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DYNAMICS OF LAND USE IN DIFFERENT STATES OF INDIA

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ABSTRACT

The study examines the trends and dynamics of annual shifts among different land use classes in Indian States which may have adverse implications for agricultural growth and ecological balance. A general declining trend was observed in the area under permanent pastures and grazing lands and barren and unculturable lands. The area under non-agricultural uses, cultivable wastes and fallow showed a positive growth in most of the States. Intersectoral land budgeting revealed that area shifts are occurring from both desirable and undesirable ecology sectors towards agricultural as well as non-agricultural sectors. Further, the study identifies the operation of vicious circle of land use dynamics within agricultural sector.

Considerable shifts in area under different land use classes have occurred in the country during the post independence period on account of several factors such as rising population, expansions in urban housing (urbanization), industrialization and infra-structures, and the Government programmes for reclamation of barren and waste lands. These shifts in land use may have tremendous implications towards future agricultural and industrial growth, urban expansion and the ecological balance in different parts of the country. While some land use shifts might have occurred in the desirable direction, some others might have been in the undesirable direction. It is, therefore, necessary to make a comprehensive examination of these land use shifts in different states of the country. The present study was undertaken with this in view and the following specific objectives :

- (i) To estimate the trends in different land use classes in different states of the country and examine their adverse implications for agricultural growth and ecology.
- (ii) To study the dynamics of annual shifts among different land use classes in different states and its adverse implications.

Methodology

Both linear and log linear trend equations were estimated to study the trend in land use in each class in each state and for the country as a whole.

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From the estimated significant trend values (which were found to be significant mostly at 1 per cent level, with some at 5% and 10% levels), compound growth rates in per cent terms and annual rates of change in absolute terms (in '000 ha) were calculated.

Following Pandey and Tewari (1987), the dynamics of land use shifts in each state was examined with the help of a simple identity of linearly additive land use changes. The first accounting identity linearly sums up the area under all land use classes which is equal to total reporting area.

$$(1) R = F_r + P + M + N + U + W + F_c + F_o + C$$

where, R = Total reporting area;

F_r = Area under forests;

P = Area under permanent pastures;

M = Area under miscellaneous tree crops;

N = Area under non-agricultural uses;

U = Usar and barren lands;

W = Culturable waste land;

F_c = Current fallows;

F_o = Fallow land other than current fallows; and

C = Net area cultivated.

$$(2) \Delta R = \Delta F_r + \Delta P + \Delta M + \Delta N + \Delta U + \Delta W + \Delta F_c + \Delta F_o + \Delta C$$

Now, the total land endowment can be conveniently grouped into three broad sectors, viz. (i) ecological sector (E) comprising F_r , P , M and U , (ii) agricultural sector (A) comprising W , C , F_c and F_o and (iii) non-agricultural (NA) sector. The ecological sector can be further divided into two sub-sectors, viz., (i) the desirable ecology (E_1) comprising F_r , P and M , and (ii) undesirable ecology (E_2) comprising U . Then, the net changes within each sector can be grouped as :

$$(3) \Delta E = \Delta E_1 + \Delta E_2 = (\Delta F_r + \Delta P + \Delta M) + (\Delta U).$$

$$(4) \Delta A = \Delta F_c + \Delta F_o + \Delta W + \Delta C.$$

$$(5) \Delta R = \Delta E_1 + \Delta E_2 + \Delta A + \Delta N$$

Thus, the annual rates of change in different classes were worked out in this study and budgeted as per the identities (3), (4) and (5) above. This budgeting facilitated the analysis of direction of land use shifts and their dynamics.

There were several re-organisations made among different state boundaries during 1950's and 60's. Also, there were some conceptual problems in accounting area under different classes which were resolved in early sixties. Further, the Agricultural Revolution of late sixties initiated significant changes in land use both within agricultural sector as well as outside agricultural sector. Therefore, the year 1966-67 was

Table 1. Estimated compound growth rates (in per cent terms) in different

Sl. No.	States	Total reporting area	Area under forest	Area put to non-agril. uses	Barren & unculturable land
1	2	3	4	5	6
1.	Andhra Pradesh	-0.01	0.04	0.36	0.64
2.	Assam	-0.05	-0.45	+1.40	-1.20
3.	Bihar	0.00	-0.20	-0.49	-2.00
4.	Gujarat	0.10	1.50	5.30	-4.30
5.	Haryana	0.00	-2.10	1.90	13.60
6.	Himachal Pradesh	-1.86	-12.30	0.00	-6.00
7.	Jammu & Kashmir	0.00	0.19	-1.70	0.22
8.	Karnataka	0.04	0.58	1.40	0.00
9.	Kerala	0.06	0.51	0.20	0.00
10.	Madhya Pradesh	0.01	-0.25	0.53	0.00
11.	Maharashtra	0.00	-0.13	2.00	10.10
12.	Meghalaya	-0.01	0.59	3.90	0.00
13.	Mizoram	0.20	0.08	0.00	-10.40
14.	Nagaland	-1.60	0.57	7.70	0.00
15.	Orissa	0.00	3.70	-4.00	-9.60
16.	Punjab	0.28	6.00	1.40	-7.00
17.	Rajasthan	0.00	4.40	1.90	-4.30
18.	Tamil Nadu	0.01	0.27	1.70	-2.80
19.	Tripura	0.09	-0.72	0.00	18.87
20.	Uttar Pradesh	0.03	4.40	0.93	-4.80
21.	All India	-0.04	0.04	1.60	-3.50

considered as the base period, and the statewide land use data from 1966-67 to 1983-84 was obtained from various secondary sources for use and analysis in this study.

Results and Discussion

The main objective of the study was to identify the unfavourable trends and dynamics of annual shifts among different land use classes which may have adverse implications for agricultural growth and/or

land use classes in different states during 1966-67 to 1983-84

Permanent pastures and grazing land	Land under misc. tree crops	Cultivable waste land	Fallow land other than current fallows	Current fallow	Net sown area
7	8	9	10	11	12
-1.40	-0.68	-2.60	3.40	0.00	-0.20
-6.10	1.80	-1.10	-4.90	0.00	1.40
1.50	1.11	-1.60	0.32	0.00	0.00
-1.80	-12.70	11.50	-2.40	0.00	0.00
-4.20	-9.40	-3.30	0.00	-3.40	0.39
-1.80	0.00	0.00	9.59	-2.00	0.39
-1.10	0.00	0.47	-6.80	0.00	0.37
-1.70	0.00	-1.80	-1.70	0.00	0.21
-16.30	-7.10	3.10	0.00	5.10	0.14
-1.40	3.30	-1.40	0.00	1.20	0.38
0.63	0.00	1.40	-2.60	-2.50	0.00
-4.50	3.80	-2.30	0.00	0.00	1.60
8.10	0.00	0.00	11.10	10.40	3.70
0.00	0.00	0.00	0.00	8.00	9.30
-3.70	-1.10	-0.30	3.40	-2.20	0.00
-4.00	-1.90	-7.90	0.00	-10.00	0.41
0.00	8.00	0.00	0.00	0.00	0.48
-4.80	0.00	-4.30	-1.40	3.90	-0.29
-10.00	-1.20	-7.50	-4.40	-6.00	0.29
10.90	-3.00	-1.10	-1.20	3.40	-0.07
-0.80	-1.20	0.00	0.45	0.73	0.23

ecological balance. The estimates of compound growth rate and annual rate of change in different land use classes in different states are presented in Table 1 and 2. The salient observations regarding undesirable trends having adverse implications as made from both these tables are discussed below.

Significantly declining trends are noticed in the total reporting area in some states, particularly in Himachal Pradesh, Nagaland and at all

Table 2. Estimated annual rates of change (in 000 ha.) in different land

Sl. No.	States	Total reporting area	Area under forest	Area put to non-agril. uses	Barren & unculturable land
1	2	3	4	5	6
1.	Andhra Pradesh	-1.60	2.29	7.76	0.83
2.	Assam	-3.58	-8.60	11.10	-17.93
3.	Bihar	0.00	-7.92	-7.49	-20.37
4.	Gujarat	20.32	24.32	40.04	-131.38
5.	Haryana	-0.02	2.33	5.80	15.01
6.	Himachal Pradesh	-183.50	121.64	0.00	-10.30
7.	Jammu & Kashmir	0.00	4.60	-4.35	-0.27
8.	Karnataka	6.72	16.89	13.00	0.00
9.	Kerala	2.03	5.08	0.49	0.00
10.	Madhya Pradesh	4.77	-33.84	11.49	0.00
11.	Maharashtra	0.00	-6.89	17.34	157.58
12.	Meghalaya	-0.13	4.60	2.92	0.00
13.	Mizoram	0.45	0.91	0.00	-25.62
14.	Nagaland	-20.42	0.15	2.60	0.00
15.	Orissa	0.00	190.64	-27.27	-45.43
16.	Punjab	0.42	9.84	5.74	-12.00
17.	Rajasthan	0.00	64.48	26.47	-160.50
18.	Tamil Nadu	0.85	4.99	26.81	-19.16
19.	Tripura	0.88	-4.41	0.33	9.05
20.	Uttar Pradesh	7.78	71.13	18.50	-66.07
21.	All India	-100.45	2.28	250.00	-810.47

India level, with the absolute annual rate of decline being about one lakh hectare at the country level which is very high and alarming. These trends need be brought to zero level through proper land use survey using remote sensing techniques.

In regard to area under forest, negative growth rates are observed in the states of Assam, Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra and Tripura. While in Assam, the declining trend in forest area is due to continuing Jhoom cultivation practice, it appears

use classes in different states during 1966-67 to 1983-84

Permanent pastures and grazing land	Land under misc. tree crops	Cultivable waste land	Fallow land other than current fallows	Current fallows	Net sown area
7	8	9	10	11	12
-14.07	-2.06	-28.22	-36.09	0.00	-1.88
-12.10	4.17	-5.70	-5.91	0.00	32.80
2.45	2.16	-7.81	3.01	0.00	0.00
-11.97	-1.14	114.31	7.63	0.00	0.00
-1.68	-0.28	-1.47	0.00	-5.93	13.12
-21.70	0.00	0.00	0.36	-1.07	2.22
-1.19	0.00	1.40	-0.83	0.00	2.63
-26.36	0.00	-10.18	-10.00	0.00	21.84
-1.81	-6.50	3.10	0.00	1.56	2.82
-41.77	3.12	-28.14	0.00	9.20	71.43
9.80	0.00	12.56	-23.68	-24.11	0.00
-0.87	4.80	-11.28	0.00	0.00	8.40
3.33	0.00	0.00	21.85	14.31	2.05
0.00	0.00	0.00	0.00	7.10	8.40
-15.84	5.44	-45.83	5.36	-14.10	0.00
-0.18	-0.08	-5.19	0.00	9.50	17.80
0.00	1.05	0.00	0.00	0.00	62.21
-9.82	0.00	-17.72	-7.80	44.01	-16.67
-3.78	-1.10	-0.28	-0.11	-0.17	0.71
14.92	-22.90	-14.87	-7.62	30.21	-10.50
-94.22	-46.69	0.00	42.22	95.62	216.10

that in the other states the pace of afforestation on deforested areas is not matching properly. These trends are likely to lead to a very grave situation on two fronts, one of declining forest causing severe ecological imbalances including adverse agroclimatic changes in these states, and the other of an acute shortage in meeting the rising fuel and fodder demands in the local rural areas and timber demand in urban areas on account of population and developmental pressures. Therefore, special attention and programmes are needed to check Jhoom cultivation in Assam and accele-

Table 3. Budgeting of inter-sectoral land use shifts

Sl. No.	States	Annual rates of change ('000 ha.)					
		Desirable Ecological sector (E ₁)	Undesirable ecological sector (E ₂)	Non-Agril. sector (N)	Agril. sector (A)	Net sectoral changes*	Total reporting area (R)
1	2	3	4	5	6	7	8
1.	Andhra Pradesh	-13.84	0.83	7.76	-66.19	-71.44	-1.60
2.	Assam	-16.50	-17.93	11.10	21.19	-2.17	-3.58
3.	Bihar	-3.31	-20.31	-7.49	-4.80	-35.91	0.00
4.	Gujarat	11.21	-131.38	40.04	106.68	26.55	20.32
5.	Haryana	-4.29	15.01	5.08	6.12	21.92	-0.02
6.	Himachal Pradesh	-143.34	-10.00	0.00	1.51	-151.86	-183.50
7.	Jammu & Kashmir	3.41	-0.27	-4.35	3.20	1.99	0.00
8.	Karnataka	-9.47	0.00	13.00	1.67	5.19	6.72
9.	Kerala	-3.23	0.00	0.49	7.48	4.74	2.03
10.	Madhya Pradesh	-72.49	0.00	11.49	52.49	-8.51	4.77
11.	Maharashtra	2.91	157.58	17.34	-35.23	142.90	0.00
12.	Meghalaya	3.73	0.00	2.92	-2.88	3.77	-0.13
13.	Mizoram	1.32	-25.62	0.00	38.21	13.91	0.44
14.	Nagaland	0.15	0.00	2.60	15.50	18.25	-20.42
15.	Orissa	169.36	-45.48	-27.27	54.91	42.06	0.00

1	2	3	4	5	6	7	8
16.	Punjab	9.58	-12.00	5.74	3.14	6.46	0.41
17.	Rajasthan	65.57	-160.50	26.17	62.21	-6.59	0.00
18.	Tamil Nadu	-4.83	-19.16	26.81	2.28	5.51	0.05
19.	Tripura	-9.28	9.05	0.00	0.15	-0.09	0.88
20.	Uttar Pradesh	63.15	-66.07	18.50	-2.78	12.80	7.78
21.	All India	-138.63	-810.74	250.00	353.94	-341.16	-107.45

*The net sectoral changes equal algebraic sum of $\Delta N + \Delta E_1 + \Delta E_2 + \Delta A$.

rate immediate afforestation on denuded forest lands in the other six states mentioned above. The remaining states show a positive growth rate in their forest areas as per the reported data.

The three states of Bihar, Jammu & Kashmir, and Orissa show negative growth rates, i.e., deceleration in regard to area put to non-agricultural uses. The reporting of the data on this account needs close scrutiny because no apparent reason could be attributed for this decline in area under non-agricultural uses in these states, particularly when at least rise in population and urbanisation have occurred in all the states during this period. Of course, being industrially backward, these three states seem to have not experienced much the demand pressure for land for industrialisation and infrastructural developments. All the other states, except Himachal Pradesh, Mizoram and Tripura, show a positive growth rate in area put to non-agricultural uses which is due to population rise, urbanisation and industrialization factors. The annual rates of increase in the area under non-agricultural uses is observed to be very high (more than ten thousand ha) in Gujarat, followed by Tamil Nadu, Rajasthan, Uttar Pradesh, Maharashtra, Karnataka, Madhya Pradesh and Assam in that order. This is apparently because of the greater thrust on industrialisation and infrastructural developments shown by these states besides of course the rise in population and urbanisation. However, such a high rate of annual increase in this class of land use in these states may have serious long run implications in terms of the area under miscellaneous tree crops and net sown area around the urban centres which may get diverted to non-agricultural uses

In regard to barren and unculturable land, favourable declining trends are noticed in a large number of states and the country as a whole. However, an undesirable positive and high rate of growth in this class of land use is observed in the three states of Haryana, Maharashtra and Tripura. Detailed investigations at micro level are needed in these states in regard to nature and causation of the increase in barren lands and the possible remedies.

A general declining trend is observed in the area under permanent pasture and grazing lands in most of the states and at the country level, except in the four states of Bihar, Maharashtra, Mizoram and Uttar Pradesh which show an increasing trend. Similarly, a declining trend is also observed in the land under miscellaneous tree crops in several states such as Andhra Pradesh, Gujarat, Haryana, Kerala, Orissa, Punjab, Tripura and Uttar Pradesh, as also at the country level. In fact, the deve-

lopmental factors through rise in demand for land for urbanization, industrialization and infrastructures are causing substantial land use shifts from these two classes to nonagricultural uses. Both these land use classes significantly contribute to local village economy and the ecology, and are quite vulnerable to land demand pressures for nonagricultural uses. Hence, the declining trends in both these land use classes need be checked.

The trends in the remaining three land use classes of culturable waste land, fallow lands (both current and the others) and net sown area have great significance towards agricultural production. In the four states of Gujarat, Jammu & Kashmir, Kerala and Maharashtra, an unfavourable increasing trend in cultivable waste land is observed. Similarly, in several states, Andhra Pradesh, Bihar, Himachal Pradesh, Kerala, Madhya Pradesh, Mizoram, Nagaland, Orissa, Tamil Nadu and Uttar Pradesh, as also at the country level, a significant positive growth is observed in fallow lands (either current or other or both). Increasing trend in both these land use classes is at the cost of increase in net sown area which remained either constant or even declined in many of these states particularly Andhra Pradesh, Bihar, Gujarat, Maharashtra, Orissa, Tamil Nadu and Uttar Pradesh. In fact, the culturable lands around urban centres are reported as wastes or fallows for some years and then disposed off for nonagricultural uses. These trends are nullifying the efforts for waste land reclamation and may adversely affect agricultural growth, and, hence, need be checked.

The results obtained from the inter-sectoral budgeting of land use shifts are shown in Table 3. The net sectoral changes shown in this table are the algebraic sum of the annual rates of change in different sectors and, hence, must approximately tally with the annual rate of change in the total reporting area as per the identity equation (5) above. Keeping an allowance for estimational errors leading to divergence between the net sectoral changes and the changes in the total reporting area not to exceed ten thousand hectares, i.e., less than one per cent of the total reporting area, the inter-sectoral budgeting gave the following results. A high error component was observed in the nine states of Andhra Pradesh, Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Mizoram, Nagaland and Orissa. Therefore, for these states, no definite conclusions about the magnitude of inter-sectoral shifts can be made. However, the high significance levels of the estimated trend coefficients do put greater reliance on the direction of land flows even in these states. For the other eleven states, the results fairly tallied in the budgeting of inter-sectoral

land use shift and, hence, both the direction and magnitude of land flows can be analysed for definite conclusions in these states.

The results of inter-sectoral budgeting indicate that, in general, land use shifts are occurring from both the desirable ecology (E_1) and undesirable ecology (E_2) sectors to agricultural as well as non-agricultural sectors. The shifts from E_2 to other sectors are considered as the favourable dynamics, as occurring in the states of Assam, Bihar, Gujarat, Himachal Pradesh, Tamil Nadu and Uttar Pradesh. But the land use shifts from E_1 to other sectors, as occurring in the states of Andhra Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu and Tripura are considered as the unfavourable dynamics which need be controlled. The land use shifts from E_1 to other sectors will have serious economic as well as ecological implications. Some land use shifts from agricultural sector to non-agricultural sector are also observed in some states, though with definite conclusion only in two states of Meghalaya and Uttar Pradesh, which have serious implications towards agricultural growth in these states. The other remaining states are experiencing a net addition to the agricultural sector. Likewise, the states of Haryana, Maharashtra and Tripura exhibit the unfavourable trend of increasing area under undesirable ecological sector comprising usar and barren lands.

The intra-sectoral dynamics of land shifts within agricultural sector indicate an increasing trend in the area under fallow lands in several states. Also, a substantial rate of increase in waste lands in some states, particularly Gujarat and Maharashtra, is completely nullifying the aggregate country level impact of waste land reclamation being done in some other states of the country. In the states of Andhra Pradesh, Tamil Nadu and Uttar Pradesh, a net decline in cultivated area despite a substantial reclamation of waste and fallow land for cultivation indicates towards the operation of the vicious circle of land use dynamics. The vicious land use dynamics is also observed in more or less similar terms in the states of Bihar, Madhya Pradesh, Maharashtra and Orissa. This vicious land use dynamics while it adds to net cultivated area through reclamation of waste lands on one hand, also depletes the cultivated area by an equivalent or more amount of increase in area under fallow lands on the other hand. These unfavourable trends of both the increase in area under undesirable ecological sector (E_2) and the vicious land use dynamics lead to degeneration of this important natural resource and, hence, need to be controlled.

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