoon, when we had visited this region. Choryasi taluka receives on an average 1197 mm, which is by no means less to create water shortage. Water is supplied to the villages by tankers.

The population in Hazira region has grown rapidly, at the average rate of 93 per cent in 1981-91 period, which is phenomenally high as compared to average 20 per cent decadal growth during the previous years. The panchayats in the region are supplying water to the industries. The drinking water source is the village wells. As mentioned earlier, because of the undulating terrain, water would collect in the low lying regions, percolating down to recharge the aquifers. Thus, even though the lands were saline, sweet water was available in the wells. The coming of industries, and the drastic population increase has led to overdrafting of groundwater. Also, the updulating terrain has been leveled off leading to decline in the recharge rate. At the time of acquiring lands and then asking the panchayats to supply their township with water, the industries had promised the village that they would construct a regional drinking water network . For example in Hazira village Essar had given such promise and in Mora RIL had promised so. But no where the promise was kept. People of Hazira are quite agitated about the issue.

What is described above is a process of industrialisation. The rural population is displaced from agriculture and absorbed in the secondary and the tertiary sectors. The population shifts from producing their own food to purchasing it from the market. Then, one may ask, what is so wrong with whatever has happened in Hazira area. The only chick in the armoury is bypassing of the local population by the type of industrial development.

The industries which have come are highly capital- intensive for example Rs.3.6 crores of investment generating one job in RIL, Rs.2.1 crores generating 1 job in Essar and for all industries in Hazira area, Rs.2.4 crores generating one job. Hence the employees are highly skilled and have come from outside. The construction activity has been given on turnkey basis to large firm one of that being Larsen and Tubro. This firm has come with it's own labour, for skilled as well as unskilled job. The local population has not been absorbed in the industries, even though the youth have low level technical education. Many local entrepreneurs have anticipated that they would get some business from the company, such as transport business and in anticipation have purchased small trucks. But that has also not come by. Transporters from Surat City and from Bombay are operating the truck business. The local population is left without any sustainable livelihood. On one hand agriculture was being abandoned due to land transfers and water shortages, on the other, there were no regular employment. The residents of Hazira , who have sold their lands at market rate, have a large bank balance to provide some security. But many of them have also indulged in conspicuous renovating their houses, purchasing vehicles and large number of consumer durables.

Not a chick in the armour but a big hole in the edifice is the pollution created by the industries. The Essar plant has large dumps of dolomite use for manufacturing of steel. This region has a very high wind velocity and hence the dolomite dust is everywhere. So is the iron dust. Along the road sides are dumps of iron dust, which are filled in the polypropylene bags to carry out land reclamation on the site where Essar is located. The industries are also throwing their waste water in the river. The fishing in the river on which the local tribal population is dependent is to be affected. Systematic data is required with respect to land and water pollution.

It is much too familiar observation, that with the coming of industries in a region, the grazing regions are gone. In some of the villages, Ichchhapur, Damka, Limla and Mora, where the public sector undertakings are located, the area under grass production has either declined or

vanished. Their access to common grazing located on an island in the river has become difficult because of the location of industries on the river bank,. Thus cattle population has decreased in these villages. Because agriculture has also decreased, the need for cattle has also decreased, and many families had sold their oxen. Thus, on the whole, the livestock related activities have also declined, but that could not be ascertained. In short, the self-reliant economy has been integrated with the dominant development paradigm of dependencies. Is this necessarily disadvantageous to the rural population (In this context, we wish to refer a study of 80 families affected by NTPC plant at Kavas. Out of these 80 families, only 14 had been given a compensation above Rs.One lakh, all others receiving just Rs.50,000 for the loss of land. Rehabilitation policy has only recently been framed. Before that, lands were acquired at very low rates. The compensation amount, in this case was also very low and arbitrarily decided, putting very low value on the life of the people whose lands were taken away. Is Rs.50,000 adequate to provide security to a family permanently? If this amount was put in the bank as a fixed deposit, it would have fetched the family Rs.600 per month as interest, on which the family had to survive. As is the case with most projects, only few members (36 out of total 400) of the Project Affected Families (PAFs) were employed by the industry, and that too at the lowest skill and employment level. On the other hand, the compensation amount was used up for day to day requirements (60 per cent families), on housing renovations (7 per cent families), on education and marriages (15 per cent families) and rest on miscellaneous purposes. None could buy land elsewhere from the market. Thus landlessness increased without adequate alternative employment. Also, the family's asset composition changed from productive (agricultural implements, cattle, etc.) to consumer goods (television, radio, motorcycles, LPG stoves, refrigerator, etc.). Inspite of increase in consumption of consumer durables, which apparently shows improvement in the living standards, two-third of the surveyed population felt that their quality of life deteriorated after loosing of land and coming of the industry. About 90 per cent felt that the conditions of their villages declined after the coming of the industry. This study was commissioned on the instance of the World Bank because of the criticism levied about the adverse impacts of land acquisition for Thermal plants. The study does not, however, discuss the environmental aspects as the Terms of Reference were only restricted what the title states. Patel, A (1994), Socio-economic and Demographic Survey of PAFs of the NTPC Project at Kawas, Centre for Social Studies, Surat.) ?

The population is highly dissatisfied with the coming of industries in the region. Their water sources have dried up, there is no employment, land prices have gone up, prices of all other commodities have increased, outsiders have entered their villages, thefts have increased, security of knowing each other has gone because of invasion of large number of unknown and anonymous population. Against it, no school and health facilities have come. If social amenities have come then that is for the exclusive use of the dwellers of the industrial township and not for the village population. English medium schools have come where the local Gujarati speaking population are misfit and hence have no access. All these factors have created a sense of dissatisfaction. Every one buys food grains from the village market. Those who can afford, buy it in wholesale from Surat City market. The nearness to the city has atleast supported the population by absorbing them in the tertiary sector in the city. But coming of the industries has not resulted in the fulfilling of the dreams of the local people, though it might help the policy makers and planners for whom growth is just numbers.

Lakhpat

The development and processes observed in the Lakhpat taluka is strictly post-SAP and thus makes a good case study. Lakhpat is the last of taluka of Kachchh district. It has Kori to the north which has the famous mangroves of Kachchh and Arabian Sea to the west and the south. Kachchh is the largest district of Gujarat in terms of area (45,652 sq.km. - about a quarter of state's area) but having small population, 12.63 lakhs (only 3.1 per cent of state's population) in 1991. During the sixties and the seventies, the population of the district grew at slower pace than that of the state (22.0 per cent and 23.6 per cent as compared to state's 29.4 and 27.7 per cent respectively). But during the eighties, the district growth rate (20.2 per cent) neared the state averages (21.1 per cent). This is because of either decline in male out-migration or increase in male in-migration due to mining and transport related activities in the

districts. The sex ratio till the seventies was near 1000, but in the eighties that went down to 973, which was still higher than that of the state (943). The rainfall in the region is quite variable, the co-efficient of variability being covered under DDP and DPAP (Annexure II). One feature of the district is, high evapotranspiration rate because of high temperatures and high wind velocity, rendering all surface water sources dry very quickly after the rains. Ground water sources are therefore the best reserves of water.

In the post-SAP phase, massive capacities of cement plants and marine-salt industries have come or are coming in Kachchh. In the pre-SAP period, large and medium industrial project worth Rs.105 crores were sanctioned and which comprised just 0.33 per cent of the total investment sanctioned in this sector in the state in the same period. Since 1991 onwards, the projects worth Rs.7435 crores, (4.66 per cent of that in the state), have been sanctioned. But the new projects coming are capital intensive. Before 1991, with respect to medium and large industries, Rs.1.6 lakhs generated one direct employment. As against this, after 1991, Rs.58 lakhs generates one direct employment (Based on the data from Indextb). Also the pre-SAP projects were mainly located in Anjar and Bhuj talukas, where as in the post-SAP period, these are coming in Lakhpat and Abdasa talukas, where large mineral deposits are found. These developments have come amidst the population which is pastoralists and semi-pastoralists, requiring large amounts of land for maintaining their livelihood security. The first major development in Lakhpat taluka was in Panandharo villages starting from mid-seventies when Gujarat Minerals Development Co-operation (GMDC) started Lignite mining. For both these ventures, lands were acquired on the payment of a meager amount of Rs.200 to Rs.300 per acre as compensation or almost no compensation (Based on Ranjan, P. (1996), Micro Impacts of Thermal Power Industry: A Case Study of Kutch Thermal Power Station (Unpublished Master's Dissertation), School of Planning, Ahmedabad).

The greatest asset of Kachchh is it's variable ecosystems. The 'developmentalists' may consider variable and fragile ecosystem as constraint on the growth, in the classic development vs. environment paradigm of dealing with ecology. The district has well defined soil, water and air body and flora, fauna and people with potential for adaptation, change and tolerance. This balance has been maintained for centuries, which is expected to be severe by the onslaught of the forces unleased by the SAP. For example, people used to water-intensive life style will come in large numbers and impose on system where local people have been sustaining low-water consumption life style. We are referring to the population living in the GEB and GMDC colonies or now upcoming Sanghipuram on the site of Sanghi Cement to house the company's population.

The district has, in all, nine ecosystems, i) the great Rann (desert), ii) the little Rann, iii) the Banni grassland iv) the coastal mangroves, v) other coastal ecosystem of the mainland, vii) the other grass lands excepting that of Banni, viii) wastelands, which are in essence grazing lands, and ix) managed agriculture and horticulture area (Based on Gujarat Ecology Commission (1994), Current .-Ecological Status of Kachchh, GEC, Vadodara, June), the latter growing the best dates in the country. There are three wildlife sanctuary in the district, the wild ass sanctuary in the small Rann, the Chinkara sanctuary near Narayan Sarovar on the main land and Flamingo City in Khadir, one of the three islands within the Great Rann. In the year of good monsoon, about two lakh flamingos come during the winters and stay till the end of February. Kachchh also has a beautiful coast line, specially near Mandvi, which is one of the oldest port city of the district. Because of these variabilities, Kachchh is now being projected as a great tourist spot in the state.

Unlike Hazira region, which has settled agriculturalists, the population in most parts of Kachchh practice shifting cultivation. The district has only 15 per cent of it's area under agriculture. Because of arid climate and shallow soils, pre-dominant vegetation is short annual grasses. The livestock economy predominates. It is inhabited by several nomadic tribes, Rabaris, Ahirs, Charans, etc. Besides, the pastoralists, the agriculturalists also maintain the livestock for the extra supply of nutrition. The former also cultivate for the food security. Some of the male members of the pastoralist households move with the livestock grazing in the scrub forests. There are also some reserved forests termed as Rakhals where the livestock herds are taken to graze during the dry months. During that period, the herders

survive only on milk (Box 3). The people of Kachchh are distinct as compared to the whole of Gujarat due to geographical, climatic, historical, economic reasons. The impact of SAP on these tribes will therefore be different than on the regular agricultural households.

Conclusion

In this paper we have attempted to portray the macro picture of Gujarat with respect to pre and post SAP trends with respect to industrialisation, agriculture and land and water resources. It is very clear that the pre-SAP trends will only be exacerbated in the post trend period. This is because, since it's formation, Gujarat has placed highest priority on , industrialisation. There are historical reasons for it, one of that being well entrenched enterprising class for last many centuries. Being a semi-arid region, agriculture was never good and hence, the mercantile and later on the industrial class dominated the main ideology. All through the recent history of the state, the oil lobby, the rich farmers lobby, the rich and the industrial lobby has been very powerful in the state's politics. Governments have toppled when these lobbies have supported. Any way, there has always been an implicit thrust towards rapid industrialisation and implicit policy of support to industrial houses. Taking the opportunity afforded by the SAP, the state has been pushing towards becoming the best with respect to industries, titled. "The Best Now Becomes Even Better". The impact on state's land and water resources of Gujarat in the post-SAP period, specially when these have been severely damaged and mismanaged in the pre-SAP periods as the trends show.

The micro trends observed in the villages in Hazira area of decline of food grains and then decline of agriculture match with the macro trends at the state level. The cereals have been replaced by the cash crops. Overall there is a decline in the agriculture activity, not just the share of agriculture in the income. At the same time, the population depends on agriculture has not declined as rapidly, indicating that agriculture has continued to provide food security to majority. Three common explanations given for decline in agriculture in Gujarat are drought, nonavailability of irrigation on three-fourths of cultivated areas and increasing salinity of lands. But the fourth reason is, decline in water table and reduced moisture content in the soil. The net sown area has not declined but the current fallows have increased (Annexure III). Land have been alienated for industrial purposes.

Whatever irrigation facilities are available have been used for cash-crops. Now, the industry is competing for the scarce water facilities. The industries and urban settlement also pollute water sources leading to decline in agricultural productivity. The food grain production will therefore severely reduce in the state in the coming years. The report of the World Watch Institute on food security cite all these processes as reasons for decline in the food grain production in the world.

The best solution to the food security aspect in Gujarat will be a decentralised food system that is autonomous and self-reliant. For this, adequate food grain has to be assured at the state level and for which, part of the food grains, specially the coarse grains will have to be in the category of the non-tradables. There will have to be intensive coarse grain production, specially in the form of support prices. Rather than homogenising the life styles, by shifting all population to consuming green revolution cereals, hetrogenious life styles will have to be promoted so that different social groups can obtain nutritional food from diverse food types. Much needs to be done with respect to ecologically sound management of land and water resources so that the cereals production is maintained. In Gujarat, the degradation of these two resources have been the singular important reason for decline in agriculture. A rational industrialisation policy has also to be worked out so that natural resources are sustainably used. Finally, there will have to be grassroot campaigns to maintain the livelihood security and control of land and water resources of the state on a platter to the industries, while the local population will have to regain their control over them for their own survival.

Annexure-I : Net State Domestic Product by Industry Group (Ibid [12])

(At Constant (1980-81) Prices)

	1980-81	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94
PCNSDP (RS)	1940	2186	2276		2737	2644	2654	231	2585	2351
% change*		-4.7	4.1	-12.8	37.9	-3.4	0.4	-12.6	11.4	-9.0
Agriculture etc. ** ***	2672	2544	2535	1377	3580	3176	3006	2104	3352	2411
% share	40.8	31.0	29.1	17.8	32.9	29.7	27.6	21.7	30.5	23.7
% change*		-23.3	-0.4	-45.7	160.0	-11.3	-5.4	-30.0	59.3	-28.1
Manufacturing***	1354	2228	2448	2425	2846	2746	3175	2498	2562	2614
% share	20.7	27.1	28.1	31.3	26.2	25.7	29.2	25.8	23.3	25.7
% change*		14.9	9.9	-0.9	17.4	-3.5	15.6	-21.3	2.6	2.0
Tertiary***	2091	2949	3215	3344	3854	4155	4102	4190	4344	4427
% share	31.9	35.9	36.9	43.2	35.4	38.9	37.7	43.2	39.5	43.5
% Change*		6.4	9.0	4.0	15.3	7.8	-1.3	2.1	3.7	1.9

* Change over Previous year
** Includes income from agriculture, forestry, logging, fishing, mining and quarrying
*** In Rs. Crores

Annexure-II : State of Water Resources in Gujarat

	Level of Development 1991	Development Category 1991	No source villages (average) 1992-95	Talukas under DDP 70's	Talukas under DDP 90's	Talukas under DDP& DPAP 90's 1992-93	Change in talukas under DDP &DPAP between 70's & 90's	% of village* having excessive		
								Fluoride	Salinity	Nitrate
								1992	1992	1992
Ahmedabad	87.01	Dark	87.85	0.00	0.00	28.57	0.00	22.01	13.61	1.15
Amreli	50.75	White	99.33	0.00	0.00	80.00	80.00	11.24	1.28	10.43
Banaskantha	89.74	Dark	90.98	6.64	45.45	45.45	-18.18	24.81	5.01	3.34
Bharuch	39.32	White	67.26	0.00	0.00	72.73	72.73	2.32	10.33	3.12
Bhavnagar	43.16	White	99.35	0.00	0.00	83.33	58.33	8.16	2.72	12.51
Dangs	0.28	White	91.00	0.00	0.00	100.00	100.00	0.40	1.30	
Gandhinagar	83.25	Gray	34.97	0.00	0.00	0.00	0.00			
Jamnagar	42.62	White	99.23	0.00	100.00	100.00	80.00	20.41		
Junagadh	62.79	White	93.71	0.00	0.00	53.33	53.33	1.59	6.78	3.32
Kachchh	55.2	White	92.33	0.00	0.00	100.00	0.00	4.48	4.58	0.19
Kheda	53.33	White	68.43	0.00	100.00	0.00	22.22	18.29	21.07	10.07
Mehasana	193.59	Dark	83.01	18.18	0.00	0.00	-18.18	28.78	12.62	0.76
Panchmahals	45.52	White	77.03	0.00	0.00	81.82	18.18	16.41	2.01	2.85
Rajkot	50.74	White	96.80	0.00	76.92	76.92	38.46	1.76	5.85	0.23
Sabarkantha	70.99	Gray	85.72	0.00	0.00	20.00	20.00	16.78	1.52	5.14
Surat	21.72	White	53.17	0.00	0.00	0.00	0.00	1.93	2.86	1.85
Surendranagar	54.63	White	98.30	0.00	88.89	88.89	-11.11	6.29	3.99	0.15
Vadodara	52.26	White	57.06	0.00	0.00	50.00	50.00	15.81	6.36	2.79
Valsad	30.78	White	78.93	0.00	0.00	37.50	37.50	1.69	1.33	0.97
Gujarat			81.26	4.89	22.83	53.80	29.89	13.96	5.615.61	3.32

(in '00 hectares)

	1960-61	1970-71	1975-76	1980-81	1981-82	1984-85	1985-86	1989-90	1990-91	1991-92	1992-93	1993-94
Forests	11423	15731	18892	19655	19648	18819	18777	18845	18847	18846	18860	18862
Barren & Uncultivable Land	47386	30765	25572	25034	25019	26767	26757	26093	26092	26085	26069	26063
Area Under NA Use	4059	7710	10635	10670	10780	10810	10891	11160	11221	11208	11227	11253
Cultivable Waste	7639	19664	20076	19856	19696	19552	19501	19794	19700	19828	19825	19813
Permanent Pastures	10421	9485	8531	8483	8448	8466	8463	8457	8457	8481	8479	8485
Land Under Misc. Tree Crops etc.*	416	137	42	41	40	42	42	40	40	41	40	40
Current Fallows	3413	3492	4062	5394	4909	6803	9373	8575	10379	10465	7561	9472
Other Fallows	4254	4014	3779	3322	3018	455	425	529	521	353	327	327
Net Sown Area	93970	97130	96470	95765	96702	97075	94020	94716	92962	92914	95833	93906
Total Reporting Area	182986	188128	188163	188220	188260	188250	188249	188209	188219	188221	188221	188221
Area Under Food Crops				54871			54577	52556	52553	51319	54789	51809
Area Under Non-Food Crops				52588			49813	54816	53795	54258	55795	55480
Gross Cropped Area	97676	104919	105494	107459	109541	110165	104390	107372	106348	105577	110582	107289

Annexure IV : Share of Each District (pre and Post SAP) in Total Investment Sanctioned

Districts	Total investment sanctioned (in Rs.Crores)		% share in investment sanctioned	
	Upto 1991	1991 to 1996*	Upto 1991	1991 to 1996
Ahmedabad	659	7117	2.08	4.46
Amreli	214	2871	0.68	1.80
Banaskantha	110	250	1.35	0.16
Bharuch	10952	29278	34.59	18.34
Bhavnagar	136	3259	0.43	2.04
Dangs	25	0	0.08	0.00
Gandhinagar	594	750	1.88	0.47
Jamnagar	321	23066	1.01	14.45
Junagarh	443	2363	1.40	1.48
Kachchh	105	7435	0.33	4.66
Kheda	237	3463	0.75	2.17
Mehsana	646	5536	2.04	3.47
Panchmahal	452	1031	1.43	0.65-
Rajkot	60	872	0.19	0.5
Sabarkantha	160	943	0.51	0.59
Surat	10904	54532	34.43	34.15
Surendranagar	242	1421	0.76	0.89
Vadodara	4790	12150	15.13	7.61
Valsad	616	3469	1.95	2.17
Total	**31666**	**159678**	**100**	**100**

Annexure V : Villagewise Non-Agricultural Area, Choryasi Taluka

(in hectares)

Village	Total Area	1989-90	1990-91	1991-92	1992-93	1993-94
Pisad	69.57	6.00				
Bhesan	557.85	15.93	23.71	42.00	43.00	42.00
Malgama	284.90	86.25	86.25	10.00	17.00	17.00
Ichchhapur	912.61	310.07	310.00	310.00	310.00	310.00
Damka	1394.98	229.85	229.00	247.00	247.00	247.00
Vansva	497.39	•10.61	12.00	5.00	3.00	3.00
Bhatlai	264.39	20.00	20.00	107.00	107.00	107.00
Rajgari	350.83	4.00		31.00	31.00	31.00
Limla	570.21	570.00		558.00	524.00	524.00
Bhatpore	824.28	404.33	294.00	294.00		294.00
Kavas	822.14	67.00	67.00		676.00	676.00
Mora	2223.37	6.00				
Sunvali	3299.05			1958.00	1958.00	1958.00
Hazira	2012.50	31.11	31.00	1318.00	1318.00	1318.00

Source: Based on village land records.

Annexure VI: Yearwise Purchase of Vegetables by Surat Agricultural Produce Market

(inquintals)

Vegetables	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94
Sweet potato	2623	2727	2504	2755	22891	2636
Suran	2780	2839	2649	2534	1448	1721
Rotara	623	759	898	1127	664	617
Brinjal	12731	13092	13074	14473		13409
Lady Finger	7336	8113	7568	10346	11773	7679
Guwar	5634	6947	5599	6412	6217	5320
Beans	2722	3079	2660	2490	1983	2124
Papri	3930	5226	4226	4748	2802	2596
Tuwer	4135	4166	3457	3617	3119	3558
Giloda	6719	6082	5670	5893	5377	4800
Gourd	4044	3601	3874	3795	3456	3227
Bitter Gourd	1586	1736	1714	1427	1309	1115
Turia	1761	2454	2054	1620	1724	1346
Parval	3559	4772	4301	4125	3748	2724
Chibhra	2488	3741	3543	3587	3652	2922
Pumpkin	425	516	500	406	370	616
Cucumbar	396	488	424	367	411	411
Kantola	982	1169	1034	469	532	372
Tindas	170	147	140	150	201	204
Carrot	3088	2629	3315	3932	2534	3359
Mogri	76	67	103	119	68	72
Peas	2847	3246	4241	4589	3509	4032
Green Turmeric	639	964	428	338	245	7
Lemon	2702	2955	2920	2545	2445	363
Mango	9381	6659	8351	9261	7252	2491
Pandora	2	12	7	1	7	4686
Garlic	5955	5851	5671	5631	5801	3947

7 LAND USE CHANGE, DIVERSIFICATION OF AGRICULTURE AND AGROFORESTRY IN NORTHWEST INDIA

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Introduction

Land use is a synthesis of physical, chemical, and biological systems and processes on the one hand and human/societal processes and behaviour on the other. The monitoring of such systems includes the diagnosis and prognosis of land use changes in a holistic manner at various levels. Land use change may be examined by considering conversion of forest to crop and rangeland; losses of productive land through various factors; conversion of wetlands to agriculture and urban use: and conversion of other types of land to various human uses. The per capita availability of land in India decreased from 0.9 ha in 1951 to 0.5 ha in 1980-81. The situation of cultivated land is even more critical. The per capita availability of such land has declined from 0.48 ha in 1951 to 0.20 ha in 1981. This is likely to decrease further to 0.15 ha by 2000 AD. About 85 million ha of agricultural land and 37 million ha of forest lands are degraded to varying degrees out of the total land of 143 million ha and 67 million ha respectively (NLUCB, 1988). In recent years, various sustainable land use initiatives are being taken at national and global level under the Tropical Forestry Action Plan, World Food Programme, and UNCED-initiated a Forest Principles and Agenda 21. The Government of India initiated an agroforestry programme as ah integrated sustainable land use management system. On 2 June 1992, it announced the National Conservation Plan in order to tackle such multidimensional problems facing the nation today.

Agriculture has undergone drastic changes from the mid-1960s through the introduction and application of various newly developed techniques in agrosciences such as crop and water management practices. Emphasis has been given to the integrated systems approach in crop production.

It is essential to plan and implement rational policies to minimize the regional imbalances of agricultural production. The present growth in crop production has to be sustained considering ecological and economic factors. The existing as well as emerging frontiers must be examined to enhance agricultural growth on a sustainable basis. The understanding of agroclimatic relationship through crop-weather conditions, soil fertility, water use efficiency, rain water management, and appropriate cropping patterns based on regional resource potential must be emphasized. Moreover, agroforestry, integrated crop management, biotechnology, and use of renewable energy must be emphasized for use in environmentally harmonious agriculture. Training of farmers has to be adapted to the changing technological environment.

The forest affects soil and water in many ways. Leaves and branches decreases wind strength, alter the absorption of solar radiation, and increase the surface area for evaporation. The root growth and the decomposition of plant organic matter, by soil fauna and microbes, modify soil texture and structure, affecting water penetration and drainage. Changes in vegetation cover can therefore have a significant influence on the hydrological cycle and climatic system (IGBP, 1992).

The study area consists of the states of Punjab, Haryana, Himachal Pradesh, and Jammu & Kashmir. On the basis of physiography and soil resources, this zone is clearly divisible into two sub-zones: the plains of Punjab and Haryana and the highlands. Based on altitude, soil types, geology, and rainfall, each of these two sub-zones may be further subdivided. Major

sources of water in the region, in addition to rainfall and river, are lakes, the ice caps of glaciers, and underground springs. Underground water is largely concentrated in the plains of Punjab and Haryana. The region covers a varied land use, from highly intensive monocultures through rotational and intercropping to grazed rangeland and near-natural forests.

Land Use Change

Our analysis of land use for the last 40 years in the four states suggests that Punjab and Haryana have reached the absolute limit of expansion of area under cultivation with almost 84% of the area being cultivated. Six to 8% of the area in these states is under urban uses. Another 5% are under forests (mainly strip forests), and the remaining 2-3% is roads, canals, and other infrastructural and industrial uses. Cultivable waste as a category has virtually disappeared in these two states. Such intensive land use for agriculture is sustainable only with increasing and continued high doses of balanced nutrients and other inputs such as chemical fertilizers and insecticides. The proportion of area available for cultivation in Himachal Pradesh and Jammu & Kashmir because of topography and physiography is rather small and cannot be expanded without major private and public investments that in return will result in major ecological problems and should be avoided.

The cropping pattern in the region has undergone a substantial change, with wheat and rice emerging as a major crop rotation in Punjab and half of Haryana. Its expansion in Himachal Pradesh and Jammu & Kashmir has been moderate. Crops that have been replaced by wheat and rice, are gram, bajra, barley, millets and pulses. Area under cotton has grown in Haryana. In absence of expansion of the sugar industry, the area under sugarcane has remained static. The cropping pattern of the region has unnecessarily become energy-intensive and is affecting the static balance of the underground water resources in the plains of Punjab and Haryana. The growth of infrastructure, irrigation, and other technological factors are responsible for a major shift in cropping pattern in favour of wheat and rice in the states of Punjab and Haryana.

A number of policy steps must be taken to encourage farmers to switch from rice, which is a water and fertilizer-intensive crop in the region, to crops that demand less water. This can be achieved through price policy, research and development efforts, and establishment of agroprocessing industries so as to make sustainable alternatives more attractive to the individual farmers. Without supplementary organic manure, intensive agriculture leads to depletion of soil fertility. Ludhiana district in the green revolution State of Punjab, which records the highest yields of many crops, now also records the highest deficiencies of plant micronutrients. Extensive use of organic manure is the only way to overcome the deficiency. In Punjab, above 5 million tonnes of rice straw is being burnt every year during October to December. If crop residues were ploughed back into the soil, the rate of micronutrient depletion would be substantially reduced (CSE, 1982).

Since 1965, when water from the Bhakra canal was brought to the farm, the rise of the water table has also been a serious phenomenon. Since 1985, the rate of rise in the water table has been above 1 m annually. Patches of salinity have started appearing at the farm level. The situation is worse in higher rainfall areas where waterlogging follows shortly after the rains. Apart from affecting agricultural crops, a high water table causes floods even during slight rains because of the reduced moisture storage capacity of the soil. In Hissar, the bearing strength of the soil has declined to less than 50 % in 50 years (Chaudhri et al., 1991).

Diversification of Agriculture

A diversification of agriculture to increase the area under oilseeds and pulses should be encouraged. Sunflower is becoming a prominent crop among the oilseeds. Its water requirement is quite high. Although the sugarcane area has been substantially increased, it has not reduced pressure on ground water. The ground water position has been distributed by a tremendous increase in food production, especially wheat and rice (119.2 lakh tonnes in 1980-81 to 192.14 lakh tonnes in 1992-93).

The ravinous and undulating areas of Khandi tract can also be developed for horticulture, which will reduce spending on reclamation. The development of land first for agriculture and then its conversion for horticulture is not the appropriate method. Horticulture requires less water than an intensive cropping system.

More area is brought under cotton because its returns per hectare can compete with those from paddy. Crop rotation, which is a fertilizing process, should be promoted in a holistic manner. About 7 to 8% area should be cultivated under fruit trees and marketing facilities provided.

Potential for Diversification of Agriculture

The economics of Jammu & Kashmir and Himachal Pradesh have large forestry and horticulture sub-sectors. Forest area and forestry development area in both these states is substantial. The growth of different types of forests during the last two decades has been uneven, The area under forests in Punjab and Haryana is less than 5% but is slowly growing. There is not much scope for growth of block forests in these states. Most of the growth has been in strip forests on the banks of canals.

Despite major data problems for a temporal analysis of forest cover in the study area, we found that as per official records, 33% geographical area of Himachal Pradesh, 9.9% of Jammu & Kashmir, 5.6% of Punjab, and 3.8% of Haryana were under forest cover in 1986-87. On per capita basis the lowest forest cover is in Haryana and the highest in Himachal Pradesh. In absolute terms total tree cover is 20,880 sq. km in Jammu & Kashmir, 12882 sq. km in Himachal Pradesh, 776 sq. km in Punjab, and 644 sq. km in Haryana. The regeneration of forest for Himachal Pradesh and Jammu & Kashmir has been observed and needs to be monitored more carefully. A study of various forest types in combination with horticultural, pastoral, and other systems suggests that there is a wide variation in expected returns per year per hectare, which seem to be more attractive than those from crop husbandry provided marketing is taken care of.

Establishment of agroforest processing is required on a regional basis rather than on a state basis. The problem of marketing forest products, particularly wood in the absence of such industries within the region discourages individual producers from undertaking this activity.

Integration of Horticulture with Agriculture

Area under horticulture in all the four states has been growing rapidly since 1970-71 with fastest growth in Himachal Pradesh. The economics of Himachal Pradesh and Jammu & Kashmir have a significant horticulture sub-sector that is growing and emerging as a major component of the agricultural and agroprocessing facilities are some of the important problems of this sector.

Himachal Pradesh and Jammu & Kashmir are considered the fruit baskets of the region because of favourable climate and topography. In Punjab and Haryana, area under horticulture is small (less than 1%) but increasing. Some illustrative measures of rates of returns from horticulture suggest returns from ranging from 30 to 40 %. However, the experience of marketing, particularly of apple, suggests that expanding wood demand for packing of fruits is creating serious stress on the forests, especially silver fit and spruce. This has already been noted by the Government of Himachal Pradesh and Jammu & Kashmir. Subsidized cardboard boxes are being experimented with.

In view of the climate and the rugged terrain, fruit production is the only highly profitable enterprise where crop growing is not of much utility. Moreover, horticulture enhances the cohesiveness of the soil, preventing soil erosion.

With increase in demand for fruits, the National Commission on Agriculture has indicated that production must increase. Farmers ought, therefore, to be induced to grow more fruit trees.

Induction of farmers is possible, once a complete understanding of soil economics is arrived at.

The following possibilities are favourable to horticultural activities in the zone:

i. Agroclimatic and topographic conditions favour horticulture as an excellent source of income per unit of land area.
ii. Horticulture helps in using the land more efficiently than crops and conserving the soil, which is highly susceptible to erosion in case of cultivation
iii. Horticulture permits the maximum use of natural resources by adopting the negative propagation.

The actual impact of horticulture on environment is increased by the need for packing cases. The use of wood for packing fruits has greatly increased the burden on the forest wealth, leading to extensive deforestation (Singh, 1992).

The standard boxes for packing apple can contain 9 to 18 kg. However, 1 t of the fruit is supposed to be contained in 55 standard boxes. Apart from the wood required to manufacture the boxes, 25% is further wasted on manufacture of logs and billets, 10% on sawdust, 15% on cut off rejection. Thus, one-third of the standing volume is wasted. About 65 packing cases of standard size are obtained from 1 cu m of the silver fir and spruce forest. The trend indicates that annually 10.8 km2 of forest is lost while 6 km2 is planted, i.e., about 3000 trees are lost. While the nursery stock takes about 5 years to be raised, a tree must grow about 100 to 120 years before it can exploited. The result is deforestation. Deforestation in turn leads to land degradation and soil erosion. To curb the problem and have an economically feasible and environmentally sizes of packing cases, use other materials for packing, and use wood in other forms.

The Himalaya is now under tremendous transformation that is accelerated with enormous speed. Most of the original lush green natural vegetation is presently replaced by shrubs, savannas, grass accompanied by gullies, ravines, and eroded and scraped landscape. The major use of forests presently is to meet the demand for industrial wood, which is needed in a great quantity, a large part of which is used for packing horticultural products.

Native plant cover normally provides good erosion control, hence sustenance of natural resource base for economic growth and development compatible with environment. Problems arise, though, when an area is deforested and converted into cropland, increasing soil erosion. The resulting soil loss reduces soil productivity and modifies the environment.

Agriculture and Forestry : Coexistence and Complementarity

Agriculture and forestry should be developed in an integrated way in the form of farm forestry and agroforestry under which crop productivity and fertility of soil and environment improve. The two sectors are ecologically and economically inseparable. A study of forest and agriculture indicates major difference (Table 1). However, the ecosystem approach and the crop management approach are complementary, yielding more productive agroforestry systems derived by farmers and rural people. It is desirable to grow two or more species together, a combination of species can be complementary. This is the basis of silviculture systems where crops are grown with commercial species for intercropping potential on rotation basis.

Table-1 :

Comparison of characteristics of forestry and agriculture

Forest characteristics	Agriculture Characteristics
Perennial woody plants Focus on vegetation growth Thousands of species Mixed culture frequent Multiple products and values Extensive low-cost cultivation Positive wildlife values Negative domestic animal values	Annual or oriental plants Focus on reproductive growth Tens or hundreds of species Monoculture frequent Single or few production goals Intensive high-cost cultivation Negative wild life values Positive domestic animal values

Source : Gordon and Bentley, 1990

Agroforestry Systems

Various traditional and modern agroforestry techniques are being used by farmers in different geosystems. The main systems are

- agri-silviculture (Taungya system)
- farm-and-grove system
- tree planting among agricultural crops
- silvipastural combined tree, shrub, and animal production
- home garden systems (agri-silvipasture), and
- alley cropping (wood, green foliage, or green manure for food crops).

Agroforestry : Issues and Opportunities

Around the settlements, a sizeable rural population, particularly the small and marginal farmers and landless labourers, depends on common property resources for its sustenance and other day-to-day social amenities. Those resources generally consist of village or common lands that can be brought under suitable forest species and use to raise seedlings for plantations. Such land should be allocated to the landless population and small or marginal farmers for forestry or agroforestry.

Conservation forestry is emerging as an important sustainable method for balanced production from the natural areas. This takes optimum production of fuelwood and timber from the land and puts in bulk soil humus and fertility.

The cultivation of wastelands, particularly salt-effected soils, requires hardy crop. On the basis of experiment with salt tolerance, the fruit crops have been classified as follows:

i. High tolerance: date palm, ber, tamarind, lasoda.
ii. Medium tolerance: anola, phalsa, pomegranate, karonda, fig, ananas, jamun, cherry, spota.
iii. Low tolerance: guava, mango, grape, bael.
iv. Susceptible: banana, papaya, pineapple, jackfruit, temperate fruits.

In wastelands, the plant species grown should have salt tolerance, a deep root system. Some degree of drought tolerance, ameliorative effect on soil properties and relatively fast growth.

Agroforestry may be evolved along with compatible livestock management both of land and water and integrated land and water development planned for various biomass production, regeneration of land resource base, and increase in employment and income. The

development of non-forest areas for their sustainable use would call for regenerating or recreating an integrated, interdependent land management system. This would require people's initiatives and continuous participation of people through non-government organizations and voluntary agencies. More inputs from science and technology will be required in order to derive the maximum benefit.

Integrated and Sustainable Land and Forest Development Initiatives : Suggested Measures

i. Development of land information systems and soil mapping on scale of 1:15,000 and 1:50,000.
ii. Preparation of human and livestock carrying capacity based on geoecological principles.
iii. Land capability and irrigability classification.
iv. Prioritization of critical land sensitivity and regions.
v. Understanding land use and forestry response.
vi. Integrated strategy for surface water, ground water, and rainwater through water harvesting pond.
vii. Diversification of agriculture through agroforestry, horticulture, oilseeds (sunflower), sugarcane, fruit, and vegetables around urban areas.
viii. Natural Principles of agriculture through crop combination and integrated fertility management.
ix. Development of four-tier forestry systems i.e. block forest along rivers, strip forest along roads, railway and common property, stray plantation along bunds, wells and farmhouses, agroforestry on croplands.
x. Use of people's indigenous knowledge in management strategy.

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8 LAND USE PLANNING IN CONTEXT OF AGRO-CLIMATIC SOB-REGION

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Introduction

Land is a resource that is finite in supply and in a populous country like India it is a major factor limiting the agricultural growth. The total land available for cultivation or the "arable land" during 1993-94 was 166.m.ha. This witnessed a steady increase over the last forty years at 0.31% per annum. The net sown area (excluding fallow land) has also risen at 0.44% per annum, and this has been on account of reclamation of waste and fallow lands. Cultivable wastelands, pasture and land under tree crops possess the potential to be reallocated to agricultural usage. This additional land available for cultivation during 1993-94 comprised about 30 m.ha. and has steadily decelerated since 1950/57 at 1.3% per annum. Thus these lands capable of production have been taken up for agricultural activities through reclamation and intensive cultivation going side by side. The tropical, sub-tropical and temperate climate prevalent in different parts of India enables cultivation throughout the year and offer tremendous opportunities in this relation. While substantial progress has been achieved in converting cultivable wastelands, fallows etc. into arable land, the issue at the forefront of land for agricultural purposes is to better utilise the available land, to support adequately nearly 16% of the world's population residing in India.

The land resources per capita of agricultural population available in India is 0.8 ha, which has recorded a decline at 2.3% /annum during the last decade. With the total density of population rising fast at 2.5%/annum, and no major increase being witnessed in the total availability of cultivable land, it becomes imperative that level of efficiency in landuse between 1984-1994, sown area has gained in the States of MP, Orissa, UP, WB falling in the east, in Karnataka and Kerala in the South and Rajasthan in the west, albeit very marginally. These are the States that have extended agriculture by putting cultivable wastelands, pasture etc. to cropping. The constantly rising population and pressure of agricultural workers into the existing arable land, offsets any gains that might have been achieved by intensive agriculture. (Refer Table 2). The constantly rising demographic pressure on land is a serious cause for concern. The situation in rural India is awful, as of the total of more than a million land holdings nearly 75% are of less than 2 ha. The average size of land holding in the country has declined from 2.28 ha to 1.57ha (1991) due to population pressure and lack of non-agricultural employment opportunities (Alagh 1996).

Technology breakthrough including development of irrigation is essential for accelerating the pace of agricultural growth. During the last decade, the net irrigated area in the country has increased at 1.8% per annum, with surface irrigation being the dominant mood. Development in the irrigation capacity also is accompanied by concurrent rise in cropping intensity at 0.6%/ annum. The intensity of cropping grew from 125% in 1984 to 130.2% in 1994. States such as Karnataka, Kerala, MP, Orissa, U.P. and Bihar to some extent have taken considerable strides in developing their irrigation capacity; the NIA as percent of sown area here rising at rates varying between 2.8% to 8.7% per annum. The results of a study conducted by IFPRI/ICAR has revealed that output growth from use of irrigation was below average in agro-climatic regions with low to medium rainfall and humid climates. While this may be so there is need for intensifying land development programmes too at the same time, including reclamation of degraded lands for optimal land use planning.

The Agro-Climatic Regional Planning (ACRP) is designed to realise possibilities offered by different regions. Planning strategies for zonal and subzonal levels have been suggested under the auspices of the ACRP exercise. For wider adaptability at the State level and easy

implementation, the Zonal/ Subzonal strategies have been translated into State sub-regional plans. This was done as some difficulty was encountered in making planning decision, as some sub-zones were spread across State borders. Hence, these were redefined by splitting them and adding to respective States.

In the following discussion a review of the pattern of land resource use for State subregions has been attempted. Relationships between major land classes /uses have been arrived at together with land use typologies and related issues and strategies. The strategies suggested by Zonal Planning Teams for utilisation of different kinds of wastelands too have been highlighted.

Table-1 :
Change in Important Landuse & Irrigation Between 1984-85 and 1994-95

state	Reporting Area	NSA (%) 1994	% Change (84-94)	Forest (%) 1994	% Change (84-94)	ALAC (%) 1994	% change (84-94)	NIA (1994) (000 ha)	% change (84-94)	Surf. Irrigation (%) 1994	G.W. (%) 1994	Cropping Intensity (%)	% change (84-94)
A.P	27440	37.9	-0.08	22.8	0.7	12.45	-0.3	3971	1.2	63.4	36.6	123	0.5
Assam	0	0	0	0	0	0	0	159	-0.8	94.7	5.3	0	0
Bihar	17082	42.2	-0.7	16.9	-0.1	12.5	-1.0	3697	2.8	46.3	53.6	133	0.1
Gujarat	18877	50.8	-0.1	9.9	0.02	15.2	0.05	2714	1.6	22.3	77.7	115	0.12
Haryana	4382	80.4	-0.3	3.4	1.2	1.6	-0.6	2674	2.0	52.2	47.8	167	0.9
H.P.	3348	16.7	-0.4	31.1	1.8	40.3	0.06	105	0.9	88.5	11.5	174	0.2
Karnataka	19040	56.1	0.1	16.2	0.09	11.2	-1.4	2265	2.9	64.1	35.8	115	-2.9
Kerala	3885	57.7	0.3	27.8	0	3.9	-3.3 '	339	2.3	72.5	27.5	136	0.3
M.P.	33596	58.5	0.2	11.4	-12.2	15.1	-0.9	5553	6.4	49.7	50.2	126	0.8
Maharashtra	30752	58.5	-0.04	17.2	-0.06	11.7	-0.4	2501	1.1	45.4	54.5	118	0.5
Orissa	15617	40.4	0.02	35.3	-0.8	14.5	1.4	3181	8.8	84.7	15.2	154	0.05
Punjab	5037	83.1	-0.01	5.7	2.7	0.8	0	3787	0.5	38.7	61.3	182	0.8
Rajasthan	33600	48.2	0.6	7.2	0.9	26.5	-1.1	4758	2.2	36.0	62.8	119	0.5
Tamil Nadu	12432	44.9	-0.4	16.9	0.2	12.4	2.2	2924	1.0	54.3	45.7	121	-0.09
U.P.	29837	58.0	0.03	17.3	0.07	9.2	-0.4	16398	2.6	32.2	67.9	148	0.9
W. Bengal	1699	64.5	0.9	140	10.9	28.9	3.8	0	0	55.0	34.3	158	2.3
India	305005	46.72	-0.02	20.7	0.11	9.71	-0.43	50101	1.79	0	0	130	0.6

Note: ALAC refers to cultivable wastes = permanent pastures & other grazing lands + area under miscellaneous tree crops
Source: ARPU Datafiles

Table-2 :
Pressure on Agricultural Land & Change Between 1984-94

State	Cultivated Area ('000 ha)			Population Density (p/sq. km)			Land -Man Ratio (ha/person)		
	1984	1994	Growth	1981	1991	Growth	1984	1994	Growth
A.P	13585	13225	-0.3	195	24	2.1	0.9	0.7	-2.3
Assam	0	0	0	304	341	1.2	0	0	0
Bihar	9767	9384	-0.4	402	497	2.1	0.6	0.5	-2.8
Gujarat	10334	10396	0.06	174	210	1.9	1.6	1.3	-1.8
Haryana	3784	3725	-0.2	292	369	2.4	1.7	1.4	-2.1
H.P.	633	610	-0.4	77	92	1.8	0.6	0.5	-1.8
Karnataka	11613	11822	0.2	194	234	1.9	0.5	'1.1	-1.8
Kerala	2226	2289	0.3	655	747	1.3	1.1	0.7	-0.8
M.P.	20105	20438	0.2	118	149	2.4	1.03	1.1	-1.9
Maharashtra	18926	18946	0.01	204	256	2.3	0.9	1.03	-2.0
Orissa	6542	6470	-0.1	169	202	1.8	1.3	0.9	-1.6
Punjab	4238	4258	0.05	333	401	1.9	1.9	1.3	-1.6
Rajasthan	17719	17956	0.1	100	128	2.5	0.5	1.9	-2.7
Tamil Nadu	7344	6520	-1.2	372	428	1.4	0.6	0.5	-2.7
U.P.	18386	18438	0.03	377	472	2.3	0.8	0.6	-1.9
W. Bengal	5579	5673	0.2	615	766	2.2	0.7	0.5	-2.4
India	156437	156419	0	208	267	2.5	1.1	0.8	-2.3

Notes: 1) Cultivated Area includes Fallows
2) Land-Man Ratio depicts the ratio of cultivated area and total agricultural workers
Source: APRU Datafiles

Cultivated Area and Pressure of Population

An exercise was undertaken to cross tabulate the State sub-regions on the basis of their growth performance in terms of cultivated area and population density (Table -3). Land-man ratio is a significant indicator of assessing how much pressure is being exerted on agricultural land. Sustainability of agriculture would be undermined if the pressure is too great. More than often due to continuously increasing demand for food crops cultivation is being extended to marginal areas. The cost of bringing such areas under productive uses is high and is also accompanied by limited returns as well as further degradation of land.

Sub-regions that are witnessing matching growth in population as also cultivable area such as Tamil Nadu (4) (Delta region) and Gujarat (1) (Southern Hills region) are the ones where extensive agriculture is possible as for now, on account of large fallows which are being diverted to cultivated area is noticeable in sub-regions. Pressure on agricultural land is substantial in these areas. A low increase in population coupled with medium acceleration in cultivable areas has been noticed in majority of the sub-regions falling in the states of Gujarat, Karnataka, Maharashtra, M.P., Punjab, Rajasthan and UP. ACRP strategies for land management and reclamation need to be adopted here for maintaining sustainability of land and agriculture.

Table-3 :
Distribution of State Sub-regions According to Growth in Cultivated Area and Population Density

Cultivated Area Growth (%/annuum)	High (>1)		KE(3) TN(7) WB(6)	GU(1)	TN(4)
	Medium (0- 1)		AP(1,4) GU(3,6,7) HA(3) KA(1 ,2,3,4) KE(1) MA(1,4,6) MP(2,3,4, 5,6,7,8,9,1 0,12) OR(1,5) PU(1,2) RA(2,3,5) TN(6) UP(3,5,6,7,8) WB(1,4)	GU(2)	AP(5) HA(1) MP(11)
	Low (-1- 0)	KE(2)	AP(2) BI(1, 3,4,5) GU(4,5) HA(2) HP(1) MA(2,3,4) MP(1) OR(2,3,4) PU(3) RA(4) TN(1,2) UP(1,2,4) WB(2,3,5)	AP(6)	
	Very Low (<- 1)	HP(2) TN(3)	AP(3) TN(5)	RA(1)	BI(2)
		Very Low (<1)	Low (1- 2)	Medium (2- 3)	High (>3)

Population Density Growth (5 / annum)

Table-4 :
Distribution of State Sub-regions According to Level of Irrigation Development and Cropping Intensity

	Very High (>75%)			AP(2) BI(1,2) KE(2) OR(1,3) RA(4) UP(2,3,4,5,6,7) WB(1,3)	HA(1,2,3) HP(1) OR(4,5) PU(1,2,3) UP(1) WB(2,5)
	High (50-75%)				
Irrigation Development (% NIA/NSA)	Medium (25-50%)		AP(1) BI(3) GU(4) KE(1,3) MA(4) MP(1,4,5,6, 8,9,11,12) OR(2) RA(1,2,3) TN(1, 3,4,6) WB(4)		
	Low (<25%)	AP(3,4,5,6) BI(4,5) GU(1,2,3,5,6,7) HP(2) KA(1, 2,3,4) MA(1, 2,3,5,6) MP(2,3,7,10) RA(5) TN(2,5,7) UP(8) WB(6)			
		Low (<120%)	Medium (120- 140%)	High (140-160%)	Very High (>160%)

Cropping Intensity (%)

Irrigation Development and Growth in Cropped Area

Irrigation development has been noticeable in states of Bihar (@ 2.8%/annum, between 1984 and 1994), Karnataka (@ 3% / annum), Madhya Pradesh (@ 6.4% /annum) and Orissa (@ 8.7% /annum). States of Bihar, Karnataka, MP and Orissa had a very narrow base in terms of net irrigated area and growth has led to gains in intensity of cropping as well. In Haryana and Punjab irrigation development has plateaued, increase in gross cropped area and cropping intensities are thus not fast paced. Tamil Nadu has recorded a decline in the intensity of cropping, despite 1.02% per annum rise in its irrigation capacity.

For the agro-climatic sub-regions the relationship between level of irrigation development and cropping intensity was observed (Table 4). The distribution of subregions brings out the fact clearly that two parameters are related to each other. Low cropping intensity is the result of poor irrigation development and this situation is in AP, Gujarat, Karnataka, Maharashtra, MP and Tamilnadu. These states have large area under rainfed agriculture. In order to bring about growth in agriculture it is essential that investments for irrigation are stepped up. Subregion of AP (5) (South Telangana) is characterized by a heavy pressure on land that is

poorly irrigated and is by and large single cropped. All sub-regions of Haryana (1,2,3), Punjab (1,2,3) and WB (2,5) (Alluvial and Terai areas) predictably have high cropping intensity largely due to intensive irrigation. In the class of medium irrigation's well as cropping intensive fall a large number of regions, belonging to States of Kerala, MP, Rajasthan & Tamil Nadu. Irrigation development and water harvesting technologies here are needed to bring in land under productive usage.

Variations in Land Use Over State Subregions

The relationship between NSA (Net Sown Area), LAC (Land Available for Cultivation) and forests have been studied with a view to ascertaining possibility of adding to NSA in the long run. The association between pairs of landuses are studied by cross tabulation. NSA and forests and NSA and LAC are specified for analysing the association among subregions. Land available for cultivation comprises of wastelands which can be reappropriated for productive uses, excluding the fallows. Pastures and grazing lands, culturable wastes and land under miscellaneous tree crops constitute an additional land available for cultivation. Areas with high ALAC possess potential for future developments, as NSA can be extended on to these land uses productively. (Tables 5 and 6).

Table-5 :

Distribution of Sub-regions According to Net Sown Area and Forest Area

Very High (>70%)	HA(2,3) KA(1) MA(4) PU(2,3) RA(1) UP(2,3,6,7) WB(1)	HA(1)			
High(55-70%)	BI(1,2) GU(4,6) MP(6,10,11,12) UP(5,8) WB(2)	GU(3) KE(1) MA(2,3,5) MP(1,7,8,9) OR(4) RA(3) WB(4,5)	PU(1)		
Medium (40-55%)	KA(2) MP(4,5) RA(5)	AP(2) BI(3) GU(2,7) KA(3) MP(2) RA(4) TN(2,3,4)	AP(1,4) TN(1,6)	GU(1) KE(2,3) OR(1) WB(3,6)	
Low (25-40%)	TN(5)	AP(5) MA(6) RA(2)		AP(6) KA(4) MP(3) OR(2,3) UP(4)	MA(1) OR(5) TN(7)
Very Low (<25%)	GU(5)	AP(3)	BI(4,5) HP(2)	HP(1)	UP(1)
	Very Low (<10%)	Low (10- 20%)	Medium (20-30%)	High (30-50%)	Very High (>50%)

Forest Area (%)

Table-6 :
Distribution of Sub-region According to Net Sown Area and Additional Land Available for Cultivation

Very High (>70%)	HA(1,2,3) KA(1) PU(2,3) UP(2,3,6,7)	MA(4) RA(1)	WB(1)		
High (55-70%)	BI(1,2) GU(4,6) MA(2,5) MP(8) UP(5,8)	MP(1,6,7,9, 10,11,12) OR(4) RA(3)	WB(4,5)	WB(2)	
Medium (40- 55%)	AP(2,4) GU(2) KE(3) MP(5)	GU(7) KA(2,3) OR(1) WB(6)	MP(2,4) RA(4) WB(3)	RA(5)	
Low (25-40%)	AP(5,6) TN(5) UP(4)	MA(1) MP(3) OR(3)	KA(4) MA(6) OR(2) RA(2)		MA(1) OR(5) TN(7)
Very Low (<25%)	BI(4,5)	UP(1)	AP(3)	GU(5) HP(1,2)	UP(1)
	Very Low (<5%)	Low (5-10%)	Medium (10-15%)	High (15-20%)	Very High (>20%)

Additional Land Available for Cultivation (%)

None of the subregions was in high NSA- high forest category as these two landuses have an inverse relationship. Very high NSA and low forest area is seen in 12 sub-regions, largely seen in Haryana, Karnataka, UP and Punjab. Also low forest area (10- 20%) and medium to high NSA (40-70%) occurs chiefly in regions belonging to states of Gujarat, Maharashtra, MP, Tamilnadu. Nearly 49% of the subregions have forest area less than 20%, where as 52% of the regions have NSA more than 40%. It can be observed that higher the share of NSA, smaller is the share of forests in the reporting area and vice versa.

From Table 6 it can be observed that 77% of the regions have ALAC up to 15%, while 73% of subregions have been observed to record NSA greater than 40%. The relationship for these two landuses thus also appears to be inverse. Only 16 sub-regions from MP, Rajasthan, Karnataka, AP, WB, Gujarat and HP largely have ALAC more than 15%. Sub-regions falling in the groups of very high ALAC and low NSA are of importance from the viewpoint of adding to cropped area.

As continuations to the above exercise, the agro-climatic subregions were compared with references to landuse combinations and grouped within the related types. Seven broad types of landuse distribution can be specified for analysis of common set of problems among the subregions. Typologies were delineated using the three parameters of NSA, ALAC and forests. Development strategies in agriculture depend heavily on availability of land resource (ALAC) and on the existing levels of cultivation. Forests share on inverse relation with NSA, by itself can be productive land use. Each of these categories was categorized as high, medium and low and the distribution of sub-regions can be seen in Table 7.

The issues related to development of these regions have been highlighted, as under:

Table-7 :
Typologies in Land Resource Use

Type	Subregions	Area '000 ha	%to R.A
HNSA, LLAC, LF	Plain & Arid (HA 2,3), Northern Dry region (KA 1), Central & Southern Punjab (PU 2,3) North & East Plains, North & West Plain (UP 2,3,6,7), Barind & Alluvial (WB 1,2)	35691	11.7
HNSA, M/HLAC, LF	North & North East Plains (BH 1,2) North Gujarat & North Saurashtra (GU 4,6), Central Plateau (MA 4), Gird, Jhabua, Malwa & Nimar Plateau (MP 10,11,12), North Arid (RA 1), Central Plains and Bundelkhand (UP 5,8)	44213	14.5
HNSA, M/HLAC, MF	Chhatisgadh, Vindhya Plateau, Central Narmada valley (MP 1 ,7,9), Central Vidarbha (MH5)	13726	4.5
HNSA, LLAC, MF	Middle Gujarat (GU 3), Foothills of Shivalik (HA 1), Scarcity region (MA 3), Rarh and Eastern Plateau (WB 4)	12105	3.9
LNSA, M/HLAC, M/HF	Nellore (AP 3), HP(1,2), Hills & Coastal regions(KA 4), Konkan (MH 6)	11685	3.8
LNSA, LAC, H/MF	Chhotanagpur Hills & Plateau (Bl 4,5) Eastern Vidarbha (MA 1), Western Hills(UP 1)	16785	5.5
MNSA, NLAC, MF	South Coastal & South Telangana (AP2.5), Southern Gujarat & Southern Saurashtra (GU 2,7), Southern region (KA 3), Northern Hills & Plain (MA 2), Satpura Plateau (MP 8), Coastal (OR 4), Eastern Plains(RA 3)	31368	10.3

Note:

	Low	Medium	High
NSA	<30%	30-60%	>60%
LAC	<5%	5-15%	>15%
Forests	<10%	10-20%	>20%

Source : ARPU Data Files

Type I category covers 11.7% of the reporting area of the country. It describes the landuse occurring in the Gangetic plains in UP and WB, Punjab, Haryana and parts of Karnataka. Soil are fertile here and already committed (High NSA, Low ALAC), landuse management is difficult. In addition, reallocation to alternative landuses management is limited. The region falling in this type suffer from drainage problems leading to salinity of soil and ground water. The pressure of paddy- wheat rotation (Punjab & Haryana) has caused micro nutrient deficiency and toxicity of soil. In addition intensive irrigation has resulted into water management problems and water logging in canal areas. Rivers flowing the regions often cause flooding and "USAR" lands pose a major problem.

Type II covers plains of Bihar, UP and MP, plateau areas in Maharashtra and MP, N.Gujarat and Saurashtra and Ganganagar district of Rajasthan. It accounts for 14.5% of the reporting areas of the country. Major problems of land use in these subregions centre around salinity and alkalinity of soils as well as groundwater and impeded drainage. Soil erosion is

encountered in plateau areas, together with ravinous and wastelands. USAR land too occurs in the UP sub-regions. Level of irrigation development in Gujarat, MP and Bihar areas is low, leading to low crop productivity. Poor water management is a limiting constraint for development.

Type III includes sub-regions that have medium to high availability of land for cultivation and medium level of forests. Such areas accounts for 4.5% of the country's reporting area. Land and soil degradation, impeded drainage and low irrigation development are major issues. These result in low intensity of cropping and limited land productivity as well as income and employment.

Type IV encompasses subregions that are intensively cultivated, but have low level of land available for cultivation and medium forest. Such regions cover 3.9% of the country's reporting area. Wastes and degraded lands are encountered here. Poor irrigation development coupled with need for water management and conjunctive use, has limited the output from land.

Type V characterizes the subregions in the hill regions chiefly, Western Himalayas, Western Ghats, and coastal areas of AP and Karnataka. Together the sub-regions account for 3.8% of the country's RA. The region is marked by poor management of rain water and soil erosion on slopes / undulating terrains. Flooding and drainage are major problems during monsoons. Soil is often alkaline /saline and "Kharlands" are encountered in coastal areas. Land has low productivity and this problem is compounded by heavy pressure of population. As land resources are available, with adequate investments and planning for integrated soil/ water systems, the problems of this type can be overcome.

Type VI is partly in common with Type V and covers 5.5% of the reporting area. It covers the plateau and hills in the east and hills of UP. This has high proportion of forest area and low NSA. This type is marked by degraded land and underutilised resources. Heavy runoff leads to serve soil erosion. Wastelands abound in the region and land productivity levels and quite low. Degradation of forests and cultivation of marginal areas exists on account of high pressure of population. Checking land degradation, water harvesting and management are essential for land use planning here.

Type VII with medium NSA, LAC and forests occupy nearly 10.3% the country's RA. This is widely distributed in various states of AP, Gujarat, Karnataka, Maharashtra, MP, Orissa and Rajasthan. This typology requires integrated land and water management strategy. Efficiency in landuse and its productivity possesses considerable scope for improvement. This can be achieved by adoption of eco-sustainable strategies for landuse pattern. This needs to be backed up by intensive farming practices as well as diversification to other activities allied to crop based activities.

Strategies for Development

The sub-regions suffer from, location specific problems arising from their particular resource base. Land and water management go together, hence strategies need to include complementary water management strategies too. The macro strategies are briefly discussed below and stem from the work of the Zonal Planning Teams largely.

For Type I landuse, strategies have to facilitate cropping intensity increase, crop diversification and farming system. Thus strategies may include- a) Watershed development with water management and wasteland development, b) Flood control measures and regulation of canal water. Conjunctive use of canal and ground water c) Soil correction measures for treatment and reclamation of saline soils, d) Development of horticulture, livestock activities.

Sub-regions of Type II have poor soils, heavy runoff due to slopes and undulating topography. Soil salinity and alkalinity too prevail. These problems could be corrected by the adoptions of

the strategies as-a) Integrated watershed management, b) Adoption of water harvesting methods and restrict overdraw of ground water, c) Development of tubewells d) Reclamation and conservation of soil, e) Rationalization of cropping and crop diversification, f) Introduction of dry farming methods and afforestation.

The problems encountered in sub-regions falling under Type III can be mitigated by the adoption of- a) Integrated watershed development to curb soil degradation, runoff, erosion and water scarcity, b) Water harvesting measures and development of minor irrigation, c) Land development through afforestation with optimum mix of fodder, fuel, fruits and timber trees, d) Development of suitable Kharif production technology as well as high value crops.

In Type IV the occurrence of floods and related problems, poor irrigation development and wastelands can be mitigated through the following strategies - a) Improvement in canal management and conjunctive use of canal and ground water, b) Soil conservation measures for reclaiming alkaline/saline soils, c) Integrated watershed development for better management of water resources, d) Diversification of economic activities and increase in area under HYV. e) Afforestation

Type V depicts low level of landuse, but high prospects for development, erosion in hills, impeded drainage, siltation in plains in and occurrence of "Kharlands". The strategies for development here may include -a) Watershed development, b) Soil conservation and terracing to reduce soil erosion, c) Reclamation and improvement of problem soils. d) Development of wastelands through'*' sylvi -horticulture. c) Diversification of activities towards livestock, fruits, timber and better crops. This region possesses prospects for productive and sound landuse, and thus should be given priority.

The VI has high forest acreage and there exists scope for land improvement. Planning should thus take care of - a) Improvement and management of forests, b) Water management and development of minor irrigation, c) Rational land use plan in hills according to scopes and land capability d) Horticulture development, e) Livestock development, f) Cropping systems improvement.

Type VII also possess potential for development. Degraded and depleted land resource exists due to drainage problem. Here planned efforts are required for irrigation development and land reclamation. The strategies therefore need to include: a) Land reclamation and development, b) Soil correction, c) Water management-improved drainage and conjunctive use of canal and ground water, d) Integrated farming system and adoption of eco-sustainable strategies for landuse pattern, e) Diversification of cropping towards horticulture.

The strategies suggested above for effective use of land resources have to take cognisance of the local capability and institutional support available. They need to be prioritised keeping in view demands at national level and the long-term perspective of regional planning.

Table-8 :
Distribution of Sub-regions based on Barren and Uncultivable lands and growth between 1984-1994

High (>10)	BI(1) OR(5) PU(2,3) RA(1)	Bl(1,2,3) OR(1,2,4) PU(1)	HP(2) OR(3)
Medium (0- 10)	HA(2) MA(1) UP(2)	GU(1,4) HA(1) MA(4,5) MP(7,9) TN(5)	Bl(4,5) MA(2,6) TN(4)
Low (<0)	KE(1,2,3) MP(1) TN(7) UP(6)	AP(5) GU(2,3,7) HA(3) HP(1) KA(1,4) MP(2,3,8) RA(5) TN(2,3,6) UP(3,4,5,8)	AP(1, 2,3,4,6) GU(5,6) KA(2,3) MA(3) MP(4,5,6,10,11, 12) RA(2,3,4) TN(1) UP(1,7)
	Low (<2)	Medium (2-5)	High (>5)

% to Reporting Area

Barren and Uncultivable

Cultivable wastelands include salt affected lands, gullied/ravinous lands, waterlogged/ marshy lands, undulating uplands, jhum or forest blanks and sandy areas. These areas comprised 14.7 million ha (1994) for the country as a whole, accounting for 4.5% of the geographical area. These areas can be designated as additional land available for cultivation (ALAC) are in addition to pasture /grazing lands which can be re-appropriated for productive agricultural uses. These are degraded lands which can be brought under vegetation cover with reasonable effort, though are currently under utilized and deteriorating for lack of appropriate water and soil management or on account of natural causes.

Uncultivable and barren lands comprised 19 million ha (6.2% of country's area) and are largely unproductive lands, not available for cultivation. The distribution across the states reveal that Rajasthan, Maharashtra, Gujarat, AP & MP together account for 56.5% of the total barren lands encountered in the country. The share of States ranged between 8.9% in j the case of Maharashtra to 13.9% of Rajasthan. This severely restricts land availability for agricultural expansion in these States. As far as the share in the States geographical area is concerned, Gujarat has a large percent under barren wastelands at 13 % this has though declined marginally from 13.7% at the rate of 0.3% per annum over the last decade. Rajasthan has 8.1% of its area designated as barren, here too the share is declining at annual rate of 0.62 %. Andhra Pradesh with 7.5% of area has recorded decline from 8.4% in 1994 at the rate of 1.01 % per annum, between 1984 and 1994. The share of barren lands in the remaining States in most noticeable in MP (5%), Maharashtra (6%) and Orissa (4%). In Bihar, an increase in the share is being witnessed at a rate of 5% per annum, as also in Maharashtra at 0.6% / annum. Rest of the states are under going decline in the occurrence of this land class, at rates ranging between 6.2% (Karnataka) to 5% in Kerela.

For the State subregions the distributions in terms of share of barren lands in the States area and the growth encountered there in over the last decade, the examined (Table 8). The snow-clad regions in HP and hills of Orissa having a high share in reporting area, have also undergone high growth in the landuse. The subregions largely belonging to States of Kerala, AP, MP, UP, Tamil Nadu, Maharashtra and Rajasthan have witnessed deceleration in growth. Subregions in Bihar (North Plains), Orissa (Ganjam), Punjab (Plains) and Rajasthan (Ganganagar) presently having a very low share of barren lands in 1994 have recorded high rates of increase on the other hand during the last decade. In AP except for S.Telangana subregions, Kutch & N.Saurashtra in Gujarat, hills and plateau subregions of MP and the plains and plateau subregions of Rajasthan have a high share of barren lands. However, in these subregions the area has declined annually between 1984 to 1994. While land may have been used for agriculture, possibly, urbanisation and industrial use of barren land may have led to this decline. Bihar (4,5), Maharashtra (2,6) and Tamil Nadu (4) i.e. the Chhotanagpur

region, Konkan & Western Hills in Maharashtra and delta area of Thanjavur in Tamilnadu require immediate adoption of measures to curb the spread of wastelands, through appropriate strategies.

Land Resource Planning and ACRP Strategy

The discussion in the proceeding paragraphs reiterate that regions differ in terms of resource bases and problems encountered in terms of soil and land degradation. Additionally the degrees to which land is put to productive uses also is disparate across regions. This is the result of resource endowment on one hand, on the other hand the level of irrigation development, pressure of population and physical location too define the extent of area cultivated, vis-a-vis degradation of land. Adoption of regionally differentiated strategies as per agro-climatic factors assumes importance in the context, keeping at the forefront the biogenetic and physical diversity encountered. The strategies for reclamation of wastelands have to be vastly disparate, for instance, in dry lands or in tidal swamps and coastal area, or in saline catchments of major canal systems and therein lies the importance of the ACRP approach. The schemes for land management and watershed development however range from simple to expensive, particularly in case of agro-forestry, multiple cropping etc. The policy challenge therefore lies in an adequate mix of government intervention, supported or supplemented by private markets and community organization. Agro-Climatic Regional Planning's role in suggesting mix of land/water resource strategies hence assumes considerable significance.

Balanced development and higher agricultural growth requires land development coupled with crop diversification and goals for enhancing cropping intensities. However, the possibilities offered by different regions are varied. Agro-climatic planning is designed to effectively utilise the regional potentials. Derivation of optimum cropping pattern lies at the heart of this exercise, which has carried out crop projections desirable for each subregion. Operationalising the ACRP strategies albeit need technological and institutional backup, adequate infrastructure and price support, supported by land reforms. Again it may be pertinent to note that strategies for land management assume primary importance. A crop based approach in isolation cannot deal with issues for agricultural development in different conditions. Comprehensive recommendations of the Zonal Planning Teams pertaining to alternative regimes, for watershed development, drainage/flood control, conjunctive use of surface / ground water, management of hills, forest based agriculture etc. form the backbone of the ACRP exercise. Needless to add that each of the above would have different investment and policy implication. Level of community organization is a precondition for better usage of hill slopes, sandy areas, and reclamation of saline as well as development of water harvesting structures. The recommendations of ZPTs have to inherently subsume local participation even though subsidies/ public intervention mechanism are essential for initial start up.

ACRP strategies are designed with respect to resources, the constraints and potential. The matching of strategies with regional needs has been attempted in context of the typologies described earlier. The regional priorities need to be defined for arriving at action set of regional planning. The structure and operationalisation of the strategies could possibly get altered in the interest of decentralized and participatory planning for regional development. Internalization of such strategies involves projectization, scheduled implementation and monitoring by local institutions and it is an inter-departmental and multi-agencies task. The prevailing institutional mechanisms, prevailing condition and the mode of adoption of the strategies suggested under agro-climatic planning exercise.

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9 INTEGRATED MISSION FOR SUSTAINABLE DEVELOPMENT - A SYNERGISTIC APPROACH TOWARDS MANAGEMENT OF LAND AND WATER RESOURCES

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Introduction

The term sustainable development gives scope for wide range of interpretation, but it broadly encompasses aspects of utilising sources in a judicious way such that they can endure in the longer run. The term includes, besides economic development, providing of genetic diversity, maintaining biological productivity and addressing social considerations. One can say a resource is to be used avoiding depletion and considering renewability as well as economic ramification. Human aspirations are in conflict with these aspects resulting in imbalances leading to large-scale depletion of natural resources.

Integrated Mission for Sustainable Development (IMSD) is one of the projects conceived by the Dept. of space which aims to provide practical solutions to such problems through the technology of Satellite Remote Sensing. The advantage of utilising this technology lies in the speed, absence of bias, synoptic view, repetitive coverage, accuracy etc. resulting in excellent information for decision making. The technology is also cost effective compared to conventional surveys (Table 1). Decision-makers are seized of these issues but there is not enough database for them to act upon. Remote Sensing Technology provides such data and an opportunity for planning and implementation of various decisions related to the development process. In this approach, land and water management aspects are addressed, as they are the two main aspects influencing the ecological cycle directly or indirectly, all through.

Table-1 : dost/hectare for carrying out integrated resource mapping

(Rs.)

Theme	Conventional Method	Remote Sensing Approach
Hydrogeomorphology	1)30	0.31
Landuse/land cover	1.00	0.22
Soil	2.00	1.10
Slope	0.08	0.08
Transport network	0.05	0.05
Drainage	0.05	0.05
Meteorological data	0.01	0.01
Socio-economic data	0.07	0.07
Action plan	0.54	0.54
Total	**5.10**	**2.43**

Background

During the drought of 1987 all over the country, a remote sensing approach was utilized to explore the possibility of obtaining solutions for drought mitigation. Due to the promise shown by the technology, the concept is tried in 21 drought prone districts of the country spread all over the country. The first cut results were presented by Chairman ISRO /Secretary DOS to Planning Commission. The methodology adopted was satisfactory leading to the expansion of the study to include about 153 districts under IMSD Phase-ll during the year 1992. At this stage, the scope of the work was enlarged not only to address drought but also land and water development through and integrated approach on watershed basis. While IMSD phase-ll was under Space has generated maps and plans for 92 selected DPAP blocks of the country. For this study identification of the blocks was done on the basis of having more than 20% wastelands in the study area.

Methodology

Three seasons satellite data was interpreted (1: 50,000 scale) and with the help of Survey of India toposheet of same scale to prepare thematic maps. The satellite data obtained from IRS series (IA-IC) were of excellent quality to prepare maps on 1: 50000 scale. Additionally, socio-economic and rainfall data are also gathered and depicted on 1:250,000 scale. Drainage, Watershed information is extracted from SOI toposheet with additional inputs from satellite data for upgradation.

Landuse / Landcover

These maps are prepared using two season data (Kharif & Rabi) for a crop calendar year. The main categories shown are single crop (Kharif/Rabi), Double Crops, Forests (Density and Vegetation), Different types of wastelands, degraded lands, water bodies etc.

Hydogeomorphology

These maps are prepared using Rabi/Summer data. They depict different rock types (Lithology), landforms indicating ground water prospects and potentials.

Soil

They indicate Soil series /Associations of series (sixth level of abstraction as per USDS soil classification system). Important informations on physical, chemical and morphological properties are interpreted for capability / Irrigability and Soil suitability.

Other thematic maps like Transport & settlement network, slope, drainage, watershed are prepared using toposheet updated with satellite imageries.

Watershed maps are prepared based upon the five-fold classification of AIS & LUS and further improvement. The resource regions are divided into basin, catchment, subcatchment, watershed, subwatershed, mini-watershed, micro- watershed etc. Eventually 500-1000 ha. watersheds are delineated to serve as spatial units for implementation of action plans.

Transport network, settlement location and village boundary maps depict various types of roads, location of villages with their boundaries are shown/Information of village boundaries is taken from revenue maps wherever required. Rainfall maps are based on information obtained from different meteorological observatories under IMD, State Govt. etc. Rainfall information is shown in the form of ISO HYETAL maps & bar charts indicating monthly average rainfall and number of rainy days, every month.

Slope maps are prepared using SOI toposheets with 20m contour interval. The map has a seven-category legend being followed by All India soil and Land Use Survey Organisation.

Socio economic data is collected from census handbook, district gazetteer and other sources.

Data Integration

Once the data base is created, the resource potential is evaluated by integrating so that action items can be assigned to each parcel of land. This is done by overlaying different layers leading to the development of composite land development units (CLDUs). Sets of guidelines are also developed from field traverse/experience. These guidelines are unique combinations, in the form of a table represent the benchmark situations which can be extrapolated to similar terrain conditions. Different action items for land and water management are assigned based on social and economic viability. While this process can be done in a manual way, computer based geographic information systems (CIS) are suitable to interpret vast data in a speedier & logical way. It offers facility for periodical up-gradation also. The action plan items are site specific involving crops & cropping systems (Intensive Agriculture, Agroforestry, Silvipasture etc. and locating water harvesting structures (check dams, nala, bunds, percolation tank etc.) for judicious utilisation of surface and ground water (based on water budgeting, water balance studies etc.). The study also addressed measures to conserve soil (trenching, contour bunding etc.,) & water management (sprinkler and drip irrigation) & through land management (FYM and fertilizer application). Socio economic analysis plays a key role in suggesting the development of infrastructure facilities like establishment of milk collection centres (based on spatial distribution of cattle populations and road net-work), schools (literacy levels amongst children), fertilizer and seed depot establishment (economic profile of farmers and agricultural land holdings), schemes for weaker sections (Demographic profile especially of SC/ST Population) etc. Certain suggestion are also given for crop/animal husbandry using information available from contemporary technology developed from different institutes like ICAR, DST, NIC, CGWB, AIS & LUS.NAEG etc.

Department of Space has taken number of measures for the smooth running of various steps involved in this processes to fulfil the local aspirations as well as involve the district machinery. Watershed identification is done by the District Collector / Project Director, DRDA based on overall backwardness of the study area/ watershed. At mapping level, quality Assurance and Standardization teams consisting of expert have been constituted to oversee/maintain uniformity of content and consistency in the level of information generated and presented in the maps. The suggested action plans are validated in the field and suitably modified by officials of different line departments of the districts based on their local experiences which enhances the acceptability of action items. Expert committees constituted for each state/district review action plans before implementation is taken up. Implementation of action plans is carried out by the district administration with the help of local population and NGO's through various centrally sponsored schemes like DPAP, DDP, IWPD, IRDP, MWS, EAS, JRY,NWDPRA etc.

Bottlenecks

IMSD approach is not institutionalised yet. Hence it is not a mandate for any planning or development process. Hence its utility is seeking wider acceptance. Secondly, the officials who are to use the maps are not trained for the same. Orientation courses are being held by DOS/State Remote Sensing Centres to bridge the gap in the area of map reading/orientation. There is practical problem of physically identifying the parcel of land going under a particular action item for treatment in the field. To overcome this, action plan maps are being over laid on satellite data/ cadastral maps bringing the reference level to 1:12,500 from 1:50,000 thereby making it easier to orient one self with ground situations for effective implementation. All these measures are contributing to the increased use of satellite technology in development. For the success of this programme and effective implementation, meetings are being held periodically with the local population to seek their views and suggestions. Monitoring for the evaluation of success of this approach is being done through adequate data to support. Remote Sensing provides a quick and efficient tool to monitor change/improvement in vegetation cover, water levels in tanks etc. These change detection studied can provide information for periodical review of various implementation works.

Results of Implementation - Case Studies

The IMSD programme being carried out in India presently covers 175 districts (almost a third of the country), representing diverse terrain, agro-climatic zones, and social practices. With the involvement of user agencies and departments, six selected watersheds in Bhiwani, Ahemadnagar, Kalahandi, Anantpur, Jhabua and Dharmapuri districts covering diverse situations, have been taken up for actual implementation of the IMSD strategy to demonstrate convincingly the efficacy of the methodology. Detailed action plans for the above identified watershed in these districts have been prepared, which includes demarcation of sites for the following:

- construction of rain water harvesting structures
- implementation of soil conservation measures
- identification of areas suitable for afforestation, agro-forestry, agro-horticulture and fuel wood as well as fodder development
- evolution of appropriate methods for sand-dune stabilisation
- identification of appropriate locale-specific agricultural practices for maximising food grain output and protection of natural environment

The action plans have been critically evaluated by expert committees for taking up action plan implementation works. The result obtained clearly demonstrate the potential of IMSD strategy for benefiting the people at the grass roots level and improving food and economic security of these people at the grassroots level.

A Case Study

This paper presents the methodology and results obtained in the applications of remote sensing and GIS for suggesting landuse alternatives for sustainable land management in a selected watershed in Ahmednagar district, Maharashtra.

Study Area

The study area is referred to as GV-130 watershed as per watershed codification. Its area is about 12100 hectares and lies between north latitudes 19°4'32" and 19°15'15" and east longitudes 75°05' and 75°15'. Physiographically the area consists of hilly and undulating terrain, foothill zones and plains. It receives rainfall during the southwest monsoon and the normal rainfall varies from 500mm to 700mm. It is generally drought prone and agriculture is dependent on the monsoons leading to uncertain and lower crop intensity.

Natural Resource Setting

Geomorphology

The major geomorphic units identified were dissected plateaus with varying severity of dissection and valley fills along stream courses. The plateau is of basaltic origin.

Slope

Seven categories of slopes have been identified. The general slope direction of the watershed is southeast to northwest.

Groundwater

The data obtained on various groundwater related parameters . (physiography, drainage, structure, geomorphology etc. analysed in conjunction with ground based data) indicated that plateaus with slight dissection and valley fill areas have good ground water potential.

Landuse/Landcover

The spatial distribution of landuse/landcover of the watershed as interpreted from satellite imagery was presented in table 1. As seen from the table about 53 percent of the total area in the watershed is under cultivation. Wasteland constitutes about 36 percent of the geographic area of watershed. Forests occupy about 9 percent of the area.

Soils

In all 11 soil categories (series and association) were identified in the watershed.

Drainage

The drainage pattern of the project area is dendritic to sub parallel. The thematic information was organised in ARC/Info GIS and intregrated to generate the CLDU map. A set of decision rules already framed (based on ground observations, discussion held with experts in relevant fields and available literature) were applied on the integrated coverage, using the logical expressions in GIS. These rules consider the available resources and suggest the best alternative landuse possible for sustainable resource utilisation.

Results

The Action Plan map showing the spatial distribution of different agro-based alternate landuse suggestions viz; double crop, horticulture, agrohorticulture, silivipasture, afforestation and agroforestry were derived from the CLDU map. The spatial statistics for existing land cover and suggested landuse are given in Table 2&3.

Table-2 :
Area statistics for land use/ land cover map

Landuse/land cover	**Area (sq. km.)**
Kharif	8.92
Rabi	12.64
Double Crop (Kharif+Rabi)	43.17
Fallow	0.763
Degraded/under utilised forest	5.42
Scrub forest	2.83
Forest Plantation	3.02
Land with/without scrub	42.97
Water bodies	1.321
Total	**121.043**

Table-3 :
Area statistics for Action plan

Action item	Area(sq. Km.)
Afforestation	5.84
Fuel and Fodder Plantation	20.274
Silvipasture	3.23
Horticulture	12.585
Agro-foresty	0.801
Agro-horticulture	16.714
Double crop	12.565
Area not recommended for any activity	49.039
Total	**121.043**

Reference

National Remote Sensing Agency (1995) IMSD Technical Guidelines, Dept. of Space, Govt. of India, Balanagar, Hyderabad.

10 REMOTE SENSING AND GIS FOR LAND USE PLANNING

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Nationwide Land Use/Land Cover Mapping Using Indian Remote Sensing Satellite Data-a Digital Mapping Approach

Agricultural land use is an expression of the interplay between the bioclimatic and geopedologic factors that are greatly modified and influenced by the specific needs and socio-economic constraints of the land owners. It is upon these demands, that are more often than not inconsistent with the potentials of land-water dynamics, that the harmful consequences arises as implicit in land degradation, drop in productivity, recurrent floods and droughts.

Planning, policy formulations and decision making, to be realistic, effective and sustained, require qualitative and quantitative information primarily on existing land uses. Even where drastic changes in the land uses are neither feasible nor warranted, such information is necessary for developing suitable packages consistent with bioclimatic and geopedologic environment for optimizing production. Such information particularly relating to the cropped area, current fallows, plantations, forest, grasslands, wastelands, etc is required for the two cropping seasons of India, namely Kharif (June-Oct.) and Rabi (Dec.-March) both singly and in aggregation.

Traditional data gathering methods ranging from sample surveys to systematic land use surveys are generally too expensive and time consuming to perform more than once. Therefore, alive to the proven capability of Remote Sensing, a decision was reached at a national level for employing this for district wise use mapping. / viable methodology has therefore been developed by the Regional Remote Sensing Service Centre (RRSSC), Nagpijr. Six need based software programs, namely MERGEIRS, COMPOSITE, GROW, REFERENTIAL REFINEMENT, AGGREGATE and MPPRINT were also developed. For digital processing with VIPS-32 image processing package implemented on VAX 11/780 computer at seven work centres i.e. five RRSSC's and two states centre of U.P. and Tamilnadu. The methodology comprises the following. IRS-1A LISS -I data of Rabi and Kharif seasons covering the district are chosen with reference to crop calendar of the area and the quality checked to insure against serious data quality problems such as cloud cover, stripping, line dropouts, etc. Kharif season data of the same date but different rows are then merged as single scene and split to economize on disk space and computation time. The individual scenes are rectified with references to survey of India topographical maps in the scale of 1:250,000 by generating appropriate transformation model. The areas under notified forest as shown on Survey of India topographical maps are digitised and extracted. The georeferenced images with frost mask are then used for supervised classification using maximum likelihood algorithm. Training sets for supervised classification are based on the ground truth collected during field reconnaissance as well as using information from other sources. For field reconnaissance, the observation blocks of 0/25 ha are chosen on Survey of India topographical maps before proceeding for fieldwork such that they are well spread and represent all the different land use classes. About 60 per cent of the ground truth collected are used for training sets and 40 per cent for validating classification accuracy. Separately NDVI output is generated for the entire district to extract Water bodies as well as forest classes and composited classified scenes using COMPOSITE programme. NDVI values are correlated with forest classes and water bodies using specific look-up-tables (LUT) while compositing. Individual composited classified scenes are then mosaiced using GROW. The

district boundary as well as cultural features are then overlayed. The statistics of land use classification data for the entire district and map outputs are generated.

Similar classification procedure is followed for Rabi season data and results are obtained in the form of statistics and Dunn output. Forest and water bodies are not separately extracted for Rabi season. This information derived from Kharif season data are composited on Rabi season classified image.

A unique feature of the methodology is that it allows human logic and intuition through a specifically developed programme for correcting and modifying discrepant classification arising out of spectral similarity of two or more classes in a non-forest stratum. In referential refinement, classification of a pixel in one cropping season is evaluated and, if necessary, corrected, the references to its classification in the other season. For example, a pixel classified as a crop in Kharif and established as a scrubland in Rabi season calls for revision of Kharif season classification on the simple logic that scrubland remains scrubland throughout the year, unless it is reclaimed and brought under cultivation. But the Rabi use subsequent to Kharif season being scrub, the Kharif land use of the pixel is undoubtedly an erroneous identity. Usually, luxuriant vegetative growth of weeds and scrubs under good soil moisture conditions during kharif season take the spectral signatures of crop. Such a pixel needs to be realistically refined as scrub and carried through in the output. Likewise, a pixel qualifying for crop in kharif and plantation using .similar logic, yet another example could be plantation in kharif and fallow in Rabi necessitating refinement of Kharif pixel as a crop. A host of such other situations have been visualised to draw a truth table and develop a software.

Finally, using AGGREGATION program, the changes in Kharif and Rabi seasons involving commissions and ommissions of the areas under different classes are effected. The aggregated classified imagery portrays cropped areas under both Kharif and Rabi seasons as well as residual fallows of both the seasons. Areas under fallow in Kharif season and cropped in Rabi season are displayed in the imagery as cropped area. Similar aggregation are evidenced in other classes also. The aggregated land use classified data are subjected to photo-write, printer plotter output and statistics generation. The iterative and interactive nature of the stratified approach is amply demonstrated for land use/land cover mapping of 168 districts in operational mode.

Land Use / Land Cover Change Detection

One of the major components of monitoring the impact of irrigation projects is the change in landuse/ cover pattern over a period of time. Keeping in view the large area extent of the catchment and command and command areas, the conventional techniques proved to be costly, time consuming and less reliable. The remote sensing data with its unique characteristics of large synoptic view and repetitive coverage makes it more productive to use this technology for this type of studies. In addition, this technique provides cost effective, highly reliable and timely results which further enhances its capability to use in operation of irrigation projects.

To study the impact of irrigation projects one should analyse the land use pattern before and after the commissioning of the irrigation projects. The two seasons Indian Remote Sensing satellite (IRS) data pertaining to the study area are classified using supervised classification. The classified images are refined together based on the rule based approach. The aggregated outputs are generated for pre and post construction periods. The change detection analysis is carried out and statistics are generated for pre and post construction periods. The change detection analysis is carried out and the statistics are generated.

The analysis has been carried out for the changes in land use pattern of the agricultural land existing prior to the commissioning of the project and the new areas that are brought under agriculture. The change in overall cropping intensities in both catchment and command areas are analysed.

The above methodology was used operationally for Majalgaon, Dhom and Kanher irrigation projects in Maharashtra.

Establishment of Agro-Climatic Planning and Information Bank in Karnataka

Recognizing that the requirements of planning and decision making are different for various agro-climatic regions and realising the need for consolidating the large amount of statistical and spatial information already generated by various organizations and to create a single-window access to this knowledge base, the Planning Commission decided to establish a Pilot Centre for Agro Climatic Planning and Information Bank APIS at the NNRMS- Regional Remote Sensing Service Centre (RRSSC) Bangalore. This Pilot Centre will be a model for countrywide replication of the concept of APIB. The main objectives of APIB are to support and strengthen operational services for decision making in support of sustainable development of agricultural and allied sectors. The main tasks of APIB are: i) Compilation of data and generation of value added information, ii) Computerized storage and retrieval of information and planning tools, iii) Dissemination of information and planning services in formats appropriate to various users, iv) Sponsoring of special studies and data generation programs, v) Providing service for the State and National level planning exercises and vi) Arranging Training and Workshops to create awareness among the users of the bank.

The APIB would also strengthen and reinforce area-based planning exercise initiated under the Agro-Climatic Regional Planning Project and provide value added information to the decision makers at all levels (farmers, extension functionaries, cooperative societies, research and financial institutions' planners et.al) who are involved in agricultural activities directly or indirectly including those interested in development of agro-industries and agro-exports. The information base already generated by various organizations (Department of space, NIC.NBSS & LUP, IMD and others) as district / state level on natural resources demographic trends, facilities available for credit processing and marketing and modernized computer facility geared to analysis of trends in prices, technology and trade form the core components of APIB. The bank will churn the data/information and generate inputs to planning. It would help in strengthening the hands of the rural entrepreneurs in evolving necessary corporate strategy so that Indian farm products could become more competitive in the global markets. The APIB would help in the evaluation of various risks to agriculture and recommend alternative strategies to improve the productivity of agricultural and allied sectors.

A package of developmental alternatives for conservation of soil and water and changes required in land use planning have been suggested at the taluka level- one each from the districts of Bijapur, Tumkur, Dharwad, Belgaum, Bellary and Chickmangalur. The Chief Executive Officer (CEOs) in charge of Zilla Panchayats have been supplied with these packages for implementation at the micro level. Non -Governmental Organisations in the district, Dryland Development Board, the line departments in the district are actively involved in translating the action plan into developmental effort at the micro level. The implementation is in progress in five watersheds in Bijapur district.

As part of their planned programme under "Potential -Linked Credit Plans", the NABARD has approached APIB for supply of information on land capability, slope categories, problem soils, irrigated and unirrigated cropland and fallow lands. This information was supplied for two watersheds, viz. Aaheri in Bijapur taluk, Savalasang in Indi taluk (booth in Bijapur district).

Integrated Mission for Sustainable Development (IMSD)

In several parts of the country, misuse and mismanagement of land and water resources have set in degradation processes through loss of soil productivity and environmental qualities. These are manifest in accelerated soil erosion, silting up to storage reservoirs, rising steam beds, frequent floods, waterlogging, salinization and diversification. Associated with these problems competing demands on land resources are gradually leading to land scarcity. Every year, large areas of prime agricultural lands are lost to urbanization and developmental

activities. Forests are being intruded for agriculture and subjected relentlessly to grazing pressures.

In order to optimise and sustain outputs from primary systems to meet the growing demands of rising population, developmental planning with integrated approach has been accepted world over. Primarily this approach helps optimal management and better utilization of natural resources towards improving living condition of the people.

Integrated development is a comprehensive action programme aimed at optimal realization of resources potential in the light of the physical, economical, social and other development goals. Such an endeavour entails harmonious development of land, water, vegetation and other resources of an area in a sustainable manner, so that the changes proposed to meet the needs of development are brought about without diminishing the potential for their future use as well as those of the future generations.

The study of Integrated district developmental planning, aimed at demonstrating the role of remote sensing in conjunction with Geographic Information System has been taken up collectively to accomplish the following broad objectives.

- To develop viable methodology for integrating spatial and nonspatial data bases using CIS in district development planning.
- To write and implement appropriate software programmes to assist in complex planning decisions as a part of the methodology.
- To evolve a pragmatic developmental plan, consistent with resource potential and problems, basic needs of the people, Governmental priorities and national policies for overall development of the district.
- To demonstrate the development plan to the state authorities and other concerned agencies for acceptability.
- To transfer the methodology to the user agencies for applications in other areas.

A practical approach in planning, directed at preservation, conservation, development, management and exploitation of the natural resources of the district for benefit of the people has to operate within the framework of physical and biological attributes, socio-economic conditions and institutional constraints.

Physical and biological attributes comprise baseline data on geomorphology, geology, soils; hydrogeology; hydrology; climate; demography; plant, animal and other biological resource. Socio-economic conditions relate to information on basic needs of the people, input-output relationships, marketing and transportation arrangements, developmental incentives and facilities, such as technologies, equipments, labour, material, energy /power etc. Institutional constraints relate to laws, regulation and ordinance; governmental policies and priorities; political acceptability; accepted customs, beliefs and attitudes of the people, and administrative support.

The separate inventories of the physical and biological attributes, socio-economic conditions and institutional constraints are integrated using GIS. This provides the physico-socio-economic profile of the district and permit suitable development models in the different sectors of economy and production. The system as a whole, would thus be operated upon to develop appropriate alternatives of conservation - production programmes commensurate with the production potential.

Data Bases

Developmental Planning in a complex process of decision making based on information about the status of resources, socio-economic conditions and institutional constraints. Reliability of the data bases, both the spatial and nonspatial, is therefore crucial to the success of the developmental planning. Equally important is the timely inflow of information to serve planning needs. Remote sensing technology which meets both the requirements of reliability and

speed is an ideal tool for generating spatial information bases. The data bases are meant to serve and efficient system of information gathering, compiling classification, transformation, storage, retrieval and synthesis/ analysis system.

Digital Cartographic database (DCDB) is prepared by digitising the district boundary and other cultural features from 1:50,000 SOI topographical maps.

Masks of district, taluks, watersheds, forests and cultural features are generated. The district and tahsil masks are used to extract data pertaining to these administrative units from the classified image and hence are useful in a real statistics generation.

Resources / Data Bases

Consistent with the district level planning requirement thematic maps are generated on 1:50,000 scale. Both the digital and visual techniques are followed interactively using IRS data. Special techniques of stratification, layered approach, composition, aggregation and refinements are adopted wherever necessary to improve the quality of mapping. The primary thematic maps generated are on Geomorphology, Geology, Hydrogeology, Soils, Land use/Land cover. Forest/Vegetation.

Derived Data Bases

Basic maps are used to produce utilitarian types of maps to serve planning decisions. They are derived, in some cases, by direct translation of single thematic and in others by combination of two or more thematic maps or chosen parameters of the different themes.

Socio-Economic and Institutional Data

Socio-economic conditions and institutional constraints greatly influence the development programmes. Voluminous information on these aspects exists in various governmental departments, which are ascertained and quantified. These are demographic, input status, facilities, sociologic, financial, policies and priorities. The complementary data like agronomic, forest related, industrial, achievements and ongoing activities were also considered for analysis.

Data Integration and Development Alternatives

The integration of the various thematic maps and attribute data, and further manipulation/analysis for identifying alternatives for development are carried out using the state-of-art Geographic Information System.

The digitally classified outputs corresponding to geology, geomorphology, soils, land use and their derivative are feature-coded and stored in the map information system. These individual maps from corresponding map files are integrated to arrive at "Composite Mapping Units" (CMUs). The socio-economic, institutional and other statistical data are entered into attribute database. The decision criteria would be structured within the framework of resources potentials and other determinants to evolve a pragmatic model.

Composite Mapping Unit

It is three-dimensional landscape units homogeneous in respect of characteristics and qualities of land, water and vegetation and separated from other dissimilar units by distinct boundaries. The CMU characteristics imply physical parameters of the component resources of a biophysical domain, whereas qualities are suggestive of their potential for specific uses under the defined sets of conditions. Based on the interaction among the basic resources of land, water and vegetation which form the major components of primary production system,

useful inferences are drawn about their predicted behavior in meeting the various planning goals.

Current Status of Resources Utilization and Management

To begin with, all collateral data derived from the District Census Handbook, Agricultural Census Report, Meteorological Tables and from other relevant sources, in conjunction with land use maps, are assembled and collated to assess man-land ratio, present land use, present water use, local problems, agricultural production, employment status, marketing storage, input situation.

Based on the above, surpluses and shortfalls are computed in each other at the present level of demand and supply. Projections for the future demands are then computed considering the current population growth rate. This leads to identification of thrust areas for the different taluks in the District. It is unlikely that resources potentials of a particular taluk even with an ideal plan, would meet all the variegated needs of the people, but it would be of help to ensure that the CMUs have been collectively manipulated to their optimal use without losing sight of the local problems and needs. It may be mentioned that self-sufficiency can hardly be a realistic goal at planning level.

The areas under agriculture, forests, grasslands and plantations suffering from soil erosion and other forms of degradation reflect the extent of mismanaged lands for which integrated soil and water conservation measures are indicated. The wastelands have the locked up production potential and call for appropriate reclamation measures. For a lasting solution of these problems, both the reclamation and the soil and water conservation problems have to be identified on the basis of characteristics of the associated soils and input situations. Land form and slope are other important determinants for ameliorative and preventive measures.

Land capability model based on soil, site and meteorological factors gives optimum land use potential. Mismatch between present and potential land use implies land use revision. Land irrigation model helps to assess the suitability of land for irrigated agriculture and enable predictions of its behaviour under the defined management level. Hydrology groupings, vegetation cover complex, landform and slope permit runoff estimation from a given land system unit.

Integration of geological, gecmorphological, hydrogeological and land use data with geophysical investigations gives ground water potential. This coupled with surface water potential when matched against tapped water resources help in estimating unrealised water potential to meet the prime ordeal demands of irrigation, industries, drinking water and others.

Development of Land / Water Use Alternatives

A pragmatic development model has to provide a number of alternatives in respect of each of the different landscape units or CMUs. Primarily, this is because our understanding about the interactions among the different parameters of the complex social, physical and natural system is limited to suggest a single best course of action. Furthermore, the input situation and socio-economic conditions assumed at planning stage for a particular action plan may not remain valid at the time of implementation, and thereby rendering the plan ineffective. There is also a risk factor involved in single action plan which is based almost entirely on the 'assumed best' in alliance with goals and objectives of the planning, though such an action may not necessarily agree with the individual landholder. Alternatives are developed within the framework of optimal land use. On applications of land capability classification (LCC) model, optimal broad land use category is derived from Composite Mapping Unit (CMU). This when matched with present land (indicated by CMU) help decision of broad land use revision matching LCC.

The water resources development plan and land resources development plan are generated identifying suitable sites for water harvesting structures through farm ponds, check-dams,

nalla bunds, subsurface dykes etc; sites for soil conservation; sites for agroforestry , horticultural, double cropping with appropriate conservation methods.

These recommendations are arrived in consultation and close coordination between space scientists, experts from various Central/State developmental departments, agricultural universities/ research institutions, district level official, NGOs and local farmers, so as to ensure the technical feasibility and cultural acceptability of the action plans.

The implementation of the action plans emerging out of the study has amply demonstrated, reduction of soil erosion, increase of area under vegetation, and cropping intensity, soil moisture retention, rise in ground water table and wastelands becoming greener.

Conclusion

The potential of remote sensing technology has been effectively harnessed in India for the management of its natural resources. Decision support system>for development planning have been evolved using CIS. This experience on the successful use of remote sensing technology and CIS for enriching the land use planning could be extended to different parts of the country.

11 BIOTEC PRESSURE, LAND USE AND SUSTAINABLE DEVELOPMENT IN U.P.

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Introduction

The relentlessly increasing pressure of human and livestock population and the demands of urbanization and economic development have put a severe strain on our limited land resources with the result that the quality of land resources has been deteriorating threatening the ecological balance. A very high proportion of our land is suffering from varying degrees of degradation and lying waste for one reason or the other. It is imperative for our survival and sustainable development that urgent attention is paid to the scientific management, conservation and development of our land resources. Given the significant variations in the type and quality of our land resources and the human and environmental factors affecting land use, suitable land use plans have to be prepared for different states and agro-climatic regions in the light of the specific regional setting. In the present paper we propose to highlight the imbalances created by extreme biotic pressure in land use and its implication for sustainable development and to outline the requirements of an optimum land use plan for the state of Uttar Pradesh. Paucity of space prevents us to go into the significant intro-state variations that exist in this respect.

The Physical Setting

Uttar Pradesh with an area of 2.94 lakh sq. km. is the fourth largest state in India accounting for a little less than one-tenth of the country's area. The state is divided into four agro-climatic zones, namely the Western Himalayan Region, the Middle Gangetic Plains Regions, the Upper Gangetic Plains region and Central Plateau and Hills. With its rich alluvial soil, average precipitation of around 100 cm. per year and plenty of surface and ground water resources, the state is endowed with highly favourable conditions for agricultural development over most parts.

Populations Pressure

In fact it were these favourable conditions that attracted a large inflow of people to the region from time immemorial with the result that the land-man balance in the regions has become highly unfavourable. The total population of the state increased from 6.32 crores in 1951 to 13.91 crores in 1991, i.e. by 220 per cent. The population of the state is continuing to grow at a fairly rapid rate. The growth rate has declined only marginally from 2.30 per cent per annum during 1971-81 to 2.26 per cent per annum during 1981-91. With its high birth rate of 37 per 1000 and low couple protection rate of 33.8 per cent there is a large demography growth potential in the state. According to the medium protection of the Expert Committee on Population Projection, the population of U.P. in 2001 A.D. is likely to touch the figure of 16.56 crores.

The rapidly rising population has resulted in a sharp increase in the biotic pressure on land in the State. Population density per sq. km. which has 165 at the turn of the century had gone up to 215 in 1951 and has more than doubled since then to reach the high figure of 473 in 1991. The extensive margin of cultivation in the state has been exhausted and net sown area has remained static since 1961, while net sown area per person has declined from 0.30 ha. in 1951 to only 0.15 ha. in 1991.

Demand and Supply of Foodgrains

At the present level of productivity, i.e. 1.5 tonnes per ha an area of 0.15 ha. would yield an output of 225 kgs. per year, which may be taken as just sufficient for nutritional requirement. However, there is an actual pent up demand for foodgrains as the incidence of poverty is relatively high in the state and the minimum nutritional requirement of a substantial part of population is not met.

According to our estimates taking into account the income elasticity of demand for foodgrains (which is nearly 1) and the projected population and income growth and requirement of foodgrains for agricultural purposes as well as seed, feed and wastages, the aggregate demand for foodgrains in U.P. is likely to increase at the rate of 3.6 per cent per annum. During the period 1968-91 foodgrain output in U.P. did register a growth rate of 3.5 percent per annum, but during the period 1989-94 the growth rate decelerated to 1.8 per cent per annum. Demand for non-foodgrains is expected to increase at an even faster rate of 5 to 8 percent per annum. Net sown area in the state has been nearly static for quite some time. Sustained increase in agricultural productivity at a high rate will remain a major challenge for policy planner in the coming years.

Fuel Wood and Timber Requirement

Assuming per capita fuelwood requirement at 0.25 tonnes per year, total fuelwood requirement of U.P. in 1981 can be put at 277.25 lakh tonnes or 415 lakh Cu.M. against the reported production of only 18.6 lakh Cu.M. In 2001 the demand for fuel wood is likely to be of the order of 621 lakh Cu.M. The demand for timber in U.P. has been estimated at 44.7 lakh Cu.M. per year, which is likely to go upped 66.7 lakh Cu.M. in 2001. Against this the reported output of timber in the state was only 6.86 lakh Cu.M. in 1986-87. Thus, the situation with respect to shortage of fuelwood and timber which is already very acute is likely to worsen in the coming years with adverse consequence for the limited three cover in the state.

Livestock Pressure

Along with human population the large livestock population in the state puts a heavy pressure on the biotic resources of U.P. and the total livestock in U.P. increased from 4.94 crores in 1961 to 6.11 crores in 1988 or at the rate of 0.80 per cent annum. At this rate livestock population in U.P. would be 6.78 crores in 2001. There are two livestock units per ha. of net sown area, while normally 1 hectare of cropped area cannot support more than one livestock unit in irrigated areas. Livestock density per ha. of area under fodder crops is as high as 40 and touches the figure of 115 per ha. of area classified as permanent pastures and grazing land.

Consequently there is an acute shortage of live stock feed and fodder. Using the norms suggested by the National Commission on Agriculture the total requirement of concentrates comes to 8.02 million tonnes, that of dry fodder 50.07 million tonnes and of green fodder at 72.82 million tonnes in 1981. Against this the availability of the three items was only 1.77 million tonnes, 34.14 million tonnes and 9.35 million tonnes respectively. Thus, supply as a proportion of requirement comes to only 22 per cent in case of concentrates 68.2 per cent in case of dry fodder and 50 per cent in case of green fodder. Unable of properly feed their livestock, people leave them free to graze causing damage to standing crops and other vegetative cover.

Table-1 :
Indicators of Biotic Pressure and Resource Scarcity in Uttar Pradesh

Population Density per Sq. Kms	1951	215
	1951	473
Net Sown Area per person (in ha.)	1951	0.30
	1991	0.15
Per capita Foodgrains Output (in kg.)	1950-51	186
	1990-91	255
Population Growth Rate (% per annum)	1971-81	2.30
	1981-91	2.26
Projected Demand for Foodgrains (lakh tonnes)	2001	405
Current Output of Foodgrains (lakh Tonnes)	1991	355
Demand and supply of Fuelwood	1981	
a) Demand		415
b) Reported Production		18.6
Demand and Supply of Timber (in lakh Cu.M.)	1981	
a) Demand		44.7
b) Supply		6.9
Livestock population in Cow Units	1982	
a) Per Ha. of Net Sown Area		2
b) Per Ha. of Area Under Fodder Crops		40
c) Per Ha. Pastures and Grazing Land		115
Supply of Livestock Feed as Per Cent of Requirement	1982	
a) Concentrates		22
b) Dry Fodder		68
c) Green Fodder		50

Source: Ajit Kumar Singh, Land Use Environment an Economic Growth in India, M.D. Publications New Delhi 1997

Land Demand for Non-Agricultural Purposes

With increasing urbanization and economic development the need for land for non-agricultural purposes is also going up rapidly putting additional claims on the limited land resource. Often prime agricultural land has been diverted to non-agricultural uses. In U.P. land put to non-

agricultural uses has gone up from 18.5 lakh ha. in 1950-51 to 24.57 lakh ha. in 1990-91. Thus an area of about 20,000 ha. is being diverted to non-agricultural use every year.

Land Use Imbalances

The heavy and increasing pressure of human and livestock population on the limited land resources have created serious imbalances in the land use in U.P. which is reflected in degradation and destruction of forests, extension of cultivation to marginal lands, encroachment on pastures and grazing land, diversion of good quality land to non-agricultural purposes etc. Consequently, the problems of land degradation, soil erosion and declining tree cover have assumed serious dimensions threatening the environmental balance and the very sustainability of the growth process.

A look at the trends in land use shown in Table 2 reveals the serious imbalances in land utilization patterns. Only around one-sixth of the land area is under forests most of which is confined to the U.P. hills. Area . under pastures and grazing land has shrunk to hardly 1 per cent of total area. Nearly 60 per cent of the geographical area is under the plough and even marginal and sub-marginal lands have brought under cultivation. About 19 lakh ha. or over 10 per cent of geographical area are under current or old fallow due to problems like lack of irrigation facility, waterlogging, salinity, etc. In addition about 11 lakh ha. area is under culturable waste, while another 11 lakh ha. area is classified as non-culturable waste. Thus, nearly one-fifth of the land in the state is not being put the productive use, while about one-tenth of the area is under non-agricultural uses. The productivity of the remaining two-thirds of the land, whether under cultivation or forests is generally low and large areas are suffering from land degradation of various degrees.

Table-2 : Trends in Land Use in U.P. Since 1951

Land Use Categories	Area under the Category (Lakh Ha.)					
	1950-51	1960-61	1970-71	1980-81	1990-91	20001-01*
Forests	31.9 (10.9)	37.9 (12.8)	49.5 (16.6)	51.3 (17.4)	51.6 (17.3)	66.3 (22.2)
Barren & Un-cultivable Waste	28.9 (9.9)	25.9 (8.8)	14.2 (4.8)	11.4 (3.9)	10.4 (3.5)	6.0 (2.0) '
Land put in Non-Agri-cultural Uses	18.5 (18.5)	19.1 (6.5)	20.3 (6.8)	22.8 (7.7)	24.5 (8.2)	26.9 (9.0)
Cultivable Waste	23.1 (7.9)	16.4 (5.6)	13.5 (4.5)	11.5 (3.9)	10.3 (3.5)	3.0 (1.0)
Permanent Pastures	N.A.	0.4 (0.1)	0.8 (0.3)	3.0 (1.0)	3.0 (1.0)	6.0 (1.0)
Miscellaneous Trees and Grove	14.2 (4.8)	8.9 (3.0)	12.6 (4.2)	6.4 (2.2)	5.5 (1.8)	9.0 (3.0)
Current Fallow	10.8 (3.7)	1.7 (0.6)	8.7 (2.9)	11.7 (4.0)	10.8 (3.6)	3.0 (1.0)
Old Fallow	2.9 (1.0)	12.6 (4.3)	5.5 (1.8)	7.2 (2.4)	8.8 (3.0)	3.0 (1.0)
Net Sown Area	162.3 (55.5)	171.9 (58.3)	173.1 (58.1)	172.2 (58.3)	173.0 (58.1)	175.0 (58.7)
Total Reported Area	**292.2 (100.0)**	**295.0 (100.0)**	**298.1 (100.0)**	**297.4 (100.0)**	**297.9 (100.0)**	**298.0 (100.0)**

Source: Directorate of Agricultural, Uttar Pradesh, Agricultural Statistics of U.P. (Annual)
Notes: Figures in Parentheses indicate percentage of total area
* Suggested land use pattern.

The increasing biotic pressure is reflected in a sizeable decline in area under culturable and non-culturable waste and area under miscellaneous trees and grooves (Table 3). Area under cultivation has stabilized since 1971 after showing a rise between 1951 and 1971, whereas area under non-agricultural uses has been steadily increasing. The significant increase in area under current and old fallows indicates the extension of cultivation to poor quality land and soil deterioration due to salinity etc.

The revenue statistics reveal a significant increase in forest area upto 1971 and marginal increase after that. Though nearly 17.3 per cent of area in UP. is reported under forest, the effective tree cover is much less.

According to the estimates of the Forest Survey of India based on land sat imagery 1987 to 89 only 11.4 per cent area in U.P. is under forests. Only two-thirds of this area is under dense forest with 10 to 40 percent tree canopy. What is even more important from ecological point of view is the fact that the forest area is largely confined to the U.P. Himalayas and Southern Plateau. In the Gangetic Plains forest cover at all. This is highly undesirable situation from the point of view of long run environmental sustainability of the state. Fortunately, large tracts waste land in the state exits, which can be brought under afforestation to redress this imbalance without diverting area from agriculture land.

Table-3 :
Period-wise Shifts in Area Under Different Land Use Categories in U.P. : 1956-57 to 1986-91

(Lakh Hectares)

Land Use Category	Average Area Under the Category During						
	1956-57 to 1960-61	1961-62 to 1965-66	1966-67 to 1970-71	1971-72 to 1975-76	1976-77 to 1980-81	1981-82 to 1985-86	1986-87 to 1990-91
Reporting area for Land Utilization	-4.28 (-1.44)	3.49 (1.19)	1.16 (0.39)	-0.72 (-0.24)	0.23 (0.08)	-0.03 (-0.01)	-0.15 (0.05)
Forests	-3.58 (-8.79)	8.20 (22.09)	5.58 (12.31)	0.19 (0.37)	0.16 (0.31)	0.24 (0.47)	10.79 (26.51)
Land Put to Non-Agricultural Use	0.71 (3.76)	0.62 (3.17)	0.79 (3.91)	1.19 (5.67)	1.38 (6.22)	0.64 (12.72)	5.33 (28.26)
Barren and Uncultivable Land	-0.29 (-1.13)	-5.89 (-23.14)	-6.58 (-33.64)	-1.39 (-10.71)	-0.47 (-4.05)	-5.56 (-5.04)	-15.18 (-58.97)
Permanent Pastures and Other Grazing Lands	0.19 (54.28)	0.22 (40. 74)	1.22 (160.53)	0.91 (45.96)	0.30 (10.38)	0.09 (2.82)	2.93 (737.14)
Land under Miscellaneous Tree Crops	- 1.88 (-18.41)	-1.54 (18.49)	-0.10 (-1.01)	-2.67 (-27.33)	-1.43 (-20.14)	-0.21 (-3.70)	-4.75 (-46.52)
Culturable Waste Land	-1.49 (-8.75)	-1.58 (-10.17)	0.48 (3.44)	-1.49 (-10.34)	-1.68 (-12.98)	-0.58 (-5.15)	-6.34 (-37.25)
Current Fallows	2.64 (156.21)	4.24 (97.92)	0.83 (9.68)	1.23 (13.08)	0.70 (6.58)	0.04 (0.35)	9.68 (472.78)
Net Area Sown	2.77 (1.63)	0.48 (0.28)	-1.44 (0.83)	0.91 (0.53)	-0.44 (-0.25)	-0.34 (0.20)	-1.94 (1.14)

Source: Bulletin of Agricultural Statistics, U.P., (Annual)
Note: Figures in parenthesis show per cent change

Table-4 :
Log Linear Regression Estimates on Area Under Major Land Use Categories in U.P. : 1968-69 to 1985-86

Land Use Category	Constant	Beta	T Value	R^2	F Value	Average Compound Growth
Forests	10.76	-0.0068	0.1	0.002	0.04	-0.01
Barren and Unculturable Land	9.788	0.1763*	14.1	0.92	198	-0.18
Land Put to Non-Agricultural Uses	9.612	0.2513	1.5	0.13	2.3	0.25
Culturable Waste	9.637	-0.0939**	2.8	0.34	8.1	-0.08
Permanent Pastures & Other Grazing Lands	6.244	-0.6824	7.3	0.77	53.1	0.68
Land Under Miscella-neous Tree Crop and Groves	9.521	-0.2802	4.5	0.56	20.4	-0.28
Current Fallows	8.917	0.1443*	4.7	0.58	22.3	0,14
Other Fallows	8.517	0.1278*	4.3	0.53	18.3	0.13
Net Sown Area	12.06	-0.0025*	1.3	0.06	1.6	0.002

* Significant at 1 per cent level
** Significant at 5 per cent level

Land Use for Sustainable Development

To ensure a sustainable process of agricultural and economic development it is imperative that these imbalances in land use pattern in U.P. are removed by taking urgent steps to move towards an optimum land use pattern. Such an indicative land use pattern is suggested in the last column of Table 2. The creation of such an optimum land use pattern would require action along the following lines.

i. The forest cover should be gradually extended by bringing at least 5 percent area in each district under forest tree cover. This would require afforestation over an additional 15 lack hectare area through wasteland reclamation.
ii. The effectiveness of the existing forest area has to be improved by reforestation of about 34 lakh ha. area under degraded forests.
iii. Village plans should be adopted for development for common property resources to meet fuelwood and fodder requirement.
iv. A massive programme has to be initiated for the reclamation of nearly 40 lakh hectares area classified as cultivable waste, current fallow and old fallow to make them productive by diverting to other suitable uses as indicated above.
v. To meet the rapid growing demand for foodgrains and other agricultural products, productivity of agricultural land has to be improved through intensification of modern technology for which there is ample scope. Care has to be simultaneously taken that the high dozes of fertilizers and over exploitation of land do not lead to deterioration of soil productivity over long run by promoting balance input use and scientific

cultivation practices. Measures for preventing the diversion of good agricultural land uses are also called for.

vi. A rapid expansion of irrigation facilities is required both for the raising agricultural productivity and reclamation of wastelands. There is still a large unexploited potential of surface and ground water in the state as only 58 percent of gross cropped area are irrigated against the potential of 84 per cent.

An integrated approach to land and water management is required for achieving a sustainable pattern of land use and development. Such a programme of scientific management of our natural resources needs highest priority at the national and state levels. Appropriate legislative and organizational mechanisms have to be created for this purpose and adequate resources have to be provided for. Needless to add that such a programme cannot hope to succeed without increasing people's awareness and ensuring their effective participation.

Seminar on Land Use Planning at NCAP on 28th & 29th November, 1997

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