Land use Dynamics in Rainfed Agriculture: Driving forces and sustainability

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Introduction

Agricultural land is the crucial resource, as it has to feed the billions given the fact that it cannot be increased but only be altered. As it is the land, the basic factor of production is getting scarcer as the constraints of its exploitation due to various pressures is continuing. Indian agriculture has to carry the burden of feeding the growing population from its available agricultural land of about 142 million ha, which accounts for 43 percent of the geographical area.

Some of the major concerns of rainfed agriculture are that bulk of coarse cereals, pulses, oilseeds and cotton are produced, Increasing commercial crop cultivation, more exposure to risk and high returns, land use change driven by net returns than land capability, Current fallows are increasing and grazing/pasture lands decreasing, Support two-thirds of the livestock, Investments low due to high risk and Poor extension and credit services.

Land use concerns in rainfed agriculture

The land use dynamics was worked out using the time series data of the nine-fold land use classification. Indicators viz. per capita land availability, per capita forests, per capita cultivated land, per capita wastelands and cropping intensity were used for assessing the temporal changes over the period 1950-51 to 2005-06. The per capita land available, which was 0.91 ha in 1951, decreased to 0.29, a decrease of almost 68 percent. Similarly in case of forests, the reduction was 45 percent. The reduction in per capita cultivated land (net sown area) was much higher at 81 percent during the period 1951 to 2006. This is an alarming situation. The reduced area might have been offset by the productivity gains, but how far it will sustain will be a big issue. This may be partly explained by the increased cropping intensity from 111 to 136 percent over this period (Table-1). The wastelands, which may be used for productive purposes, have also reduced with about 0.13 ha per capita from about 0.33 ha during this period.

Table- 1: Change in per capita land by category of uses

Year	Population	Per capita land	Per capita forests	Per capita Cultivated land	Per capita wastelands	Cropping Intensity (%)
1951	361090000	0.91	0.11	0.24	0.33	111.1
1961	439230000	0.75	0.12	0.18	0.30	114.7
1971	548160000	0.60	0.12	0.12	0.26	118.2
1981	683330000	0.48	0.10	0.09	0.20	123.3
1991	846420000	0.39	0.08	0.07	0.17	129.9
2001	1028610000	0.32	0.07	0.05	0.14	131.1
2006	1131471000	0.29	0.06	0.05	0.13	135.9
% Reduction		**68**	**45**	**81**	**62**	**-22**

Although it may be mainly attributable to the population growth at the outset, it may be seen that the population growth itself is stabilizing at around 2, which was almost 2.5 percent per annum during 1960s to1980s, compared to this, the food grain crops area was a mere 0.26 percent. The growth of crops like sugarcane, condiments and that of oilseeds was around 2 percent. Significant strides in area have

been made by fruits and vegetables, which grew at around 3 percent. Thus, it may be inferred that although over the years there was tremendous pressure on land for agricultural and other uses, its management by way of increase in double-cropped area coupled gains in productivity have sustained the agricultural production. However, we might have reached a plateau and it may be time to assess the land allocation for various alternative purposes before the situation becomes alarming.

Rainfed Districts in Major States

The country has almost 37 percent of the districts under the drought prone and desert development programme. Out of the total area, 41 percent is under these districts. States like Rajasthan, Karnataka and Maharashtra have over 60 percent area under DPAP/DDP coverage.

Table-2: Particulars of Rainfed Districts

State	DPAP/DDP districts	% Geographical area
Andhra Pradesh	12	43
Bihar	6	10
Chattisgarh	8	16
Gujarat	20	53
Haryana	7	47
Himachal Pradesh	5	85
Jammu & Kashmir	4	50
Jharkhand	14	44
Karnataka	21	61
Madhya Pradesh	23	29
Maharashtra	25	63
Orissa	8	17
Rajasthan	27	67
Tamil Nadu	17	23
Uttar Pradesh	15	15
Uttaranchal	7	28
West Bengal	4	13
Total	**223**	**41**

Agricultural Holding Size

Fragmentation and subdivision of agricultural holdings is a common problem in the Indian context. Just in the span of a decade (1990-2000), the agricultural land holding has decreased from 1.55 to 1.23 ha in Andhra Pradesh (Table-3). Similarly in Karnataka, the average size came down from 2.11 to 1.78 (Table-4). These account for about 2.1 and 1.6 percent reduction annually.

Land Holding Distribution

An analysis of land ownership among various land holding categories (marginal, small, medium and large) in some states indicate that the situation is moving towards the egalitarian line, with reduction in gini values, especially in states like AP and Karnataka (Table-5). On the other hand in a state like West Bengal, where, the gini values are already lower have further come down over a period.

Table- 3: Agricultural Holding Size in Andhra Pradesh

Districts	**1990**	**2000**
Srikakulam	0.84	0.73
Visakhapatnam	1.11	0.92
East Godavari	1.05	0.79
West Godavari	1.15	0.93
Krishna	1.21	1.02
Guntur	1.12	1.00
Nellore	1.22	1.12
Kurnool	2.72	2.07
Anantapur	2.76	2.00
Cuddapah	1.83	1.36
Chittoor	1.30	1.02
Nizamabad	1.30	1.01
Medak	1.58	1.19
Mahabubnagar	2.23	1.67
Nalgonda	2.04	1.48
Warangal	1.40	1.26
Khammam	1.80	1.44
Karimnagar	1.30	1.05
State average	**1.55**	**1.23**

Table- 4: Agricultural Holding Size in Karnataka

Districts	**1990**	**2000**
Kolar	1.46	1.21
Tumkur	1.65	1.67
Mysore	1.39	1.03
Mandya	0.83	0.66
Hassan	1.32	1.03
Shimoga	1.76	1.39
Chickmagalur	1.97	1.55
Chitradurga	2.56	2.24
Bellary	2.70	2.30
Dharwad	2.90	2.89
Belgaum	2.38	2.02
Bijapur	3.75	3.24
Bidar	2.80	2.08
Raichur	2.97	2.42
Gulbarga	3.28	2.55
Dakshina Kannada	1.17	1.00
Uttara Kannada	1.04	0.91
State average	**2.11**	**1.78**

Table-5: Gini values of Land Ownership Change in Some States

Andhra Pradesh	Karnataka	West Bengal
• In 1990 : 0.39 to 0.50 • In 2000: 0.42 to 0.52 • In 11 districts Gini values reduced marginally • In 5 districts values remained constant	• In 1990 :0.41 to 0.59 • In 2000: 0.39 to 0.57 • In majority districts decrease in gini value (15 out of 20)	• **In 1990 : 0.24 to 0.39** • In 1995 : 0.20 to 0.35

Population and Land Availability Perspective

It is estimated that about 500 million people will be living in rainfed areas by 2025 when India's population is expected to reach 1500 m. Due to accelerated rural-urban migration, particularly, from drought prone areas, decrease in people engaged in farming likely per capita land availability will shrink. In semi-arid and sub-humid areas, the operational holding is likely to be so small that it might be uneconomical to cultivate some of the conventional cereal crops.

Commodities and Productivity Trends

A food grain yield of 2 t ha^{-1} (from <1.0 t) required from drylands (and about 4 t ha^{-1} from irrigated agriculture) to feed population by 2025 AD. Similarly ensuring protein security will become an important issue in view of the predominantly vegetarian habits of the populace. A matter of concern is dwindling availability of vegetable (pulses) proteins whose current supply is about 25 g $head^{-1}$ day^{-1} against the minimum dietary need of about 70 g. Further, as compared to the past, much rapid shifts in cropping pattern are now taking place mainly driven by profitability, rather than productivity factor. However, in terms of crop diversification in rainfed agriculture, the trend seems to be towards less diversification, or may be specialization is happening (Table-6). With change in dietary habits and consumption patterns, it is estimated that by 2025 there will be a lesser demand for cereals and manifold demand for products like milk, meat, fish, fruits, pulses and edible oils. This requires a matching reallocation of land use in favour of livestock, pulses and oilseeds.

Table- 6: Simpsons index (% change in 1990 to 2004)

% Change	No. of RF Dists	% of Disticts
< 0	280	84
0 to 5	45	14
> 5	7	2

Livestock and Fodder Production

The Working Group on Animal Husbandry and Dairying of the Planning Commission in its Report (2002) projected a demand of 1170 m t of green and 650 m t of dry fodder with the corresponding supply figures at 411.3 and 488 m t respectively. This leaves a deficit of 64.87 % for green and 24.92% for dry fodder, respectively. By 2025, with significant increase in milk and other animal products, it may be necessary to devote at least 10% of the net sown area for fodder production, which is presently around 5%.

Water Availability Issues

Current rainwater use efficiency for crop production in rainfed areas is 30-45 %. Though the per capita water availability is estimated to reach the critical limit of 1700 m^3 by 2008, many of the rainfed regions are already facing acute water shortage due to demographic pressure. Assuming that rainfed areas have to produce 150 million tonnes of food grains by 2025, an estimated additional 24 million ha m water would be required which equals the estimated harvestable run off. It is imperative that we create and expand markets for natural resources to accelerate agricultural growth. Similarly establishing economic incentives around water use by creating strong water rights for users and paying irrigators to use less water will be another measure. Developing more aggressive markets for agricultural and forest carbon is necessary to generate new value streams in rural areas. Another intervention would be expanding markets for environmental services such as watershed management and biodiversity.

Prime Drivers of land use change

The availability and suitability of the technologies that make a difference. Similarly the market prices and incentives available influence the land use changes. Significant government policies and capital expenditure in the sector can also impact. Market forces like risk management instruments and the relative demand scenario for various commodities are the major driving forces for land use change.

A case study in Andhra Pradesh has brought out the following lessons on diversification and land use:

- Availability of new technologies and high returns (eg. high yielding maize hybrids, Bt cotton etc.,)
- Possibility of mechanization and good returns (300% increase in area of bold seeded chickpea on black soils in Prakasham and Kurnool district in one decade)
- Non availability and rising labour costs and assured markets (eg.Subabul and eucalyptus based farm forestry in 1.5 lakh ha. in Guntur, Prakasam, Khammam and Krishna districts in one decade on soils which are good for pulses and oilseeds
- Government programmes (eg. NHM triggering area under horticulture in several districts due to incentives like subsidy on drip irrigation and planting material etc)
- Processing facilities (eg. Soyabean area in Adilabad)
- Unfavourable weather/climate variability (eg. Sharp decline in short duration pulse area in Khammam, Krishna and Warangal districts due to rains during harvest)

Some Opportunities

To promote prudent resource use and influence proper land use, the following may be handy:

- Tools like crop or weather insurance can be used either as positive or negative incentive to encourage technology adoption in rainfed areas
- The insurance product may have an inbuilt condition that a given product is applicable only if a particular crop or commodity is grown on a suitable land or climatic zone
- Government can subsidize part of the premium for farmers who adopt scientific land use or rational water use
- New opportunities are also arising in the area of CDM and carbon credits where farmers can be compensated for adopting conservation practices which contributes to scientific land use and sustainable productivity on a long term basis, but relatively lower returns on short term