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Land use dynamics in Maharashtra: An economic analysis

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Abstract

An analysis of the structural changes in land use patterns over time offers valuable insights for the planned and sustainable management of land resources. Understanding these changes is crucial for fostering balanced development, conserving natural resources, and ensuring long-term ecological and economic stability. In light of this, the present study aims to analyse spatio-temporal changes in land use categories. The study was undertaken using data from secondary sources on area under land use categories were compiled from various issues of Statistical Abstract of Maharashtra State and other publications of Government. On the basis of availability of data, economic analysis in terms of percentage, compound growth rate (CGR), instability index and location coefficient has been worked out.

Results revealed that, the temporal changes in land use dynamics of Maharashtra state, land put to non-agricultural uses, land under miscellaneous tree crops and groves, current fallow and fallow other than current fallow land showed an increase while, permanent pastures and other grazing lands, cultivable waste land, net area sown, area under forest and barren and unculturable land registered a decline during post- liberalization period over pre-liberalization period. The growth rates and instability were found to be higher for fallow land categories (fallow other than current fallow and current fallow). In Maharashtra, the net area sown exhibited the highest concentration among all land use categories throughout the study periods. However, its concentration declined in the post-liberalization period compared to the pre-liberalization period.

Keywords: Land use, Fallow land, net area sown, pre-liberalization, post- liberalization, compound growth rate, instability index, spatio-temporal changes

Introduction

Land continues to be a vital source of livelihood for a significant portion of population in rural India and it continues to be the basis for well-being of a large section of the rural poor. The highly skewed and fragmented distribution of land holdings makes it even more vital as an asset in the Indian countryside. Agriculture and other primary sector activities that are based on land continue to be the prime source of livelihood for a majority of the population. Land and water resources and the way they are used are central to the challenge of improving food security across the world. Demographic pressures, climate change and the increased competition for land and water are likely to increase vulnerability to food insecurity, particularly in Asia and Africa. Providing sufficient food for everyone worldwide is the greater challenge now a day.

Dynamics in land use pattern is a complex phenomenon affected by several socio-economic, climatic conditions and institutional factors. Technological changes have also led to shift in land use pattern. Intensive cultivation, resulting in changing marginal land into more productive agricultural lands through capital intensive cultivation, ignited by technological changes. Land is important not only for producing food stuffs-cereals, pulses and other crops for consumption but also to generate surpluses to meet increasing demands of rising population. In developing industrial sector for laying down the transport network, communication, construction of dwellings and public institutions, planning its utilization for economic development and sustainable land use, options are kept as a priority for ecological reasons (Gairhe, 2011) [9].

The challenge of natural resources management in India is evident from the fact that, an ever-increasing population put enormous demand on land resources, which are indispensable for a country like India with 2.4 per cent of the worlds' geographical area supporting over 16 per cent of the world's population. Further, the country has 0.5 per cent of the worlds grazing lands but has over 18 per cent of world's livestock population. The total wastelands area of the country was observed to be 56 million hectares in 2015-16, while it was 57 million hectares in 2008-09. This indicates a conversion of about 1 million hectares of different wastelands categories in the country to non-wastelands during 2008-09 to 2015-16. (Anon., 2023) [4]. However, the per capita availability of arable land in the country is only 0.15 ha, which is expected to come down to

nearly 0.08 ha by 2025 (Chand and Raju, 2009) [8].

It is a paradoxical situation that on the one hand more production is required from the scarce soil resources for meeting the demand of ever-expanding population, while on the other, cultivable areas are being shifted towards non-agricultural uses. Maharashtra has experienced a considerable shift under different land-use classes during post-independence period. Land-use is a highly dynamic process. It implies that policy discussions and development planning have to be based on a sound understanding of these dynamics. Therefore, it is imperative to make a comprehensive study of the pattern and magnitude of land-use shifts for sustainability and productivity of agriculture in an area.

Methodology

The present study was based on the data from secondary sources of land use for the period of 57 years from 1960-61 to 2016-17, collected from various published sources *viz*; various issues of Statistical Abstract of Maharashtra State, Handbook of Basic Statistics of Maharashtra State published by the Directorate of Economics and Statistics (DES), Government of Maharashtra, Mumbai. The entire period was decomposed into three periods, *viz*; Pre-liberalization (1960-61 to 1990-91), Post-liberalization (1991-92 to 2016-17) and Overall Period (1960-61 to 2016-17). A spatio-temporal change in land use pattern was estimated with the simple tabular method, compound growth rate and instability index to examine the nature of land use shift in land use categories.

Percentage Change -The temporal change has been calculated by using the following formula,

$$Change(V1) = \frac{St1 - St2}{St1} \, x \, 100$$

Where,

$V1$ = Change in any variable,

$St1$ = Status at Period-I, and

$St2$ = Status at Period-II

Growth rate: The growth in the area under different land use categories were estimated by using the exponential growth functions of the form,

$$Yt = abt\,ut$$

Where,

Yt : Dependent variable (land use categories);

a : Intercept;

b : Regression coefficient;

t : Years which takes values 1, 2, …, n (57);

ut : Disturbance term for the year t.

The non-linear equation was transformed into log linear form for estimating the magnitudes of the various parameters and was estimated by using Ordinary Least

Square (OLS) technique. The compound growth rate (CGR) in percentage is then computed from the relationship,

$$CGR\ (g) = (Antilog\ of\ log\ bl - 1)\ x\ 100$$

The significance of estimated regression coefficients was tested using the student's 't' test.

It is estimated as follows,

1. Estimate the parameter of a log-linear trend line for the variable (Y_t) for which instability is to be estimated
2. If the estimated parameter is statistically significant, then the instability index is defined as

$$IIN = CV\ X\ (1 - r2)0.5$$

Where,

IIN = Instability index;

CV = Coefficient of variation;

$r2$ = Coefficient of determination.

$$CV = (SD/\ Mean)\ X\ 100$$

Where,

SD = Standard deviation

3. If the estimated parameter in the regression equation is not significant, then the CV itself is the instability index

Location Coefficient - Location coefficient (b) identifies spatial distribution of a land category across different districts/regions of state (Ramasamy *et al.,* 2005; Pandey and Ranganathan, 2018, Siwana *et al.,* 2018) and can be defined as,

$$b = \frac{Lj\ /\ Li}{Lj\ /\ Ls}$$

Where,

Lj = Area of jth category of land in state, Li = Area of all categories of land in state, Lj = Area of jth category of land in a country, Ls = Area of all categories of land in a country.

A higher value of $'b'$ implies a higher regional concentration of a particular category of land-use or vice versa.

Results and Discussion

The land use pattern is determined by the factors like relief features, climate, soil, density of population, technical and socio-economic parameters. The type of land use is for different categories like residential, commercial, industrial, agricultural and recreational public use infrastructure development. The changes in these land use categories are observed over the period of time due to infrastructure and other development activities.

Percentage change

The average land use pattern of Maharashtra state as a

whole was worked out for the Pre-liberalization (Period-I) and Post-liberalization (Period-II) period, along with the

changes in land use pattern between the two periods and the same are presented in Table 1.

Table 1: Changes in land use categories of Maharashtra (Area in '00' hectares)

Sr. No.	Land use category	Period-I (1960-61 to 1990-91)	Period-II (1991-92 to 2016-17)	%Change
1	Forest land	53738.13 (17.47)	52540.06 (17.08)	-2.23
2	Barren and uncultivable land	17520.49 (5.70)	17185.70 (5.59)	-1.91
3	Land put to non- agricultural uses	8969.42 (2.92)	13585.19 (4.42)	51.46
4	Permanent pastures and other grazing land	15081.90 (4.90)	12944.54 (4.21)	-14.17
5	Land under miscellaneous tree crops and groves	1890.58 (0.61)	2340.23 (0.76)	23.78
6	Cultivable Waste land	9633.58 (3.13)	9225.58 (3.00)	-4.24
7	Current fallow land	10179.23 (3.31)	12409.35 (4.03)	21.91
8	Fallow other than current fallow land	9914.74 (3.22)	11635.42 (3.78)	17.35
9	Net area sown	180692.77 (58.74)	175715.19 (57.13)	-2.75
10	Total reported area	307620.85 (100.00)	307581.26 (100.00)	-0.01
11	Area sown more than once	15432.75 (5.02)	47471.15 (15.43)	207.60
12	Gross cropped area	196125.52 (63.76)	223186.35 (72.56)	13.80
13	Net irrigated area	16674.86 (5.42)	31312.40 (10.18)	87.78
14	Gross irrigated area	20273.69 (6.59)	39889.43 (2.97)	96.75
15	Cropping intensity (%)	108.53	127.09	17.10

Source: Author's estimate, **Note:** Figures in parentheses indicate percentage to the total reported area

It can be referred from Table, at Maharashtra state, land put to non-agricultural uses, the area under miscellaneous tree crops and groves, current fallow land and fallow other than current fallow have increased by 51.46, 23.78, 21.91 and 17.35 per cent, respectively during Period-II over Period-I, but permanent pastures and other grazing land, cultivable waste, net area sown, area under forest and barren and uncultivable land have declined by 14.17, 4.24, 2.75, 2.23 and 1.91 per cent, respectively during the same period.

The increase in the current fallow land by 21.91 and fallow other than current fallow land by 17.35 was observed at Maharashtra state as whole, at the same time net sown area was decrease by 2.75 per cent in Period-II over Period-I. The reasons behind shrinking of this land category might be due to uncertainty of monsoon, fragmentation of lands, expensive inputs, labor scarcity, better employment opportunities in urban areas, low profit margins, etc., these all are making cultivation costlier.

Area sown more than once and gross cropped area increased by 207.60 and 13.80 per cent in Maharashtra particularly during the aforesaid period. The increase in area sown more than once was due to an increase in net irrigated area by 87.78 per cent state level during Period-II over Period-I. A Notable increase in gross irrigated area was observed to the

extent of 96.75 per cent in Maharashtra during same period. The incremental area sown more than once could be justified with the above discussed increase in gross and net irrigated area at the state level. The increasing trends of cropping intensity were observed during Period-II over Period I in Maharashtra.

Compound growth rate
The compound annual growth rates and instability indices for different land use categories in Maharashtra estimated and the results are presented in Table 2. The results showed that during the Period-I, land under permanent pastures and other grazing, area under culturable waste and land put to non-agricultural use significantly increased by 0.38, 0.75 and 1.95 per cent per annum, respectively. In contrast, area under forest, barren and uncultivable land, fallow other than current fallow and current fallow significantly declined by 0.05, 0.17, 0.79 and 1.62 per cent per annum, respectively during the Period-I. The significance level of all significant land use categories was at 1 per cent level, except, fallow other than current fallow, which was at 5 per cent level. However, land under miscellaneous tree crops and groves and net area sown shows non-significant growth rates in Period-I.

Table 2: Annual compound growth rates of different land use categories in Maharashtra

| Sr. No. | Land use categories | Compound growth rate (per cent per annum) | | |
		Period-I	Period-II	Overall
1	Forest land	-0.05**	-0.13**	-0.08**
2	Barren and uncultivable land	-0.17**	0.05**	-0.07**
3	Land put to non-agricultural uses	1.95**	1.18**	1.55**
4	Permanent pastures and other grazing lands	0.38**	-0.56**	-0.39**
5	Land under miscellaneous tree crops and groves	0.02	1.17**	0.66**
6	Cultivable waste	0.75**	-0.20*	0.01
7	Current fallow	-1.62**	1.75**	0.49**
8	Fallow other than current fallow	-0.79*	0.61**	0.38**
9	Net area sown	0.005	-0.18**	-0.09**
10	Area sown more than once	4.01**	2.83**	4.04**
11	Gross cropped area	0.32**	0.42**	0.43**
12	Net irrigated area	2.89**	2.36**	2.91**
13	Gross irrigated area	3.30**	2.00**	3.07**

Source: Author's estimate, **Note:** ** and * shows significant level at 1% and 5% level, respectively

During the Period-II, barren and uncultivable land, area under fallow other than current fallow, land under miscellaneous tree crops and groves, land put to non-agricultural uses and current fallow significantly increased by 0.05, 0.61, 1.17, 1.18 and 1.75 per cent per annum, respectively. However, area under forest, net sown area, cultivable waste and permanent pastures and other grazing land significantly declined by 0.13, 0.18, 0.20 and 0.56 per cent per annum.

The results showed that during the Overall Period, area under fallow other than current fallow, current fallow, land under miscellaneous tree crops and groves and land put to non-agricultural uses significantly increased by 0.38, 0.49, 0.66 and 1.55 per cent per annum, respectively. In contrast, barren and uncultivable land, area under forest, net area sown and permanent pastures and other grazing in Maharashtra significantly declined by 0.07, 0.08, 0.09 and 0.39 per cent per annum, respectively during the Overall Period. For the Overall Period, the growth rates of gross cropped area, net irrigated area, gross irrigated area and area sown more than once increased by 0.43, 2.91, 3.07 and 4.04 per cent, respectively in Maharashtra state as a whole. Growth rates of area sown more than once, net irrigated area and gross irrigated area were low in Period-II as compared to Period-I. During all the three study periods, area sown more than once, gross cropped area, net irrigated area and gross irrigated area significantly increased in Maharashtra state. To sum up, the results revealed that, area under forest was appeared significant negative growth rates, however positive and significant growth rates were observed in case of land put non-agricultural uses during all study periods. Growth rate of permanent pastures and other grazing lands

was negative and significant during Period-II, which might be due to conversion of area under this land use category to non-agricultural uses and or some extent to barren and uncultivable land. However, barren and uncultivable land, current fallow and fallow other than current fallow land were significantly increased during Period-II. As in case of net area sown, growth rate has been found signifantly negative in state as a whole during Period-II, as the land is shifting towards non-agricultural uses due to infrastructure development and or cultivators are leaving their land uncultivated to uncertainty of rainfall, poor economic condition of farmer, which is a prime concern for sustaining food security to ever increasing population.

Instability index
An instability index for different land use categories in Maharashtra estimated and the results are presented in Table 3. The results showed that during the Period-I, the results of instability indices showed that, current fallow was more unstable (27.35%) while area under forest land was most stable (0.71%) as compared to other land use categories in Maharashtra state as a whole. During the Period-II, the results of instability indices revealed that among all land use categories, land under miscellaneous tree crops and groves (5.28%) was more unstable while, barren and uncultivable land (0.46%) and net sown area (0.46%) both were least unstable in Maharashtra state as a whole. The results of instability indices during the Overall Period showed that in all land use categories, the current fallow was more unstable (31.47%) while area under forest was most stable (0.43%) as compared to other land use categories in Maharashtra state as a whole.

Table 3: Instability indices of different land use categories in Maharashtra

Sr. No.	Land use categories	Instability index (%)		
		Period-I	Period-II	Overall
1	Forest land	0.71	0.76	0.43
2	Barren and uncultivable land	0.77	0.46	1.20
3	Land put to non-agricultural uses	6.53	2.64	4.27
4	Permanent pastures and other grazing lands	5.62	2.90	4.88
5	Land under miscellaneous tree crops and groves	4.73	5.28	2.61
6	Cultivable waste	12.90	3.48	14.55
7	Current fallow	27.35	5.05	31.47
8	Fallow other than current fallow	15.48	2.86	15.60
9	Net area sown	2.51	0.46	2.06
10	Area sown more than once	14.80	6.64	7.84
11	Gross cropped area	3.02	1.16	1.38
12	Net irrigated area	6.61	4.11	4.56
13	Gross irrigated area	7.40	3.60	5.74

Source: Author's estimate.

Spatial changes in land use pattern
Location coefficient (L) was useful to identify the pattern of distribution of the given category of lands in across the state to area under particular category in a country. A higher value for location coefficient for the district and region indicated the higher concentration of that particular category of land in the state. In order to know the spatial distribution of different land use categories over the last 57 years of Maharashtra state as whole, the location coefficients were analysed and presented in Table 4. The notable feature is that during all the study periods, the highest concentration

was observed in the net sown area, followed by permanent pastures and other grazing lands and fallow other than current fallow, which had more concentration compared to the national level. However, land under miscellaneous tree crops and groves (0.48) and land put to non-agricultural uses (0.49) were observed to have less than half area under these categories in Maharashtra state compared to area in a country during Period-I. Land put to non-agricultural uses was observed to have the least concentration in Maharashtra as compared to national level during Period-II and Overall Period.

Table 4. Location coefficients of different land use categories in Maharashtra

Sr. No.	Land use categories	Location coefficients		
		Period-I	Period-II	Overall
1	Forest land	0.82	0.74	0.78
2	Barren and uncultivable land	0.68	0.97	0.79
3	Land put to non-agricultural uses	0.49	0.55	0.52
4	Permanent pastures and other grazing lands	1.17	1.22	1.19
5	Land under miscellaneous tree crops and groves	0.48	0.68	0.56
6	Cultivable waste	0.57	0.69	0.62
7	Current fallow	0.74	0.83	0.78
8	Fallow other than current fallow	1.02	1.10	1.06
9	Net area sown	1.28	1.24	1.26

Source: Author's estimate.

The distribution pattern of barren and uncultivable land, land put to non-agricultural uses, permanent pastures and other grazing lands, land under miscellaneous tree crops and groves, cultivable waste, current fallow and fallow other than current fallow has increased in the concentration, while area under forest and net area sown were declined during Period-II as compared to Period-I in Maharashtra state. That might be due to deforestation, a wide gap between rates of forestation and deforestation, encroachments by locals, acquisitions for infrastructural developments were the reasons for reduction in concentration of forest area in Maharashtra whereas, The reasons behind shrinking of this land category might be due to uncertainty of monsoon, fragmentation of lands, expensive inputs, labor scarcity, better employment opportunities in urban areas, low profit margins, etc., these all are making cultivation costlier.

Conclusion and policy implications
The temporal changes in land use patterns of Maharashtra state as a whole showed significant shift. The forest cover in the state is about 17.08 per cent during Period-II, which is far below the minimum suggested level of at least one-third of the geographical area and it was declined by 2.23 per cent of Period- II over Period-I. The growth rate for entire period was revealed that the highest positive growth rate was observed in current fallow land, however net area sown was found declined significantly during post liberational period in Maharashtra state as a whole. The results of instability indices in Maharashtra state for the overall period showed that current fallow land was the most unstable land use category. Interestingly, all districts, regions and Maharashtra as a whole exhibited greater stability in current fallow land during Period-II compared to Period-I.
The concerted efforts are needed to increase forest cover. This can be achieving by planting trees (afforestation) on barren and uncultivable lands, which comprise 5.59 per cent of the state's total geographical area. This initiative is crucial for maintaining ecological balance and achieving sustainability. To reach this goal, the forest cover needs to be increased to at least 33 per cent of the total geographical area. Expanding the area under agriculture has limitations. However, there's potential to increase cultivation in other ways. This can be achieved by utilizing 6.92% of cultivable wasteland and fallows land. Providing farmers with the necessary inputs and infrastructure to improve land productivity is one way. Furthermore, implementing state land-use policies to regulate the conversion of cultivable land for non-agricultural purposes is crucial for ensuring long-term food security.

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