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Changes in dry land agriculture in the semi-arid tropics of India, 1975–2004

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This paper examines the changes in dry land agriculture between 1975 and 2004, drawing both from macro-level data as well as the Village Level Studies (VLS) data of ICRISAT from six villages in Maharashtra and Andhra Pradesh. The long-term panel data facilitate an in-depth analysis of cropping patterns, productivity levels, costs and returns of crop enterprises over time. The contrasting findings about increasing asset prices and declining returns to land and management puzzle the analysts. Equally implausible are the non-viability of agricultural enterprises on one hand and increasing incomes and living standards of the farm house holds on the other. Yet the SAT areas record highest incidence of poverty among the different agro-climatic regions of India. There is a clear dividing line between dry land agriculture and irrigated agriculture in terms of productivity levels, viability, indebtedness and poverty incidence. The government has come out with relief packages for farmers and employment guarantee programmes for the agricultural labourers in these areas. Besides such temporary palliatives, long-term policy biases which caused them need to be set right to make dry land agriculture in the SAT areas viable and competitive.

Cet article observe les changements dans' agriculture de zones arides entre 1975 et 2004 à partir de données d'ICRISAT provenant d'études macro et au niveau du village portant sur six villages du Maharashtra et d'Andhra Pradesh. Les données de panel portent sur le long terme, ce qui facilite une analyse en profondeur du modèle de culture, des niveaux de productivité, des coûts et des rendements des cultures à terme. Nos résultats suggèrent que les rendements déclinent et que l'activité agricole en zone tropicale semi-aride est devenue non viable. De plus, on enregistre dans ces zones les taux de pauvreté les plus élevés de toutes les différentes zones agro-climatiques de l'Inde. Il existe une délimitation claire entre l'agriculture sèche et l'agriculture irriguée en termes de niveau de productivité, de viabilité, d'endettement et d'incidence de la pauvreté. Nous défendons l'idée qu'afin de rendre l'agriculture sèche en zone semi-aride viable et compétitive, il est nécessaire de corriger des distorsions historiques dans la politique agricole indienne.

Keywords: dry land agriculture; semi-arid tropics; changes in cropping patterns; village level studies; India

Semi-arid tropics and their share in India's agriculture

Although semi-arid tropics (SAT) are typically characterized by low and uncertain rainfall and poor quality of soils which affect both the quantity and value of the agriculture output they have been defined differently by different analysts. In the words of Gulati and Kelley (1999, p. 7) 'No precise definition of the SAT is universally accepted although Troll (1964) defines it as those tropical regions where rainfall exceeds potential evapo-transpiration two to seven months a year'. Using this definition, Gulati and Kelley broadly divide India into SAT and non-SAT regions. According to

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Table 1. SAT's share of all-India totals (%).

Item	1968–70	1980–82	1992–94	2000–02
Net cropped area (NCA)	65.0	64.8	65.3	64.9
Net irrigated area (NIA)	48.4	52.2	58.3	59.1
Gross cropped area (GCA)	61.5	60.9	61.7	60.7
Gross irrigated area (GIA)	47.5	50.7	56.9	55.1

Source: The data in columns 2 to 4 are from Gulati and Kelley (1999).

them, SAT spans over 175 districts of India, covering 65.3% of the net cropped area and 61.7% of the country's gross cropped area in the triennium, 1992–94 (Table 1). This region also accounted for 58.3% of net irrigated area and 56.9% of the gross irrigated area in the country. Using the same districts, we computed these aggregates for the triennium of 2000–2002. The share of SAT in the gross and net cropped areas remained the same during the triennium 2000–2002 as it was in 1968–70, but its share in gross and net irrigated areas improved considerably. In terms of net irrigated area, its share improved by about 10 percentage points between 1968–70 and 2000–2002, while its share in gross irrigated area increased by about 8 percentage points. Yet SAT areas have relatively less irrigation coverage than the non-SAT areas even in 2000–2002.

The cropping patterns in this broadly defined SAT region have undergone substantial changes due to increased coverage under irrigation, shifts in consumption patterns, changes in technology and market prices. The percentage shares of wheat, rice and maize have increased, while those of sorghum, pearl millet and other coarse cereals have declined (Table 2). Overall,

Table 2. Area shares of selected crops in the SAT-GCA.

Crops	1968–70	1980–82	1992–94	2000–02
Rice	8.9	9.2	9.3	10.0
Wheat	10.0	12.2	12.8	12.9
Sorghum (total)	16.8	14.7	10.8	8.5
Kharif	10.7	9.4	6.0	4.0
Rabi	6.1	5.3	4.8	4.5
Pearl millet	12.0	10.2	8.7	7.8
Maize	2.7	2.9	3.0	3.8
Other cereals	3.3	2.4	2.8	1.8
Total cereals	53.7	51.6	47.4	44.8
Chickpea	6.0	6.0	5.3	4.8
Pigeon pea	2.1	2.2	2.5	2.6
Other pulses	7.9	7.5	8.0	6.9
Total pulses	16.0	15.7	15.8	14.3
Food grains	69.7	67.3	63.2	59.1
Groundnut	6.7	5.8	6.6	5.2
Rapeseed-mustard	0.5	1.3	3.7	2.7
Sesamum	1.4	1.2	1.3	1.0
Castor	0.4	0.5	0.6	0.7
Linseed	0.8	0.7	0.5	0.2
Safflower	0.6	0.7	0.7	0.3
Soybean	0.0	0.6	3.5	5.3
Sunflower	0.0	0.2	1.8	1.1
Total oilseeds	10.4	11.0	19.3	16.1
Cotton	7.3	6.6	6.0	6.9
Sugarcane	1.4	1.7	2.0	2.6

Source: The data in columns 2 to 4 are from Gulati and Kelley (1999).

the cereals have lost their combined share to a tune of 8.9% over the 32-year period. Pulses also lost their share by 1.7% in this period. The share of chickpea steadily declined while that of pigeon pea increased marginally. The total oilseeds increased their area share from 10.4% in 1968–70 to a peak of 19.3% in 1992–94 but later slid back to 16.1% in 2000–2002. The traditional oilseed crops like groundnut, sesame, linseed and safflower lost their area shares while rapeseed-mustard and castor improved their shares. The newly introduced oilseed crops, soybean and sunflower made rapid strides and occupied substantial area shares during the triennium 2000–2002. The area share of cotton oscillated and declined marginally while that of sugarcane nearly doubled in this period. A shift from food grains to commercial and oilseed crops is quite obvious from the data.

Incidence of poverty by agro-climatic zones (IFAD study)

Somewhat diverging from Gulati and Kelley's definition of SAT, Rao, Bantilan, Singh, Subrahmanyam, Deshingkar et al. (2003) divide India into four agro-climatic zones of semi-arid tropics, semi-arid temperate, arid and humid regions. According to this study an area comes under SAT if its mean monthly temperature exceeds 18 degrees centigrade and it has a growing period that ranges between 75 and 180 days. Furthermore, the same study defines arid areas as those with fewer than 75 days of growing period. The humid areas refer to those areas with more than 180 days of growing period. This narrower definition of SAT included only 37.2% of the total geographical area of the country (Table 3). In 1997–98, it covered 46.2% of the net cultivated area and 42.9% of the gross cropped area. In the same year, 58.7% of the coarse cereal area, 52.6% of the pulses area and 59.7% of the oilseeds area in the country lay in this region. Three-fifths of the commercial crop area in the country also falls in the SAT region. Only 31.9% of the gross irrigated area is in this region. About 36.9% of the value of agricultural output in the country were generated in the SAT area which, incidentally, supported 36.9% of the population of the country as well.

Table 3. Relative importance of SAT vis-à-vis other climatic zones of India, 1997–98.

	Share of all India (%)			
Importance/region	Arid	Humid	Semi-arid temperate	Semi-arid tropics
Geographical area	10.3	22.3	12.0	37.2
Population	4.3	32.3	21.5	36.9
Net cultivated area	11.4	21.1	19.0	46.2
Gross cropped area	11.3	22.6	21.1	42.9
Gross irrigated area	12.4	16.4	35.1	31.9
Coarse cereals area	16.9	8.0	16.5	58.7
Pulses area	12.9	17.4	17.1	52.6
Oilseeds area	11.9	10.7	14.6	60.0
Commercial crops area	15.5	8.2	16.3	60.0
Fruits and vegetable area	2.3	49.9	19.2	28.6
Production of coarse grains	10.0	10.3	19.2	60.5
Production of pulses	7.7	16.0	24.8	51.5
Production of oilseeds	10.0	10.1	13.5	62.8
Value of production agriculture	8.7	27.8	26.6	36.9
Ratio of value of output from agriculture to gross cropped area	0.77	1.23	1.26	0.86

Source: Rao et al. (2005).

Table 4. Incidence of poverty across agro-ecological zones.

Agro-ecological zone	Head count (%)	MPCE (Rs.)
Humid	23.7	473.6
Semi-arid temperate	14.6	504.1
Semi-arid tropics	24.3	472.3
Arid	12.6	548.1

Source: Rao et al. (2005).

The NSSO 55th Round data (1999–2000) was analyzed to estimate the monthly per capita expenditures (MPCE) and poverty levels among rural households by agro-ecological region. The incidence of poverty was the highest in SAT when compared with the other agro-ecological regions (Table 4). The monthly per capita expenditure was the lowest in SAT, closely followed by that in humid regions. The expenditure levels in semi-arid temperate and arid regions were relatively higher than those in semi-arid tropical and humid regions. About 60 million of India's 147 million rural poor live in the rural SAT.

The data presented in Table 3 suggests that the value of agricultural output per hectare is lower in SAT due to less irrigation coverage, low rainfall and marginal soils. Also in absolute terms, the value of crop output per hectare worked out to Rs.23,995 in humid areas, Rs.28,284 in semi-arid temperate areas, Rs.17,464 in arid areas and Rs.16,417 in semi-arid tropics. In per capita terms, the crop output was Rs.3147 in humid areas, Rs.4103 in semi-arid temperate areas, Rs.8251 in arid areas and Rs.4137 in semi-arid tropics. The number of rural people dependent on a hectare of land was the highest at 7.62 for humid areas, closely followed by semi-arid temperate areas with 6.89. This number was relatively lower at 2.12 for arid areas and at 3.97 for semi-arid tropics. As a result, the living standards are low and the incidence of poverty is the highest in semi-arid tropics and humid areas among the agro-ecological regions of the country. The incidence of poverty is marginally higher in semi-arid tropics (24.3%) than in humid areas (23.7%).

Evidence from micro-level data

We now turn our attention to micro-level data generated in the Village Level Studies (VLS) of ICRISAT to examine the issues of livelihoods, poverty, viability and investments in the SAT villages. Based on cropping, soil and climatic criteria, three contrasting dry land agricultural regions were selected for study in the VLS: the Telangana region in Andhra Pradesh, the Bombay Deccan in Maharashtra, and the Vidarbha region also in Maharashtra. Districts representative of those regions, namely Mahabubnagar in Telangana, Solapur in Bombay Deccan and Akola in Vidarbha region were selected. Two villages representative of each of these three districts were chosen. The selected villages were Aurepalle and Dokur in Mahabubnagar district, Shirapur and Kalman in Solapur district and Kanzara and Kinkheda in Akola district.

Mahabubnagar district receives 630 mm of annual rainfall, which is not only low but un-assured with a coefficient of variation (C.V) of 31%. Red soils (alfisols) with low water retention capacity are the most common soil types. In Solapur district, the rainfall is the same (630 mm) as Mahabubnagar and is un-assured with a C.V of 35%. But this district has deep black heavy clay soils (vertisols) with high water retention capacity. Because of the difficulty in working the soils during rainy season, crops are taken in the post-rainy season making use of stored moisture. Akola district has an annual rainfall of 890 mm which is relatively assured with a C.V of 22%. It has medium deep black clay soils (inceptisols) with medium water retention capacity. Crops are grown during rainy season both in Mahabubnagar and Akola districts.

Table 5. Pattern of land ownership and operation in VLS villages, 2001–04 (ha).

	Average land/land owner in the sample				
Village	Owned	Leased in	Leased out	Fallow	Operated
Aurepalle	1.72	0.30	0.04	0.02	1.96
Dokur	1.47	0.17	0.05	0.01	1.58
Kalman	4.72	0.53	0.10	0.06	5.09
Shirapur	2.78	0.18	0.02	0.08	2.86
Kanzara	3.64	0.44	0.18	0.12	3.78
Kinkheda	3.23	0.04	0.35	0.24	2.68
Average	2.93	0.28	0.12	0.09	3.00

During 1975–84, 40 households from each of the six villages were studied by the resident investigators through high frequency rounds (once in 21 to 25 days) of data collection. When the VLS were resumed in 2001–02, the sample was increased from 240 to 446 households to make it more representative of the population. But data were collected by annual surveys at the end of the cropping years due to financial constraints. We have analyzed the data for three years, 2001–04, and the results are discussed below in detail. Wherever possible, comparisons were made with the situation in 1975–84 to capture the changes in SAT agriculture over the three decades.

Size of holding

With the growth in population and subdivision of families the pressure on land increased, rendering the ownership holdings smaller and smaller over the three-decade period. The average size of ownership holding, which was 5.17 ha in the VLS sample during 1975–78, has fallen to 2.93 ha in 2001–04 (Table 5). Similarly, the average size of operational holding has also fallen from 5.90 ha in 1975–78 to 3.00 ha in 2001–04. In all the villages except Kinkheda, operational holding exceeded the ownership holding because leased-in land was higher than the leased-out land in the case of our sample households.

Comparison of cropping patterns with the base year (1975–76)

In Table 6, some comparisons were made between the cropping patterns in 1975–76 and 2001–04 (figures for 1975–76 were drawn from Jodha 1977). The average size of holding fell

Table 6. Changes in the percentage area under food grains under sole and mixed /intercrop systems between 1975–76 and 2001–04.

		1975–76			2001–04		
Sno	Village	Average size holding (ha)	Percentage area of sole crops under food grains	Percentage area of mixed crops under food grains	Average size holding (operational)	Percentage area of sole crops under food grains	Percentage area of mixed crops under food grains
1	Aurepalle	4.4	39.0	88.0	2.0	22.6	5.9
2	Dokur	2.6	85.0	40.0	1.6	32.6	2.9
3	Shirapur	4.4	83.0	86.0	2.9	66.6	0.2
4	Kalman	8.1	93.0	99.0	5.1	52.5	1.2
5	Kanzara	5.8	59.0	47.0	3.8	20.7	0.5
6	Kinkheda	6.1	76.0	21.0	2.7	12.7	0.3
Average		5.2	72.5	63.5	3.0	34.6	1.8

by more than one half in Aurepalle and Kinkheda while it fell between 30 and 40% in the other four villages. The average size of holding of the entire VLS sample fell by 42% from 5.2 to 3.0 hectares over the 26-year period. The relative importance of the food crops decreased in all the villages for both sole crops and inter/mixed crops. On average, the percentage area under food grains to the gross cropped area under sole crops fell from 72.5 to 34.6%.

The decline in the share of food grains in the gross cropped area under inter/mixed crops was even sharper, falling from 63.5 to 1.8%. Thus, the shift away from food grain crops was even greater in the VLS villages than what was observed at the macro-level. At the all-India level, the share of food grain crops in the gross cropped area fell from about 77% in 1960–61 to about 66% in 2000–2001. The shift in favour of cash crops was particularly pronounced in Mahabubnagar and Akola villages. In Solapur villages, rabi sorghum is still the preferred crop (with no close substitutes) due to which the share of food grains in the total area under sole crops remained high. Mixed cropping (mixing the seeds of four to five crops and broadcasting) practice has given way to intercropping (planting two or three crops in different rows).

Detailed comparisons of cropping patterns in Aurepalle, Shirapur and Kanzara

Sharma (1988) worked out the average cropping patterns for the years 1976–81 in Aurepalle, Shirapur and Kanzara. The same are compared with the three-year average (2001–04) figures for Aurepalle, Shirapur and Kanzara villages in Tables 7, 8 and 9 respectively.

In Aurepalle, the fibre-yielding cotton crop has gained prominence, occupying more than one-third of the cropped area. Cereals lost area considerably, with their combined share dropping to 28.5% from 49.5%. Sorghum lost nearly one-half of its area. In percentage terms, the biggest drop was in pearl millet. Due to water shortages, even the irrigated cereal, paddy lost its area share significantly. Oilseed, pulses and other crops also suffered erosion in their area shares. Cotton virtually emerged from nowhere and displaced all the major crops in the base year.

Due to heavy black soils, post rainy-season cropping is dominant in Shirapur. With increased access to surface irrigation facilities, irrigated crops like sugarcane, wheat, maize and other (horticultural) crops gained area shares while all the traditional crops like rabi sorghum, pearl millet, chickpea, other pulses and safflower lost area shares. Despite some erosion in area, rabi

Table 7. Cropping patterns in Aurepalle during 1976–81 and 2001–04 (%).

Crop	1976–81	2001–04	Change
Sorghum	21.2	11.0	−10.2
Pearl millet	9.3	2.1	−7.2
Paddy	18.8	13.7	−5.1
Total cereals	49.5	28.5	−21.0
Pigeon pea	4.3	2.6	−1.7
Green gram	1.3	–	−1.3
Horse gram	–	0.6	+0.6
Total pulses	5.6	3.2	−2.4
Ground nut	1.6	0.3	−1.3
Castor	35.0	30.0	−5.0
Safflower	3.0	0.4	−2.6
Total oil seed crops	39.6	32.3	−7.3
Cotton	–	35.4	+35.4
Other crops	5.3	0.6	−4.7
Total	100.0	100.0	–

Source: The data in column 2 are from Sharma (1988).

Table 8. Cropping patterns in Shirapur during 1976–81 and 2001–04 (%).

Crop	1976–81	2001–04	Change
Sorghum (rabi)	63.5	53.5	−10.0
Pearl millet	0.2	0.0	−0.2
Paddy	1.0	0.0	−1.0
Wheat	1.9	4.2	+2.3
Maize	1.9	3.8	+1.9
Total cereals	68.5	66.1	−2.4
Pigeon pea	7.5	7.0	−0.5
Green gram	0.5	0.0	−0.5
Chickpea	3.7	1.2	−2.5
Other pulses	8.7	4.1	−4.6
Total pulses	20.4	12.3	−8.1
Ground nut	1.6	0.8	−0.8
Sunflower	0.3	0.0	−0.3
Safflower	3.0	0.0	−3.0
Total oil seed crops	4.9	1.6	−3.3
Sugarcane	1.6	14.1	+12.5
Other crops	4.6	5.9	+1.3
Total	100.0	100.0	–

Source: Data in column 2 are from Sharma (1988).

sorghum still accounts for more than one-half of the total cropped area. Pigeon pea is the only other crop which held its ground.

Unlike rabi sorghum in Shirapur, kharif sorghum in Kanzara lost about four-fifths of its area share over the study period. Kanzara also benefited from increased access to surface irrigation, particularly, in the rabi season. Wheat emerged as an important food crop, relegating sorghum to second place. Cotton and cotton-based intercrops gained heavily in terms of the area shares. Some new crops like soybean, fruit and vegetables have also gained prominence. Pulses, cereals and oilseeds have given way to cotton during the period of 26 years.

Table 9. Cropping patterns in Kanzara during 1976–81 and 2001–04 (%).

Crop	1976–81	2001–04	Change
Sorghum	25.0	5.3	−19.7
Pearl millet	1.0	0.0	−1.0
Paddy	1.2	0.0	−1.2
Wheat	3.4	15.8	+12.4
Maize	0.0	0.5	+0.5
Total cereals	30.6	21.6	−9.0
Pigeon pea	16.0	1.3	−14.7
Green gram	4.8	2.8	−2.0
Chickpea	2.2	0.9	−1.3
Other pulses	2.2	3.0	+0.8
Total pulses	25.2	8.0	−17.2
Ground nut	5.0	0.0	−5.0
Sunflower	0.0	0.2	+0.2
Soybean	0.0	3.0	+3.0
Total oil seed crops	5.0	3.2	−1.8
Cotton	37.5	61.8	+24.3
Other crops	1.7	5.4	+3.7
Total	100.0	100.0	–

Source: Data in column 2 are from Sharma (1988).

Table 10. Comparison of productivity levels of important crops in VLS villages, 1976–81 and 2001–04 (Kg/ha).

Village	Crop	1976–81	2001–04
Aurepalle	Sorghum	201	475
	Castor	256	513
Dokur	Paddy	3119	4129
Shirapur	Sorghum (rabi)	225	694
Kalman	Sorghum (rabi)	199	553
Kanzara	Cotton + Sorghum + P.pea	135 + 40 + 36	153 + 80 + 40
	Cotton + P.pea	178 + 59	247 + 101
	Hybrid sorghum	871	1812

Source: Data in column 3 are from Walker and Subba Rao (1982).

In general, the productivity levels of all the crops increased substantially (Table 10). Despite yield increases by more than 100%, sorghum cultivation has become uneconomical both in kharif and rabi seasons in all the study villages. Faster increases in input prices and wage rates than those in output prices have caused this paradoxical situation (Table 11). Interestingly, even the new cash crops to which the farmers have shifted were unprofitable. In Aurepalle cotton did not recover all the costs and the return to land and management was quite meagre at Rs.136 per ha. In Dokur, even the returns to land and management from castor were negative. So was the case with rabi sorghum in Shirapur and pigeon pea in Kalman. The viability of crop enterprises was slightly better in Akola villages. Cotton in Kanzara and wheat in Kinkheda yielded positive returns to land and management. The fact that wheat is invariably irrigated and cotton receives partial irrigation support in some of the plots might be responsible for this situation. Crops grown under irrigated conditions attract much higher input subsidies (for fertilizer, power and irrigation) than those grown under rainfed conditions and are, hence, able to display a better viability. The 'green revolution' technologies introduced in the 1960s were mostly suitable for rice and wheat. These two crops also received favourable minimum support prices (MSP), backed up by procurement wherever needed. This kind of procurement support was lacking for rainfed cereals such as sorghum, millet and other coarse grains. The public distribution system through which food grains are supplied at 50% of the economic cost is also focused on rice and wheat. This has hastened the substitution of coarse grains by rice and wheat in the consumption basket of the rural people. As a result, the demand for coarse grains dropped and caused a fall in their relative prices. This kind of policy support in favour of superior cereals, rice and wheat has rendered the cultivation of coarse grains such as sorghum and millet non-viable. The heavy incidence of production subsidies in favour of irrigated crops has adversely affected the viability

Table 11. Viability of crop enterprises in VLS villages, 2001–04 (Rs./ha).

Village	Crop	Total cost	Gross returns	Net returns	Returns to land and management*
Aurepalle	Cotton	16,727	14,800	−1927	136
Dokur	Castor	10,307	6,523	−3784	−1931
Shirapur	Sorghum (rabi)	12,320	8,504	−3816	−1507
Kalman	Pigeon pea	7,709	4,014	−3695	−1966
Kanzara	Cotton	21,975	22,568	593	3927
Kinkheda	Wheat	7,422	7,924	502	2724

* The rental value of land is not subtracted from the returns.

Table 12. Returns over variable costs from livestock (Rs. per household).

S.no	Village	Gross returns	Total variable costs	Returns over variable costs per village	Returns over variable cost per household
1	Aurepalle	759,977	649,532	110,445	1104
2	Dokur	639,308	395,307	244,001	3050
3	Shirapur	1,481,306	1,183,217	298,089	3387
4	Kalman	1,041,210	779,130	262,080	2788
5	Kanzara	549,622	337,016	212,606	4089
6	Kinkheda	209,380	428,651	−219,271	−6852

of all rainfed crops. The policy distortions at the macro-level have affected the viability of rainfed crop enterprises at the micro-level, leading to rapid shifts in cropping patterns.

Returns over variable cost from livestock

The livestock sector fared no better than the crop sector in VLS villages during 2001–04. Because of certain methodological problems, the returns over variable costs were computed instead of the net returns. The methodological problems relate to computation of appreciation/depreciation and interest costs on fixed capital, which have to be handled in a project analysis mode. Because of difficulties involved in figuring out fixed costs in particular years, only the returns over variable costs were considered. The total returns over variable costs from all types of livestock in the VLS villages are presented in Table 12.

The returns over variable costs per household were the highest in Kanzara, followed by Shirapur and Dokur (Table 12). In Shirapur, crossbred cows were the major source of income, while both buffalo and cows contributed to the income in Kanzara and Kalman. Sheep and buffalo contributed to the income in Dokur village. The returns over variable costs were relatively lower in Aurepalle, while the livestock caused heavy losses in Kinkheda.

Changes in net household incomes, 1975–78 and 2001–04

Although the returns to land and management were negative for many important crops, the total household incomes have increased over the study period. Between 1975–78 and 2001–04 there were drastic changes in the distribution patterns of net incomes in the six VLS villages (Table 13). The shares of net crop income in the household incomes ranged between 29.8% in Aurepalle and 46.1% in Dokur during 1975–78. But in 2001–04, the net crop incomes were positive only in Kinkheda and Dokur. The contribution of net crop income was still significant in Kinkheda at 27.3%, but it contributed only 4.4% to the household income in Dokur. The negative contribution of crops (losses) ranged between 3% in Kanzara and 14.9% in Kalman. The share of income from livestock fell in Aurepalle and Kinkheda but increased in all the other four villages. Most significant contribution of livestock income was in Shirapur where it accounted for 30.4% of the total household income.

The share of agricultural labour income declined in all the villages. The decline was moderate in Akola villages and was drastic in Solapur and Mahabubnagar villages. The share of non-farm labour income declined in Aurepalle and Kinkheda but increased in all the other four villages. Caste occupations and migration were classified under other sources during 1975–78 but were listed separately in 2001–04. Their combined share was significant in Aurepalle and Dokur and was moderate in Kalman and Kanzara. The biggest increase was noted in the case of other non-farm sources which emerged as the single biggest component of household incomes

Table 13. Percentage shares of different sources in net household income in VLS villages, 1975–78 and 2001–04.

	Aurepalle		Dokur		Shirapur		Kalman		Kanzara		Kinkheda	
Source of Income	1975–78	2001–04	1975–78	2001–04	1975–78	2001–04	1975–78	2001–04	1975–78	2001–04	1975–78	2001–04
Crops	29.8	−4.5	46.1	4.4	33.7	−5.8	46.0	−14.9	43.9	−3.0	43.4	27.3
Livestock	25.5	10.6	2.0	9.4	15.0	30.4	0.8	12.9	9.0	11.6	13.1	5.1
Agri-labor income	32.8	19.6	46.3	13.2	42.6	14.5	42.1	14.8	38.7	33.0	40.8	28.1
Income from non-farm labor	11.6	8.9	1.1	8.7	0.2	6.3	4.1	10.7	2.6	7.3	5.3	1.9
Caste occupation	–	29.2	–	6.2	0.2	1.0	–	5.0	–	5.5	–	1.7
Migration	–	12.6	–	20.7	–	2.4	–	1.7	–	4.6	–	2.6
Other non-farm sources*	0.3	24.1	4.5	37.2	8.3	51.3	7.0	69.8	5.8	40.9	−2.6	33.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Absolute level (Rs.)	2,361	25,814	2,967	32,671	2,955	41,665	1,942	33,493	3,856	29,836	2,522	33,426
Equivalent level at 2001–04 prices	16,117	25,814	20,253	32,671	20,445	41,665	13,257	33,493	26,323	29,836	17,217	33,426

* Includes income from business, services and other miscellaneous sources.
Source: Data for 1975–78 are from Singh et al. (1982).

Table 14. Levels of household income and per capita income, 1975–78 and 2001–04.

	Net household income			Per capita income		
Village	1975–78*	2001–04	% Increase	1975–78	2001–04	% Increase
Aurepalle	16,117 (2361)	25,814	60.2	2883	5854	103.0
Dokur	20,253 (2967)	32,671	61.3	3821	5585	46.1
Shirapur	20,445 (2995)	41,665	103.8	3038	7802	156.8
Kalman	13,257 (1942)	33,493	152.6	2163	7126	229.4
Kanzara	26,323 (3856)	29,836	13.3	4280	5262	22.9
Kinkheda	17,217 (2522)	33,426	94.1	2780	5314	91.1
Average of VLS villages	18,935 (2774)	32,818	73.3	3226	6157	90.9

* In the net household income column for 1975–78, the figures reported are the equivalent values at 2001–04 prices and the figures in the parentheses are the ones at 1975–78 prices.

in 2001–04. Their share exceeded 50% in Kalman and Shirapur; ranged between one-third and one-half in Kanzara and Dokur; and between one-quarter and one-third in Kinkheda and Aurepalle.

The net household income has increased in all the villages when compared with the present value of 1975–78 incomes (Table 14). The increase was marginal in Kanzara (13%) and phenomenal in Kalman (153%). Barring Kanzara, all other villages in Maharashtra recorded higher increases in net household income when compared to the Andhra Pradesh villages. On an average, the household income of the six villages has increased by 73% during the 26-year period. In terms of per capita income, the growth was even higher at 91% due to a decline in the average family size from 8.37 to 5.38 over the 26-year period. The sharpest increase in per capita income was noted in Kalman, followed by Shirapur and Aurepalle. In all these three villages, per capita income has more than doubled. Kanzara, Dokur and Kinkheda registered less than 100% growth in per capita income. The average annual per capita income of Rs.6157 translates into $0.42 per person per day. Considering the World Bank standard of $1.00 per person per day for extreme poverty, the people in these SAT villages are still to be considered very poor.

While income represents one side of the coin, the consumption expenditure and nutrition standards reflect the other dimension of poverty. Table 15 gives the levels of calories and proteins consumed per capita by sample households in the six VLS villages. It also gives the percentage of households where the per capita consumption is less than 2000 calories and 50 gm of proteins. Aurepalle recorded the highest calorie consumption of 2409 while Kinkheda reported the highest per capita daily protein consumption of 52 gm among the six villages. The Andhra Pradesh villages reported much higher levels of calorie consumption than the

Table 15. Nutrition statuses across VLS villages, 2001–04.

	Consumption per day		Percentage of households	
Village	Calories	Proteins (gm)	Less than 2000 calories	Less than 50 gm
Aurepalle	2409	50	39	54
Dokur	2293	42	43	78
Shirapur	1983	48	57	52
Kalman	2143	51	43	37
Kanzara	1973	51	60	48
Kinkheda	2006	52	47	44
Average	2135	49	47	53

Maharashtra villages. Among the Maharashtra villages, Kanzara and Shirapur recorded slightly less than 2000 calories of energy, while Kinkheda and Kalman reported per capita daily calorie consumption exceeding 2000 calories. Dokur reported the lowest protein consumption of 42 gm per capita per day. The consumption of proteins was about the same in the other five villages. In Aurepalle 39% of the households had a per capita calorie consumption that was less than 2000 calories. Dokur and Kalman were the next best with about 43% of households in these villages getting less than 2000 calories. Ironically, Kanzara, which had better incomes, reported that about 60% of households in the village were energy deficient (consuming less than 2000 calories). Shirapur also had more than 50% of the households deficient in energy consumption. Kalman and Kinkheda reported the prevalence of malnutrition to the extent of 43 and 47% respectively. Protein malnutrition was most rampant in Dokur village. More than three-quarters of the households consumed less than 50 gm of protein per capita per day. The other Mahabubnagar village, Aurepalle, had 54% of households deficient in protein consumption. Protein malnutrition was relatively less in Maharashtra villages due to production of pulses on their farms. Kalman reported better nutritional levels and a lower proportion of people lacking adequate nutrition. The other three Maharashtra villages recorded protein malnutrition ranging between 42 and 52%.

Estimates of income poverty by village

We have seen that the income levels of sample households in the six villages have shown improvement between 1975–78 and 2001–04. But those were the average figures for the entire sample. The proportion of the poor in the sample depends upon the distribution of incomes between different households within a village. To be eligible to receive the benefits from poverty alleviation programmes, the income of a household should be less than Rs.13,500 at 1993–94 prices. The same is equivalent to Rs.20,000 at 2002–03 prices. The households whose net annual income was less than Rs.20,000 were counted in each of the villages to arrive at the proportion of poor people in them.

In the entire sample, 41% of households had an annual income less than Rs.20,000 (Table 16). But there is considerable variation between villages in the levels of poverty. Dokur recorded the lowest incidence of poverty at 31%. At the other extreme, Kalman registered the highest level of poverty at 49%. The two Akola villages, Kanzara and Kinkheda along with Dokur had poverty levels lower than 40% while Shirapur, Aurepalle and Kalman had poverty levels exceeding 40%.

Changes in the socio-economic position

Ownership of land was considered security against poverty and a symbol of wealth during the first generation VLS (1975–84). But once the returns to land decline, this position no longer

Table 16. Estimates of income poverty across VLS villages, 2001–04.

Village	Number of sample households	Number of poor households	Percentage
Aurepalle	100	44	44
Dokur	80	25	31
Shirapur	88	38	43
Kalman	94	46	49
Kanzara	52	18	35
Kinkheda	32	12	38
Total	446	183	41

Table 17. Comparison of current wage rates with the base year wages at current prices (Rs./day).

Village	Wage rates in 1975–78*	Wage rates in 1975–78 at 2001–04 prices	Wage rates in 2001–04	Percentage increase between 1975–78 and 2001–04
Aurepalle				
Male	2.7	18.1	52.0	187
Female	1.8	11.7	23.0	97
Shirapur				
Male	3.4	22.5	63.3	181
Female	1.8	12.1	27.0	123
Kanzara				
Male	4.1	27.5	46.6	69
Female	2.1	14.0	25.0	79
Average				
Male	3.4	22.7	54.0	138
Female	1.9	12.6	25.0	98

Source: Data in column 2 are from Walker and Ryan (1990).

holds good. The increase in real wages (Table 17) and integration of labour markets between urban and rural areas have bestowed a relatively higher premium on labour endowments.

On average, the real wages of male labour increased by 138% between 1975–78 and 2001–04. While the real wage of female labour also increased, the rate of increase at 98% was relatively slower when compared to male wages. The increase in real wages of male labour was most rapid in Aurepalle village with an increase of 187%. It was closely followed by an increase of 181% in Shirapur village. The real wages of male labour increased slowest in Kanzara village, by 79%. The biggest increase of 123% in real wages for female labour was recorded in Shirapur village. In Aurepalle, it was around the sample average at 97%. Just as in the case of male labour, the growth in real wages of female labour was the slowest in Kanzara village. However, real wages of female labour increased slightly faster than those of male labour in Kanzara.

Household categories and incidence of poverty

Increases in real wages and reduction in the returns to land and management from crop enterprises have altered the distribution of income in the VLS villages (Table 18). While the average household income still increased with the size of holding, the incremental income due to additional land is much smaller. Interestingly, the incidence of poverty was much lower in labour households when compared to that in small households. It was about the same when compared with the incidence of poverty among medium and large farm households. Although

Table 18. Relationship between land holding and incidence of poverty, 2001–04.

Size group	Operational holding (ha)	Household income (Rs./year)	Percentage of households below poverty line
Labor	0.15	26,872	38
Small	1.19	29,330	45
Medium	3.14	37,537	38
Large	7.50	40,856	39
Sample mean	3.00	32,818	41

the average income was lower in the labour households, the variability within the size group was relatively lower and, hence, the proportion of households earning less than Rs.20,000 per year was smaller. In contrast, the variability in incomes was much higher in the landowning groups due to a broad range of crop performance. It showed that labour households have more stable incomes when compared to those with larger land endowments. Although higher landownership ensures higher asset values, they are unable to ensure higher and more stable incomes. But those with adequate labour endowments can earn slightly lower but more stable incomes.

Search for alternate development pathways

With the decline of incomes from crop and livestock enterprises and limited opportunities in the agricultural labour market within the villages, households are constantly on the lookout to earn better and more stable incomes to sustain the livelihoods of their households. One development pathway is to invest in water exploration. If they succeed in striking water in wells/bore wells, they can improve their livelihood prospects within the village. But since the rate of success in water exploration is quite low, very often they land themselves in debt. Investment in business is a good pathway for development for the households that are relatively better-off. But it also entails some risk of losing investment. Investment in education of children so that they can find salaried jobs in formal or informal sectors turned out to be a good strategy wherever there was good infrastructure for education. Those who are unable to invest in either water exploration or business or education often resort to migration to urban areas or to far-off places where they can find employment for more days in a year at higher wages. What starts as a temporary migration during drought years turns, in many cases, into permanent migration. Those who are engaged in certain caste occupations find increased demand and returns for their products while others migrate in search of places where their services are in demand or acquire new skills to achieve better livelihoods. The governments have introduced several developmental and welfare schemes in the rural areas to mitigate the distress of needy households during bad years. Those who are able to participate and access the benefits can get temporary relief, if not a permanent escape from poverty. Furnished below are some of the details of investments on water exploration, contribution of non-farm sector, migration and benefits from government programmes.

The Deccan Plateau region, where the six VLS villages are located, has a rocky stratum below the ground and can yield small quantities of water at some specified locations. Since access to irrigation helps them in insulating their production from climatic risks, there is a mad scramble among the farmers to drill deep and secure water for irrigation. The 446 households in the sample have together made 551 attempts to gain access to water during the study period of two decades (Table 19). But only 36 out of the 100 attempts made are successful in that they are still yielding

Table 19. Investments in water exploration, 1985–2004.

Village	Number of attempts (number)	Irrigation sources presently in use (number)	Cost per successful source of irrigation (Rs.)	Investment per sample farmer (Rs.)
Aurepalle	126	37	21,340	15,205
Dokur	131	26	26,461	18,319
Shirapur	110	53	25,981	22,879
Kalman	99	63	23,103	25,381
Kanzara	57	16	23,300	11,934
Kinkheda	28	2	15,333	3,680
Mean	92	33	22,586	16,233

Table 20. Role of non-farm sector, in VLS villages, 2001–04 (in Rs.).

Village	Income from non-farm labour	Income from other non-farm sources	Total non-farm income	Total income
Aurepalle	2289 (8.9)	6228 (24.1)	8517 (33.0)	25814 (100.0)
Dokur	2853 (8.7)	12165 (37.2)	15018 (46.0)	32671 (100.0)
Shirapur	2609 (6.3)	21389 (51.3)	23998 (57.6)	41665 (100.0)
Kalman	3590 (10.7)	23383 (69.8)	26973 (80.5)	33493 (100.0)
Kanzara	2188 (7.3)	12211 (40.9)	14399 (48.3)	29836 (100.0)
Kinkheda	624 (1.9)	11111 (33.2)	11735 (35.1)	33426 (100.0)
Average	2359 (7.2)	14415 (43.9)	16773 (51.1)	32818 (100.0)

some water. The average command area of a functioning irrigation source is 1.8 ha and it involved an investment of Rs.22,586. The additional return from an irrigation source was estimated at Rs.3723 and the return on the investment worked out at about 10.5% per year. On an average, a sample household invested Rs.16,233 in water exploration. The returns to the investments on water exploration were moderate and roughly equalled the rate of interest charged on the investment loans. Although the returns are not high, there is a stability of income for those having access to irrigation.

Investments on water exploration

Approximately one-half of the total income of the households was earned from the non-farm sources (Table 20). This proportion was the highest in the Solapur villages, Kalman and Shirapur. Nearness to urban and industrial agglomerations helped these villages in getting substantial income from non-farm sources. This proportion was slightly less than 50% for Kanzara and Dokur while it was only about one-third for Kinkheda and Aurepalle. As the share of non-farm income in the total income increases, there will be a greater stability in the incomes of the households. Even in the future, the non-farm incomes hold the promise to increase the incomes and employment of the rural households in the SAT.

Due to inadequate opportunities for work in the villages, workers migrate longer distances and to urban areas in search of work. On average, 0.3 persons from a sample household migrated for work (Table 21). This proportion was as high as 0.9 in Dokur village. A household earned about Rs.5498 per year from migration from 65 days of employment at an average wage of Rs.85 per day. The migrants travelled an average distance of 39 km. While the migrants from other five villages travelled shorter distances and worked for fewer days, those from Dokur village travelled a longer distance and worked for a full season. Since this village faced acute water shortage and a substantial drop in agricultural activities, the labour force relied heavily on migration to distant places for work.

Table 21. Migration of labour force by village.

Village	No. of persons migrated per HH	Avg. no. of days employed	Avg. amount earned (Rs.)	Avg. earnings per day (Rs.)	Avg. distance traveled (km)
Aurepalle	0.4	78.0	5103.0	65.4	18.0
Dokur	0.9	174.0	11981.0	68.9	121.0
Shirapur	0.2	56.0	5164.0	92.2	15.0
Kalman	0.1	16.0	1777.0	111.1	9.0
Kanzara	0.2	40.0	6327.0	158.2	22.0
Kinkheda	0.1	26.0	2633.0	101.3	49.0
Average	0.3	65.0	5498.0	84.6	39.0

Table 22. Benefits received by respondent households from government programmes in different villages during 1985–2004 (Rs.).

	1985–2001		2001–04	
Village	Total	Per household	Total	Per household
Aurepalle	383,000	3830	430,341	4303
Dokur	250,130	3127	457,983	5725
Shirapur	496,094	5637	677,851	7703
Kalman	623,872	6637	1,398,432	14877
Kanzara	185,450	3566	296,040	5693
Kinkheda	42,000	1313	136,323	4260
Average	330,091	4441	566,162	7617

The union and state governments have introduced a number of developmental and welfare programmes to alleviate poverty and enhance employment opportunities, besides transferring some basic assets like housing plots, lands, livestock, agricultural machinery etc. Participation in most of these programmes is targeted to rural poor while some programmes are open to all the villagers. The benefits accessed by a sample household in VLS villages worked out at Rs.4441 during the period of 1985–2001 and Rs.7617 during the three-year period of 2001–04 (Table 22). This shows that the intensity of the government programmes and the benefits accessed are increasing over time. Participation in the government programmes is helping them to withstand the income shortfalls to some extent but is unable to lift the households out of poverty.

Malady and remedy

Despite various options now available to households in the SAT areas, a majority of the population still depends on agriculture and agro-based enterprises. Unless the viability of these enterprises improves, we cannot visualize a reduction of poverty in the SAT areas. The sharp differences between the predominantly irrigated areas and rainfed areas in terms of viability, income levels and degree of prosperity have received the attention of policy makers in recent years. It is recognized that farmers in the rainfed areas are trapped in debt due to repeated crop failures during drought years. The 'National Commission' on farmers estimated that about 44 million farmers in the country are deeply indebted and most of them are concentrated in the rainfed regions of the country. A few thousand farmers from the states of Maharashtra, Andhra Pradesh and Karnataka have resorted to the desperate step of committing suicide for the fear of losing their honour. The government of India came out with a special package of Rs.160,000 million to support farming in 28 districts of these states where the incidence of suicides has been the highest (Meeta and Rajivlochan 2006). Similarly, the government of India has also come up with the National Rural Employment Guarantee Act (NREGA) and is implementing it in most of the rainfed districts of the country to provide the necessary supplementary employment for the agricultural labourers (Ministry of Law and Justice 2005).

Policy correction needed

In order to improve the viability of crop and livestock enterprises in the predominantly rainfed areas, there is an imperative need to correct the policy bias against rainfed agriculture over the past five decades. At the moment, there is a greater divergence between the social costs and the private costs of crop production in the case of irrigated agriculture due to the heavy incidence of subsidies for power, irrigation, fertilizers and interest on farm loans. This gap between social and

private costs of production is quite small for rainfed agriculture. One straightforward suggestion is to equate the degree of subsidy for a unit of output from irrigated and rainfed areas. But such a step may not be politically feasible. Hence, the policy makers have to come out with countervailing subsidies for rainfed agriculture to put it on a level playing field with irrigated agriculture. But unless the policy correction is done, it is unlikely that rainfed agriculture can be remunerative. While there is recognition of the policy bias in favour of irrigated agriculture, there is no adequate political will to set it right. Farmers in rainfed areas are unorganized and have failed to create a unified platform and lobby for policy changes. Until such organization emerges, one cannot hope that the policy bias against rainfed agriculture will be corrected.

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