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Land use dynamics in context of sustainable agricultural development in Odisha

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Abstract

The information on land use pattern plays paramount role to develop future research strategy on land use planning of the State. In this context an attempt has been made in this paper to analyze the structural changes in the land use pattern of the State of Odisha for the period 1980-81 to 2012-13. The Compound growth functions, Coefficient of Variation and log-Quadratic functions are used here to analyze the land use data. The study reveals that the area under forest, net area sown and the total cropped area show the negative growth rates, whereas positive growth rates are found in case of area under non-agricultural uses and barren and uncultivated land. The cropping intensity and the growth rates of area, production and yield of principal crops exhibit very low growth rates. The studies prescribes for the protection of forest lands, development of degraded lands and ensure irrigation facilities and new dry land technologies to the farmers for sustainable agricultural development of the State of Odisha.

Keywords: Land, Agricultural development, log-Quadratic functions

Introduction

Odisha comprises of 4.74 per cent of India's landmass and 41.97 million people, accounts for 3.47 per cent of the population of the country, according to 2011 census. Agriculture plays a dominant role in the economy of the State and this sector along with Animal Husbandry contributes about 17.2 per cent of the Gross State Domestic Product of the State in 2012-13 at current prices. Also, agriculture alone provides direct and indirect employment of around 60 per cent of the total population of the State as per the 2011 census. After the introduction of high yielding crop varieties, increases in areas under irrigation with increase in cropping intensity resulted in higher rate of agricultural production in the State. The cropping intensity has increased from 106 in 1950-51 to more than 167 in 2012-13. The current yield levels of the crops are also higher. Fertilizer use, which was 0.76 kg/ha of nutrients during 1961-62 has increased to 58.72 kg/ha in 2012-13. The current yield levels and fertilizer use are however substantially lower than the other States and the national average.

It is observed that the pressure on land for various uses is continuously on the increase in the last three decades. A number of mines and industries have been set in the state, which affect adversely on the availability of agricultural land for growing crops. Hence, the conservation, management and development of land resources on scientific lines have to be given high priority in policy planning.

The information on land use pattern is necessary to develop future research strategies on land use planning. Many studies reveals that analysis of structural changes in land use pattern over a period of time provides scope for planned and judicious management of land. Keeping this in view an attempt is made in this paper and the objectives are:

1. to analyze the trend and temporal changes in land use during the period of 1980-81 to 2012-13;
2. to find and the growth rate, instability and trend of of different categories of land utilization during the period of 1980-81 to 2012-13;
3. to find out the cropping pattern and crop diversification of the State from 1980-81 to 2012-13; and
4. to estimate the growth rates of area, production and yield of principal crops from 1980-81 to 2012-13.

Materials and Methodology

Time series data on land utilization, crop area, crop production and crop productivity was compiled for the period 1980-81 to 2012-13 from various issues of Odisha Agriculture Statistics of Directorate of Agriculture and Food Production, Government of Odisha.

1. The compound growth rate (CGR) of area (Y) under different land use/area under crops/

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yield/production is calculated by using compound growth function. $Y = ab^t$, Here $a = \text{constant}$; $b=1+r$; $t=\text{time}$. $\text{CGR} = r \times 100$

- To measure the variability of different land use components over the period Co-efficient of Variation (C.V.) was estimated with the following formula:
- To measure the crop diversification over the period 1980-81 to 2012-13 Herfindahl Index (H.I.) was used.

$$H.I. = \sum_{i=1}^N P_i^2, \text{ where, } N = \text{Total no. of crops; } P_i = \text{Acreage}$$

proportion of the crop in the total cropped area. The H.I. value decreases with the increase in diversification.

- The acceleration/deceleration of trend of the growth of different area under land use was tested by log – Quadratic function.

$\text{Log}(Y) = a+bt+ct^2+e$, Here $Y = \text{area under different land use}$; $t = \text{time}$;

$a = \text{constant}$; b and c are co-efficient of t and t^2 ; $e = \text{error term}$.

Result and Discussion

The figures for various land uses and their changes over the periods are presented in table 1 and table 2 respectively. Table 1 gives the land use classification at nine points of time, namely 1980-81, 1985-86, 1990-91, 1995-96, 2000-01, 2005-06, 2010-11, 2011-12 and 2012-13 for total reporting area and other nine categories of land utilization. The coverage of reporting area statistics went up from 15, 540 thousand ha. in 1980-81 to 15571 thousand ha. in 2012-13. The total available land for cultivation (net area sown plus current and other fallows) in 1980-81 constituted 43.57 per cent and its proportion marginally declined to 41.16 per cent of the total reporting area in 2012-13. But the availability arable land (net area sown plus fallow land) per capita declined from 0.26 ha to 0.15 ha between 1980-81 and 2012-13. It is expected that the per capita availability of arable land will below the level of one tenth of a hectare by the end of 2030 AD with the current status of trends in land utilization versus population statistics (Singh & Singh, 1999). Therefore, there is an urgent need on the part of the land use planning agencies to take restrictive measure to reduce the deterioration of the arable land in the State.

The most essential point, which drew attention, was fallow land other than current fallow. It showed incline of 79.89 per cent during the period of 1980-81 to 2000-01 (Table 1). A very negligible decline in fallow land other than current fallow was noticed during the period 1995-96 and 2000-01. The increase in this category of land may be due to use of vast area of land utilized for quarry and mining and soil erosion and deforestation in the State. On other hand, the area under current fallow showed a decline of 4.87 per cent during the period 1980-81 to 200-01. The decline in this area may be due to utilization of this area for non-agricultural purposes. This fallow land could be brought under the cultivation to enhance the crop production of the State. Also, steps may be taken to develop the fallow land other than current fallow of the State by adopting different land use measures.

By the end of 2000-01, the area under non-agricultural uses reached a destination of 999 thousand ha from 632 thousand ha in 1980-81 registering a increase of 58.06 per cent over the period (Table 2). Contrary to this barren and uncultivable land showed an incline of 218.11 per cent during the same period (Table 2). Most of the current fallow lands, permanent pastures and other grazing lands, forest land and land under net area sown might be diverted for non-agricultural uses was

noticed during the period of 1995-96 to 2000-01. Rapid growth in urbanization and industrialization during the period was the reason for such large increase in area under non-agricultural uses. Barren and uncultivable land showed a declining trend during the period 1990-91 to 1995-96, whereas highest incline of 52.44 per cent of barren and uncultivable land was noticed during the period of 1995-96 and 2000-01. Most of the barren and uncultivable lands were included due to deforestation and land degradation.

Forest account for the largest share of 37.33 per cent of the reporting area in the reporting year 2001-02. During the period under study forest area had shown a decrease of 12.45 per cent. Maximum decrease in area under forest to the tune of 10.32 per cent and 8.04 per cent were noticed during the period 1980-81 to 1985-86 and 1985-86 to 1990-91 respectively. However, after 1990-91 there was a increase in forest area, which was found to be 4.49 per cent during the period 1990-91 to 1995-96. Leaving the baffling statistics aside, it is everybody's observation that the density of the forest has reduced drastically. It is a part of the fact that India is losing one million ha forest in a year. When the area under dense forest is considered the figures in Odisha came down to 17.7 per cent (Forestry survey of India 1990 based on INSAT Report). The reduction of forest area is mainly due to ruthless cutting of trees by the people and thieves, opening of new mines and quarries, submerged under water by the new constructed dams and establishment of new industries. It is noticed that about 29 thousands ha. forest area of the State had been diverted to non-forest use in the State during last twenty years (Economic Survey, 2004-05). Permanent pasture and other grazing land decreased from 560 thousand ha in 1980-81 to 443 thousand ha in 2000-01 constituting 3.6 per cent and 2.85 per cent of the total reporting area. However, there was increase of 10.36 per cent and 17.48 per cent during the periods 1980-81 to 1985-86 and 1985-86 to 1990-91 respectively. But again this value declined during the two periods 1990-91 to 1995-96 and 1995-96 to 2000-01. The values were 13.81 per cent and 20.89 per cent respectively. The reduction of grazing lands of the State might be due to unauthorized encroachment by the villagers for farming and using it for other domestic purposes. The reduction of this category of land exhibited an adverse effect on the grazing pressure of live stock population of the State.

Land under miscellaneous tree crops and groves not included in net area sown occupied merely 3.09 per cent of the reporting area in the year 2000-01. It showed a continuous incline during the periods 1980-81 to 1985-86 and 1985-86 to 1990-91. But during the periods 1990-91 to 1995-96 and 1995-96 to 2000-01 this value was declined. Increases of this type of land might be due to planting of horticultural and forest trees under different schemes. Similar trend was observed in case of culturable wasteland. During the period of 1980-81 to 2000-01 culturable wasteland was increased by 57.42 per cent. The highest incline of 62.25 per cent was noticed during the period 1980-81 to 1985-86.

Analysis of the data on net area sown (NSA) increased during the period 1980-81 to 1985-86. However, after 1985-86 the area is found to have declined marginally and this area was amounted to 6210 thousand ha in the year 1995-96. Further, this value was declined and in the year 2000-01 this value came down to 5824 thousand ha. The percentage decrease of NSA during the period 1980-81 to 2000-01 was 4.91 per cent. The decline of this area may be due to urban housing and industrial development of the State.

Total cropped area, which include NSA and area sown more than once was showing gradual increase since 1980-81 to 1995-96. However there was a decline of 9.92 per cent of this area during the period 1995-96 to 2000-01. This decline is mainly due to occurrence of different natural calamities like

super cyclone floods and drought in the State during last few years. Also, this area could not be raised effectively due to lack of irrigation facilities created in the State, which was only 30 per cent of the net area sown during the year 2001-02.

Table 1: Periodic Land Use Classification in Odisha (1980-81 TO 2001-02)

(Area in '000 ha)

| Sl. No. | Classification | 1980-81 | 1985-86 | 1990-91 | 1995-96 | 2000-01 | 2005-06 | 2010-11 | 2011-12 | 2012-13 |
|---------|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|---------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | Reporting area for land utilization (1 to 5) | 15540 | 15540 | 15540 | 15540 | 15571 | 15571 | 155741 | 15571 | 15571 |
| 1 | Forests | 6640 (42.73) | 5955 (38.32) | 5476 (35.24) | 5722 (36.82) | 5813 (37.33) | 5813 (37.33) | 5813 (37.33) | 5813 | 5813 |
| 2 | Not available for cultivation (a+b) | 897 (5.78) | 1054 (6.78) | 1245 (8.02) | 1411 (9.08) | 1842 (11.83) | 1842 (11.83) | 2138 | 2138 | 2138 |
| | (a) Barren and Unculturable land | 265 (1.71) | 366 (2.35) | 499 (3.21) | 553 (3.56) | 843 (5.41) | 843 (5.41) | 840 | 840 | 840 |
| | (b) Land put to non-agril. use | 632 (4.07) | 688 (4.43) | 746 (4.81) | 858 (5.52) | 999 (6.42) | 999 (6.42) | 1298 | 1298 | 1298 |
| 3 | Other uncultivated land excluding fallow land (a+b+c) | 1232 | 1641 | 2182 | 1660 | 1317 | 1317 | 1311 | 1311 | 1311 |
| | (a) Permanent pastures and other grazing land | 560(3.60) | 618 (3.98) | 726 (4.67) | 514 (3.31) | 443 (2.85) | 443 (2.85) | 494 | 494 | 494 |
| | (b) Land under misc. tree crops and groves not included in net area sown. | 423 (2.72) | 619 (3.98) | 859 (5.53) | 715 (4.60) | 482 (3.09) | 482 (3.09) | 342 | 342 | 342 |
| | (c) culturable waste | 249 (1.60) | 404 (2.60) | 597 (3.84) | 431 (2.77) | 392 (2.52) | 392 (2.52) | 375 | 375 | 375 |
| 4 | Fallow land (a+b) | 641 | 567 | 333 | 537 | 774 | 754 | 988 | 1117 | 1078 |
| | (a) Fallow land other than current fallow | 189 (1.22) | 349 (2.25) | 119 (0.77) | 323 (2.08) | 340 (2.18) | 434 (2.79) | 229 | 229 | 229 |
| | (b) Current fallow | 452 (2.90) | 218 (1.40) | 214 (1.38) | 214 (1.38) | 430 (2.76) | 320 (2.01) | 759 | 888 | 849 |
| 5 | Net area sown (6-7) | 6130 (39.45) | 6323 (48.69) | 6304 (40.55) | 6210 (39.96) | 5829 (37.43) | 5845 (37.54) | 5421 | 5292 | 5331 |
| 6 | Total cropped area | 8746 | 9260 | 9594 | 9667 | 7878 | 8799 | 8558 | 8268 | 8345 |
| 7 | Area sown more than once | 2616 | 2937 | 3290 | 3457 | 2049 | 2954 | 3137 | 2976 | 3014 |
| 8 | Net irrigated area | 1197 | 1250 | 1934 | 1690 | 1590 | 1752 | 2085 | 2079 | 1179 |
| 9 | Cropping Intensity | 143 | 147 | 152 | 156 | 135 | 151 | 167 | 166 | 167 |
| 10 | Percent of net area sown irrigated | 19.53 | 19.77 | 30.68 | 27.21 | 27.28 | 29.97 | 38.46 | 39.29 | 22.11 |

Note: Figures in the brackets denotes percentages., Source: Reports on Agricultural Statistics of Odisha, Govt. of Odisha.

Compound growth rate and Co-efficient of Variation of different land use categories

Compound growth rate of various categories of land use in Odisha indicated that the area under the barren and unculturable land and land under misc. tree crops and groves achieved significant growth rates of 5.29 per cent and 3.06 per cent during the period 1980-81 to 1999-2000 (Table 2). Also the area under culturable-waste, non-agricultural uses and fallow land other than current fallow have shown positive growth rates of 2.54 per cent, 1.77 per cent and 0.78 per cent respectively. Significant growth rate in area under miscellaneous tree crops and groves was mainly due to the diversion of current fallow land, forest land and land under net area sown to the aforesaid land use category after taking afforestation programmes and plantation of horticultural trees. On the other hand significant growth rate in area under barren and unculturable land was mainly due to diversion of forest land and current fallow. The area under non-agricultural uses showed a positive growth rate due to diversion of land under net area sown and forest land.

Negative growth rates were found in case of area under forest, permanent pastures and other grazing land, current fallow and net area sown. The negative growth rates might be exhibited mainly due to diversion of area for non-agricultural purposes i.e. such as construction houses, roads, buildings, industries and opening of new mining and quarries. Also some lands became barren and uncultured due to continuous scarcity of

rainfall in some regions of State. Further, it is found that the total cropped area showed negative growth rate during last 20 years.

To examine the extent of overall variation in the different categories of land over the period under study the co-efficient of variation was worked out and are presented in table 2. It would be seen from the table that the area under current fallow has registered the highest degree of variation being 45.01 per cent co-efficient of variation followed by area under barren and unculturable land (29.25 per cent); area under fallow land other than current fallow (21.69 per cent); culturable waste land (21.64 per cent); land under misc. tree crops and groves (20.96 per cent) and permanent pastures and other grazing land (13.49 per cent). This depicts that area under current fallow exhibited the highest dynamism because some cultivated lands were kept fallow due to continuous drought and floods in the State. The lowest quantum of variation was recorded for the net sown area being 2.26 per cent. This implies that the changes in the net area sown were almost consistent over the years. Similar trend was noticed in case of total cropped area (6.08 per cent) and area under forest (6.75 per cent). The lower variation in the total cropped area implies that we are unable to increase the area under multiple crops inspite of several agricultural development plans for increasing the agriculture production of our State. This shows that the agricultural development of the State has become stagnant during past few years.

Table 2: Periodic Variation in Land Use of Odisha
(Area in '000 ha)

| Sl. No. | Classification | 1980-81 to 1985-86 | 1985-86 to 1990-91 | 1990-91 to 1995-96 | 1995-96 to 2000-01 | 1980-81 to 2012-13 | Compound Growth rate 1980-81 to 2012-13 | Coefficient Of Variation (in %) 1980-81 to 2012-13 |
|---------|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---|--|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | Reporting area for land utilization | 0 | 0 | 0 | 31 | 31 | - | - |
| 1 | Forests | -685 (10.32) | -479 (8.04) | +246 (4.49) | 91 (1.59) | -827 (12.45) | -0.77 | 6.75 |
| 2 | Not available for cultivation (a+b) | +157 (17.5) | +191 (18.12) | +166 (13.33) | +431 (30.51) | +945 (105.35) | +1.36 | 8.80 |
| | (a) Barren and Unculturable land | +101 (38.11) | +133 (36.34) | +54 (10.82) | +290 (52.44) | +578 (218.1) | +5.29 | 29.25 |
| | (b) Land put to non-agril. use | +56 (8.46) | +58 (8.43) | +112 (15.01) | +141 (16.43) | +367 (58.06) | +1.77 | 10.66 |
| 3 | Other uncultivated land excluding fallow land (a+b+c) | | | | | | | |
| | (a) Permanent pastures and other grazing land | +58(10.36) | +108 (17.48) | -212 (29.20) | -71 (13.81) | -117 (20.89) | -0.61 | 13.49 |
| | (b) Land under misc. tree crops and groves not included in net area sown. | +196(46.33) | +240 (38.77) | -144 (16.76) | -233 (32.58) | +59 (13.9) | +3.06* | 20.96 |
| | (c) culturable waste | +155 (62.25) | +193 (47.77) | -166 (27.81) | -39 (9.0) | +143 (57.42) | +2.54* | 21.64 |
| 4 | Fallow land (a+b) | | | | | | | |
| | (a) Fallow land other than current fallow | +160(84.66) | -230 (121.69) | +204 (171.43) | +17 (5.26) | +151 (79.84) | 0.78 | 45.01 |
| | (b) Current fallow | -234 (51.77) | -4 (1.83) | 0 (0.00) | 216 (100.93) | -22 (4.87) | -1.04 | 2.26 |
| 5 | Net area sown | +193 (3.15) | -19 (0.30) | -94 (1.49) | -381 (6.13) | -301 (4.91) | -0.02 | 6.08 |
| 6 | Total cropped area | +514 (5.88) | +334 (3.61) | +73 (0.76) | -1787 (18.51) | -868 (9.92) | 0.03 | 4.26 |
| 7 | Cropping intensity | | | | | | | |

Note: Figures in the brackets show the percentage changes on the base period, *: Significant at 5% level.

Inference about the trend of area under different categories of land uses

Table 4 shows the trend of different categories of land use of Odisha. From the log Quadratic function model used for land use the higher significant accelerating rate was noticed in area under forest, while higher decelerating rates of growth were noticed in land under culturable waste, land under misc. tree, permanent pasture land, total cropped area, net area sown and barren and unculturable land.

Diversification of cropping pattern

Cropping pattern in Odisha presented in table 3. It could be seen from the table that paddy continues to be the principal crop of the State and about 50 per cent of the total cropped area was devoted for this crop. The area under cereals was about 56 per cent in the year 2001-02. Pulses, oil seeds and fruits and vegetables were the crops next important to rice. Area under the pulses was 19 to 22 per cent of the total cropped area in almost all the years. Again, area under the

oilseeds was around 8 to 12 per cent, condiments and spices was around 1 to 2 per cent during the period 1980-81 to 2001-02.

The Herfindahl Index (H.I.) for different periods was calculated for measuring crop diversification (Table 3). It showed that the transformed values of Herfindahl indices were almost same during the years 1980-81 to 1985-86 indicating insignificant change in cropping pattern of the State during this period. Again the value of H.I has decreased from 0.722 to 0.6611 during the period 1990-91 to 1999-2000 and lower value of H.I in recent year indicated that the cropping pattern of the State of Odisha is moving towards specialization with the cultivation of few crops. Relatively less diversion in recent years of study could be attributed mainly to the farmer's preferences for growing few specific crops. The diversification of cropping pattern towards specific crops suggests that intensive research efforts showed to be made by the research institutions on the crops most suited to the State.

Table 3: Cropping Pattern in Odisha

| Sl. No. | Crops | 1980-81 | 1985-86 | 1990-91 | 1995-96 | 1999-2000 | Compound growth rate (%) 1973-74 to 2002-03 | | |
|---------|---------------------------|---------|---------|---------|---------|-----------|--|-------|------------|
| | | | | | | | Area | Yield | Production |
| 1. | Rice | 47.92 | 47.54 | 45.89 | 46.85 | 53.98 | 1.88* | 1.58 | 1.92* |
| 2. | Wheat | 0.77 | 0.60 | 0.35 | 0.22 | 0.21 | - | - | - |
| 3. | Maize | 2.07 | 1.78 | 1.74 | 1.59 | 2.03 | 1.15 | 1.57 | 1.17 |
| 4. | Ragi | 3.84 | 3.10 | 2.58 | 2.37 | 2.45 | 1.22 | 1.49 | 1.16 |
| 5. | Other cereals | 4.66 | 2.16 | 1.11 | 0.85 | 0.72 | - | - | - |
| 6. | Total cereals (1+2+...+5) | 59.26 | 55.18 | 51.67 | 51.88 | 59.39 | 1.91* | 1.58 | 1.94* |
| 7. | Total pulse | 19.73 | 20.87 | 22.21 | 22.53 | 19.06 | 1.68 | 1.38 | 1.50 |
| 8. | Total food grains (6+7) | 78.99 | 76.05 | 73.88 | 74.41 | 78.45 | 1.98* | 1.54 | 1.97* |
| 9. | Groundnut | 1.97 | 3.49 | 4.13 | 3.29 | 2.93 | 1.26 | 1.60 | 1.31 |
| 10. | Sesamum | 1.78 | 3.00 | 3.56 | 3.96 | 3.25 | - | - | - |
| 11. | Other oil/seeds | 4.67 | 4.17 | 4.37 | 4.90 | 3.80 | | | |
| 12. | Total oil seeds (9+10+11) | 8.42 | 10.66 | 12.06 | 12.15 | 9.98 | 1.53 | 1.46 | 1.44 |
| 13. | Total fibres | 1.14 | 1.22 | 0.94 | 0.81 | 1.10 | | | |

| | | | | | | | | | |
|-----|------------------------------|--------|--------|--------|--------|--------|------|-------|------|
| 14. | Condiment and spices | 1.55 | 1.70 | 1.70 | 1.12 | 2.18 | | | |
| 15. | Potato | 0.10 | 0.10 | 0.10 | 0.09 | 0.10 | | | |
| 16. | Sugarcane | 0.52 | 0.52 | 0.51 | 0.51 | 0.36 | 0.83 | 2.49* | 1.77 |
| 17. | Fruits and vegetables | 9.75 | 9.75 | 10.81 | 10.91 | 7.83 | | | |
| 18. | Total cropped area (000 ha.) | 8746 | 9260 | 9594 | 9667 | 8524 | | | |
| 19. | H.I. Index | 0.2855 | 0.2852 | 0.2780 | 0.2883 | 0.3389 | | | |
| 20. | Diversion Index | 0.7145 | 0.7148 | 0.7220 | 0.7117 | 0.6611 | | | |

Note: Figures against the crops show the percentage to total cropped area. * Significant at 5% level.

Growth rates of Area, production and productivity under different crops (1973-74 to 2002-03):

Compound growth rates of area, yield and production of major crops for the period 1973-74 to 2002-03 are shown in table 4. It could be seen from the table that during the period under study maximum growth rate in area was achieved in Cereals (1.91 per cent) followed by Pulses (1.68 per cent), Oil seeds (1.53 per cent) and Sugarcane (0.83 per cent). Among the cereal crops rice showed the maximum growth rate (1.88 per cent). Similarly among the Pulses and Oil seeds Mung and Groundnut showed the highest growth rates i.e., 1.44 per cent

and 1.26 percent respectively. Again high growth rate of yield was noticed in Sugarcane (2.49 per cent) followed by Groundnut (1.60 per cent), Rice (1.58 per cent), Mung (1.57 per cent) and Ragi (1.49 per cent). Compound growth rates of production showed that crops like Rice, Sugarcane, Mustard, Groundnut, Mung and Biri achieved positive growth rates to the tune of 1.25 per cent, 1.77 per cent, 1.53 per cent, 1.31 per cent, 1.25 per cent and 1.22 per cent respectively. From this analysis it is noticed that the State's figure on growth rate are vary discouraging and are lower than the country as a whole.

Table 4: Log Quadratic Regression Result for Different Category of Land Uses (1980-2001)

| Sl. No. | Land use category | Coefficients of log Quadratic equation $\log Y = a + bt + ct^2$ | | | Value R ² | Inference about trend of growth |
|---------|---|---|---------|-------------------|----------------------|---------------------------------|
| | | a | b | C | | |
| 1 | Forest | 8.837 | -0.0339 | 0.0012 (10.91)* | 0.859 | Increasing |
| 2 | Barren and uncultured land | 5.3254 | 0.1042 | -0.0025 (3.125)* | 0.897 | Decreasing |
| 3 | Land put to non agril. uses | 6.422 | 0.0214 | -0.00018 (1.2) | 0.947 | Decreasing |
| 4 | Permanent pastures and other gaz. land. | 6.2154 | 0.0651 | -0.0034 (5.484)* | 0.6639 | Decreasing |
| 5 | Land under misuse | 5.8625 | 0.1259 | -0.00456 (6.706)* | 0.8741 | Decreasing |
| 6 | Cult. Waste | 5.3612 | 0.1407 | -0.0055 (6.79)* | 0.8277 | Decreasing |
| 7 | Fallow land other than current fallow | 5.646 | -0.0131 | 0.0009 (0.9) | 0.2518 | Increasing |
| 8 | Current fallow | 6.3087 | -0.1667 | 0.0074 (2.846) | 0.3251 | Increasing |
| 9 | Net area sown | 8.697 | 0.0092 | 0.0004 (4.0)* | 0.361 | Decreasing |
| 10 | Total cropped area | 8.997 | 0.0310 | -0.0014 (4.677)* | 0.537 | Decreasing |

Note: Figures in the brackets show the values of t;* Significant at 5% level by t – test.

Summary and conclusion

- From the land use statistics it shows that 37.3 per cent of total geographical area of the state is under forest (2001-02). But actually only 17.4 per cent of the forest land is covered under dense forest and major area of the forest land are degraded, which need to be developed under different plans and projects.
- The national forest policy 1988 should be implemented strictly to maintain the minimum desired area under forest or tree in the country to be about 33 per cent.
- Farm forestry and social forestry programs should be continued.
- Total degraded land in the state is about 61.21lakhs hector (39.31 per cent) of total geographical area (Economic Survey, 2004-05). For the development of this vast size of degraded land various soil conservation activities are being taken up in the state. but in spite of all efforts only 18.22lakhs hector (merely 30 per cent) of degraded land could be covered under various soil conservation strategy till the end of 9th plan. the project should be continued and the government should be rigid to forest rule and policies for diversions of agricultural land to use for other purpose.
- Increasing cropping intensity is also a measure to the land constraint. Cropping intensity could not go beyond 156. Also the State experienced low growth rates of area, production for different crop during last 25 years. The diversion of crop is very insignificant. The improvement

could not be done due to non-expansion of irrigated area and most of the crop are grown under rain fed condition. So expansion of irrigated area land and development of new dry land technology (location specified) are required to suggest suitable crops to be grown in different area. Farmers should encourage inter-crop cultivation, particularly in combination with water-sucking crops such as paddy, sugar-cane, wheat and so on.

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