

## MEASUREMENT OF AGRICULTURAL GROWTH OF AMRAVATI DISTRICT (M. S. INDIA) – COMPOSITE INDEX APPROACH

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### ABSTRACT

Measurement of agricultural growth is complex phenomena, which is dependent on various factors. These factors are co-related with each other. Hence, all factors may be influenced due to change in any one factor. Composite index represent entire data in one figure like arithmetic mean. In this paper, composite index has been constructed by methods suggested by Narain *et al.* (1991). Present study is based on 36 years (1971-72 to 2005-06) time series data. It includes 72 indicators of agricultural growth which are divided into two groups – first group include 60 crop indicators i.e. area, production and productivity of 20 crops and in second group 12 non-crop indicators were included. Compound Growth Rate (CGR) and Composite Index (CI) of these 72 indicators were calculated. Agricultural growth of Amravati district was measured on the basis of these composite index and gross output value of crop production based on Minimum Support Price (MSP) of crops. Study concluded that agricultural growth of Amravati district based on Area, Production, Yield and combine (A+P+Y) was 0.39\*\*, -0.40\*\*, -1.75\*\* and 0.73\*\*, respectively. Agricultural growth of Amravati district based on all 72 indicators (crop and non-crop indicators) was -0.6438\* but based on value of production was positive and its value was 5.72\*\*.

(Key words: Amravati district, agricultural growth, composite Index, compound growth rate)

### INTRODUCTION

In recent years performance of agricultural sector is not satisfactory. The growth rate of agricultural sector in 2008-09 was less than 4% as per economic survey of 2009-10 of Indian Government. Ministry of Finance and Planning Commission are emphasizing extra measures to improve poor growth rate in agriculture. There is no any exact definition of agricultural growth. There is lot of confusion between scientists about agricultural growth. Measurement of agricultural growth is complex phenomena, which is dependent on various factors. These factors are co-related with each other. Hence, all factors may be influenced due to change in any one factor. Composite index represent entire data in one figure like arithmetic mean. In this paper, composite index has been constructed by methods suggested by Narain *et al.* (1991).

Kalamkar (2009) studied the urbanization and agricultural growth in India. The study concluded that – the faster growth in urban population was largely on account of migration from rural areas. Exchanges of goods between urban and rural areas were an essential element of rural-urban linkages. Urbanization was an important determinant of demand for high value commodities. By 2020, urban population is expected to be nearly 35 per cent of total population. This is expected to fuel rapid growth in the demand for high value food commodities.

Shah (2011) studied the impact of information and communication technology (ICT) on agricultural development in India. The application of ICT solutions for the development of rural India will surely open up a vast range of possibilities to majority of the population living in rural setting to cross the digital divide to obtain access to information enterprise, it is observed that there were high continuity and change forces operating in the agricultural sector.

Vidarbha region of Maharashtra state can be divided in to two types of cropping pattern. Those are cotton dominated and paddy dominated cropping pattern. Amravati district is approximately representative district of Vidarbha region of Maharashtra state. Its cropping pattern is combination of cotton as well as paddy growing track considering the above facts the present study was undertaken with the objective to measure the agricultural growth of Amravati district on the basis of (1) composite index based on crop and non-crop indicators and 2) gross output value of crop production based on Minimum Support Price (MSP) of crops.

### MATERIALS AND METHODS

Present study included 72 indicators of agricultural growth which were divided into two groups – first group included 60 crop indicators i.e.

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area, production and productivity of 20 crops and in second group 12 non-crop indicators were included. Compound Growth Rate (CGR) and Composite Index (CI) were calculated of these 72 indicators. Agricultural growth of Amravati district was measured on the basis of these composite index and gross output value of crop production based on Minimum Support Price (MSP) of crops.

#### A) Selection of Indicators:

Seventy two important indicators related to agriculture growth had been selected for this study. These indicators were classified into two groups.

The first group consisted of 60 crops indicators which include three aspects of crops i.e. Area, Production and Productivity and 20 crops, namely (1) bajara, (2) cotton, (3) gram, (4) *kharif* groundnut, (5) *kharif* jowar (sorghum), (6) *rabi* jowar, (7) rice, (8) safflower, (9) soybean, (10) sugarcane, (11) summer groundnut, (12) total cereals, (13) total food grains, (14) total oilseeds, (15) total pulses, (16) tur, (17) wheat, (18) other cereals, (19) other pulses and (20) sunflower.

The second group consisted of 12 other indicators. These indicators were (1) net sown area (in 00 ha), (2) net irrigated area (in 00 ha), (3) total fertilizer consumption (MT), (4) number of tractors in use, (5) number of electric and diesel pumps in use (6) number of sprayers and dusters in use, (7) population density, (8) agriculture labor, (9) per cent literacy in rural area, (10) average area served per regulated market (Km), (11) credit available (Lakh Rs.) and (12) area under HYV (00 ha).

#### B) The Data:

Time series data of 36 years from 1970-1971 to 2005-2006 of area, production, productivity of above mentioned 20 crops of Amravati district were downloaded / collected from web-site of Department of Agriculture, Maharashtra Government and other related web sites. Time series data of other groups' indicators were collected from Department of Agriculture, Nagpur and Amravati.

#### C) Method of Analysis:

**C-I) Statistics of data:** For the purpose of analysis, the basic statistics of data i. e. Arithmetic Mean, Co-efficient of Variation (C.V.), Range and Compound Growth Rate were calculated.

**C-II) Compound growth rate:** Compound growth rates were calculated to study the growth of all 72 indicators, composite index and gross output value of crop production based on Minimum Support Price (MSP) of crops by fitting the exponential model to data.  $Y = a \cdot b^t$

Where, Y = Observed value of Indicators,  
a = Intercept, b = Regression coefficient,  
t = Year.

The above equation reduced to the following linear equation, on taking logarithms of both sides of equation.

$\log Y = \log a + (\log b) \times t$   
Compound growth rate (CGR %) was estimated as,  
 $CGR\% = [\text{Antilog}(\log(b)) - 1] \times 100 = (b - 1) \times 100$   
The growth rates were tested for significance,

$$t = \frac{|b|}{S.E.(b)}$$

With (n-2) degrees of freedom at 5% and 1% level of significance.

**C-III) Value of Agricultural Produce:** The value of production of selected 20 crops was calculated on the basis of Minimum Support Price (MSP). This methodology was the base of measuring agriculture growth of Amravati district by calculating values of agricultural production of 20 crops.

**C-IV) Correlation study:** Karl Pearson correlation coefficients were calculated as per method suggested by Gomez and Gomez (1984) between non-crop indicators and values of agriculture production. Significance of correlation coefficient was tested.

$$r = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{[\sum (X_i - \bar{X})^2] [\sum (Y_i - \bar{Y})^2]}}$$

**C-V) Composite index of growth:** Composite index of 60 crop indicators was calculated by the procedure suggested by Narain *et al.* (1991). Agricultural growth was measured on the basis of this composite index. The value of composite index is non-negative, and it lies 0 to 1. The value of composite Index closer to zero indicates the higher level of growth, while the value of index closer to 1 indicate the lower level of development of the respective year.

## RESULTS AND DISCUSSION

Average, Coefficient of Variance (C. V. %), Range and CGR % of all 60 crop indicators, were calculated and the data are presented in the table 1.

It is observed from the table 1 that productivity of crops was comparatively stable as compared to area and production of crops, as Coefficient of Variance (C. V. %) of productivity was comparatively less as compared to C. V. of the area and production. Area of safflower, summer groundnut, *rabi* jowar and sunflower were most unstable, as their C. V. was maximum i.e. 121.87%, 115.75%, 109.11% and 100.37%, respectively. Similarly, Production of safflower (135.36%), other cereals (126.81%), summer groundnut (119.04%), and sunflower (118.46%) were not stabilized. Productivity of other cereals (49.82%), other pulses (49.79%), gram (44.84) and total oilseeds (41.70%) were scattered maximum as compared to other crops.

Compound Growth rate (CGR%) values of table 1 indicated that area under total oilseeds (CGR % 35.87\*\*), sunflower (CGR % 25.26\*\*), safflower (CGR % 23.21\*\*) and soybean (CGR% 15.74\*\*) had significantly increased over last 36 years. The area under crop bajri (CGR% - 13.25\*\*), *rabi* jowar (CGR% -12.31\*\*), wheat (CGR% - 9.01\*\*), *kharif* jowar (CGR% -8.42\*\*) had significantly decreased.

Narain *et al.* (2004) studied the "Evaluation of Socio-economic Development in Hill States". The study was based on composite index. The study concluded that (a) The state of Mizoram was ranked first and Auranachal Pradesh was ranked last in overall socio-economic development, (b) The overall socio-economic development was positively associate with the infrastructural facilities and (c) Literacy rate was influencing the level of development in positive direction.

Narain *et al.* (2005a) studied the level of development of different districts of Kerala with the help of composite index based on optimum combination of thirty nine socio-economic indicators. The district-wise data for the year 2001-02 in respect of these thirty nine indicators were utilized for all fourteen districts of the Kerala state. The level

of development was estimated separately for agricultural sector, industrial sector, infrastructural facilities and overall socio-economic sector. The district of Thrissur was ranked first and the district of Wayanad was ranked last in socio-economic development. Wide disparities were observed in the level of development among the different districts. Infrastructural facilities were found to be positively associated with the socio-economic development.

Narain *et al.* (2005b) studied the level of development of different districts of Jammu and Kashmir with the help of composite index based on optimum combination of twenty nine development indicators. The district-wise data on these indicators for the year 2001-02 were used for obtaining level of development of all fourteen districts of the state. The level of development was estimated separately for agricultural sector, infrastructural facilities and overall socio-economic sector. The district of Kathua was ranked first and the district of Kargil was ranked last in socio-economic development. Wide disparities were observed in the level of development between different districts of state. Infrastructural facilities and literacy status of the people were found to be positively associated with the socio-economic development.

Narain *et al.* (2007) studied the "Evaluation of Socio-economic Development of Different States in India". The study was based on composite index. Findings of their study were (a) The state of Punjab was ranked first and Bihar was ranked last in overall socio-economic development, (b) Wide disparities were observed in the level of development among different states, (c) The overall socio-economic development was positively associate with the development in agricultural sector and (d) The infrastructural facilities and literacy status were influencing the socio-economic development.

Thote *et al.* (2008) studied agricultural growth of Nagpur District, their study concluded that CGR values of these 14 indicators were gram (A 2.50%) and (P 3.63%), *kh.* groundnut (A (-) 9.09%) and (P (-) 8.44%), *kh.* jowar (A (-) 5.77%) and (P (-) 6.93%), *rabi* jowar (A (-) 15.67) and (P (-) 15.94), summer groundnut (A (-) 8.89) and (P (-) 9.74), cereals (A (-) 4.22) and (P (-) 3.79), total food grains (A (-) 2.33) and (Y 0.02) and total oilseeds (Y 2.99).

Compound growth rate (CGR%-values) of four crop production showed significantly increasing trend. These four crops were total oilseeds (CGR% 34.85\*\*), sunflower (CGR% 20.51\*\*), safflower (CGR% 19.77\*\*) and summer groundnut (CGR% 15.98\*\*). However, decreasing trend were observed in case of bajri (CGR% -11.15\*\*), *rabi* jowar (CGR% -7.99\*\*), wheat (CGR% -7.36\*\*) and *kharif* groundnut (-5.86\*\*) production.

The CGR values of productivity (yield) of crops summer groundnut (CGR% 46.25\*\*), sunflower (CGR% 44.84\*\*), total oilseeds (CGR% 34.30) and safflower (CGR% 31.54\*) had expressed significant increasing trend. However, *rabi* jowar (CGR% -21.90\*\*) and rice (CGR% -1.35) had expressed significant decreasing trend. Productivity of other crops was observed significantly increasing trend except tur and sugarcane and had found non-significant CGR values.

#### **Method I: Measurement of agriculture growth based on composite index of crop indicators:**

Composite index values based on area, production, productivity and all (A+P+Y) of 20 crops was calculated for 36 years. These 20 crops all-most covered 100% area of Amravati district. The compound growth rate (CGR%) were calculated. The values are given in table 2.

Narain *et al.* (2007) had pointed out limitations of other composite index methods like Principal Component Analysis, Multiple Factor Analysis, Aggregation Method, Monetary Index, Ratio Index and Ranking Method. Hence, Composite index was calculated as per method suggested by Narain *et al.* (1991).

Table 2 revealed that all the CGR values were negative of Amravati district in case of area, production, productivity and overall (A+P+Y) (-0.39\*\*, 0.40\*\*, -1.75\*\* and -0.73\*\*, respectively). It is concluded from the data that agriculture growth of Amravati district is decreasing significantly.

#### **Method II: Measurement of agriculture growth based on value of crop production:**

In this method, the value of gross output of agriculture produce (i. e. production of all agriculture crops) was calculated at Minimum Support Price (MSP). The compound growth rate (CGR%) of these

value of production was calculated. The results are presented in the table 3.

It can inferred from table 3 that agricultural growth of Amravati district based on value of crop production was 5.72\*\*%. The CGR% value was positive and significant at 1% level. In other words we can say that value of crop production was on an average is increasing every year at a rate of 5.72 per cent.

#### **Method III: Measurement of agriculture growth based on crop and other indicator:**

The other twelve indicators were identified who were having indirect impact / contribution in agriculture growth. The statistical parameters and CGR values of these were calculated and are presented in table 4.

Credit available is most unstable as its coefficient of variation value was the highest i.e. 58.44% and Net sown area was most stable as its C.V (%) was the lowest i.e. 1.89%. It indicated that net sown area was all most not change during the study period.

In study period, CGR % values indicated that credit availability increased on an average year<sup>-1</sup> @ 10.586%, fertilizer consumption @ 6.796%, number of tractor in use @ 6.461% and area under HYV @ 6.316%. All these CGR values were significant at 1 per cent level of significance. However, agricultural labour had expressed very small but significantly positive trend (CGR% 0.513\*\*).

Correlation coefficient of these indicators with composite index based on crop indicators (A+P+Y) and value of crop production based on MSP were estimated to study the relation-ship between them. The results are presented in table 5.

It is observed from table 5 that net irrigated area, total fertilizer consumption, number of tractors in use, number of sprayers and dusters in use, per cent literacy in rural areas, credit available and area under HYV had significant correlation with values of crop production based on MSP.

In other words, we can say that these indicators having significant impact on values of agricultural produce. The correlation coefficient

Table1. Statistical parameters and compound growth rate of crop area, production and yield for AMRAVATI district

Sr. No.	A/P/Y	Crop	Indicators	Number of years	Mean	C. V.	Range	CGR %	Significance
1	Area	Bajri	CI-1	36	210.19	85.47	502	-13.25	**
2	Area	Cotton	CI-2	36	3384.17	8.81	1166	-0.54	**
3	Area	Gram	CI-3	36	212.78	83.65	544	7.75	**
4	Area	<i>Kharif</i> Groundnut	CI-4	36	194.14	63.86	403	-7.44	**
5	Area	<i>Kharif</i> Jawar	CI-5	36	5934.75	70.30	10340	-8.42	**
6	Area	<i>Rabi</i> Jawar	CI-6	36	8.64	109.11	29	-12.31	**
7	Area	Rice	CI-7	36	116.67	16.81	71	-0.66	**
8	Area	Safflower	CI-8	28	45.18	121.87	190	23.21	**
9	Area	Soybean	CI-9	19	1015.16	62.66	1762	15.74	*
10	Area	Sugarcane Summer	CI-10	36	18.25	51.05	45	2.68	**
11	Area	Groundnut	CI-11	26	23.73	115.75	106	15.71	**
12	Area	Total Cereals	CI-12	36	2463.64	30.73	2263	-2.87	**
13	Area	Total Food Grain	CI-13	36	3971.64	9.74	1394	-0.68	**
14	Area	Total Oilseeds	CI-14	28	988.04	63.83	1875	35.87	**
15	Area	Total Pulses	CI-15	36	1535.64	31.97	1452	2.96	**
16	Area	Tur	CI-16	36	695.83	28.02	548	2.55	**
17	Area	Wheat	CI-17	36	846.94	76.87	1753	-9.01	**
18	Area	Other Cereals	CI-18	36	7.92	96.86	33	1.54	NS
19	Area	Other Pulses	CI-19	36	634.67	24.09	470	2.00	**
20	Area	Sunflower	CI-20	25	30.08	100.37	129	25.26	**
21	Production	Bajri	CI-21	36	77.97	90.55	228	-11.15	**
22	Production	Cotton	CI-22	36	1913.19	38.68	3371	2.26	**
23	Production	Gram	CI-23	36	137.94	107.37	495	11.39	**
24	Production	<i>Kharif</i> Groundnut	CI-24	36	116.03	67.01	251	-5.86	**
25	Production	<i>Kharif</i> Jawar	CI-25	36	5878.53	76.21	16494	5.78	**
26	Production	<i>Rabi</i> Jawar	CI-26	36	3.75	99.26	13	-7.99	**
27	Production	Rice	CI-27	36	73.89	34.49	127	-1.99	**
28	Production	Safflower	CI-28	28	24.78	135.36	120.8	19.77	**
29	Production	Soybean	CI-29	19	1025.05	71.73	2270	12.16	*
30	Production	Sugarcane	CI-30	36	1334.64	54.46	3184	2.83	**
31	Production	Summer Groundnut	CI-31	26	27.65	119.04	123	15.98	**
32	Production	Total Cereals	CI-32	36	2456.00	32.72	3472	-0.36	NS
33	Production	Total Food Grain	CI-33	36	3380.00	25.11	4073	0.99	*

Cont...

34	Production	Total Oilseeds	CI-34	28	806.86	87.88	2401	34.85	**
35	Production	Total Pulses	CI-35	36	924.00	46.96	1409	4.29	**
36	Production	Tur	CI-36	36	578.67	35.16	728	2.73	**
37	Production	Wheat	CI-37	36	794.19	71.22	1778	-7.36	**
38	Production	Other Cereals	CI-38	36	6.53	126.81	32	4.24	**
39	Production	Other Pulses	CI-39	36	213.36	66.74	514	5.45	**
40	Production	Sunflower	CI-40	25	16.76	118.46	94	20.51	**
41	Yield	Bajri	CI-41	36	448.56	37.63	703	2.43	**
42	Yield	Cotton	CI-42	36	574.64	41.32	1065	2.82	**
43	Yield	Gram	CI-43	36	501.36	44.84	1001	3.38	**
44	Yield	<i>Kharif</i> Groundnut	CI-44	36	641.33	36.60	918	1.71	**
45	Yield	<i>Kharif</i> Jawar	CI-45	36	1142.14	33.47	1598	2.88	**
46	Yield	<i>Rabi</i> Jawar	CI-46	27	564.26	42.30	880	-21.90	**
47	Yield	Rice	CI-47	36	641.25	34.75	899	-1.35	**
48	Yield	Safflower	CI-48	28	487.86	40.85	874	31.54	**
49	Yield	Soybean	CI-49	19	915.42	30.67	1091	19.09	*
50	Yield	Sugarcane Summer	CI-50	36	72010.69	16.51	51669	0.15	NS
51	Yield	Groundnut	CI-51	26	1146.46	24.57	1300	46.25	**
52	Yield	Total Cereals	CI-52	36	1062.44	33.09	1401	2.58	**
53	Yield	Total Food Grain	CI-53	36	855.69	24.87	919	1.67	**
54	Yield	Total Oilseeds	CI-54	28	695.79	41.70	1033	34.30	**
55	Yield	Total Pulses	CI-55	36	579.03	22.07	579	1.29	**
56	Yield	Tur	CI-56	36	827.17	17.77	624	0.17	NS
57	Yield	Wheat	CI-57	36	1085.31	24.74	1075	1.81	**
58	Yield	Other Cereals	CI-58	36	808.72	49.82	1833	2.66	**
59	Yield	Other Pulses	CI-59	36	310.72	49.79	578	3.38	**
60	Yield	Sunflower	CI-60	25	557.16	34.37	800	44.84	**

Note: \* and \*\* indicate 5% and 1% level of significance, respectively.

Note: Area in "00" hectares, Production in "00" metric tones and Average yield in kg hectare<sup>-1</sup>

**Table 2. Values of composite index based on crop area, production, yield and all (A+P+Y) of Amaravati district**

Years	Area	Production	Yield	All (Area + Production + Yield)
1970 -71	1.0000	1.0000	0.713964	0.8210837
1971 -72	0.79954	0.9209991	0.65179	0.7758345
1972 -73	0.802405	0.9591587	0.697307	0.8086776
1973 -74	0.811787	0.8977348	0.642 149	0.751386
1974 -75	0.783087	0.8634896	0.593995	0.7199996
1975 -76	0.802342	0.8244816	0.579381	0.6865274
1976 -77	0.76659	0.8887169	0.642929	0.7483994
1977 -78	0.78793	0.8204945	0.608251	0.69256
1978 -79	0.787748	0.8751721	0.613187	0.7165776
1979 -80	0.7 57108	0.8220188	0.568201	0.6820231
1980 -81	0.766718	0.86109	0.571136	0.7008787
1981 -82	0.7708	0.7875488	0.529711	0.6413711
1982 -83	0.734911	0.8142511	0.540715	0.6680128
1983 -84	0.734544	0.8320417	0.528339	0.6739219
1984 -85	0.747718	0.8379379	0.567092	0.6809018
1985 -86	0.738813	0.8407706	0.49673	0.6768469
1986 -87	0.763021	0.8646674	0.560426	0.6926736
1987 -88	0.733924	0.7358746	0.487938	0.5995641
1988 -89	0.668359	0.706636	0.474947	0.5668224
1989 -90	0.593657	0.6625955	0.433594	0.5314479
1990 -91	0.60 92	0.7874226	0.462852	0.6101743
1991 -92	0.732892	0.9444801	0.611445	0.7408613
1992 -93	0.757893	0.7789317	0.409374	0.6006418
1993 -94	0.740215	0.7274088	0.305318	0.5532786
1994 -95	0.718794	0.7715491	0.405306	0.5895466
1995 -96	0.688365	0.6867333	0.364826	0.5349625
1996 -97	0.678704	0.7080994	0.339805	0.5436418
1997 -98	0.689583	0.8515052	0.481617	0.6554058
1998 -99	0.728258	0.775617	0.359065	0.5847168
1999 -2000	0.727186	0.7692996	0.366514	0.5825583
2000 -2001	0.745442	0.8316179	0.454868	0.6329703
2001 -2002	0.704923	0.8265256	0.422076	0.6299996
2002 -2003	0.795964	0.8016285	0.38308	0.6160318
2003 -2004	0.753517	0.7947086	0.33891	0.6058216
2004 -2005	0.753253	0.9042905	0.490778	0.7030699
2005 -2006	0.774545	0.8116046	0.4254	0.6294708
<b>CGR %</b>	<b>-0.39 **</b>	<b>-0.40 **</b>	<b>-1.75 **</b>	<b>-0.73 **</b>

**Note: \* and \*\* indicate 5% and 1% level of significance, respectively.**

**Table3. Gross output value of crop production**

(Rs. in Cror)

<b>Years</b>	<b>Value of crop production based on MSP</b>
1976-77	2137130
1977-78	2739301
1978-79	2299313
1979-80	2724439
1980-81	2266782
1981-82	2976354
1982-83	3119052
1983-84	2716062
1984-85	2839698
1985-86	3281956
1986-87	2168445
1987-88	3836092
1988-89	3531699
1989-90	6663128
1990-91	3660095
1991-92	2676845
1992-93	4988449
1993-94	6838456
1994-95	5922734
1995-96	8059658
1996-97	8390244
1997-98	4993604
1998-99	7272414
1999-00	8847465
2000-01	6577894
2001-02	8481188
2002-03	8996479
2003-04	10474669
2004-05	8555874
2005-06	9942306
<b>CGR %</b>	<b>5.72**</b>



**Table 4. Statistical parameters and compound growth rate of non-crop indicators of AMRAVATI district**

Sr. No.	Non-Crop Indicator	Indicator No.	Number of Years	Mean	C. V.%	Range	CGR %	Significance
1	Net sown area (in 00 ha)	NC-1	22	7471.09	1.89	581	0.144	*
2	Net irrigated area (in 00 ha)	NC-2	22	500.23	27.48	451	3.889	**
3	Total fertilizer consumption(MT)	NC-3	22	49548.36	47.31	86080	6.796	**
4	Number of Tractors in use	NC-4	22	1186.68	45.06	1633	6.461	**
5	Number of Electric and Diesel pumps in use	NC-5	22	32355.45	6.25	5883	-0.185	NS
6	Number of Sprayers and Dusters in use	NC-6	22	26098.32	17.79	15543	2.818	**
7	Population Density (Population Sq. <sup>-1</sup> Km)	NC-7	22	181.32	12.41	61	1.84	**
8	Agricultural labor	NC-8	22	438169.9	6.60	69204	0.513	*
9	Per cent Literacy in rural areas	NC-9	22	57.19	11.47	15.98	1.467	**
10	Average area served per regulated market (Km)	NC-10	22	1000.64	4.95	171	0.149	NS
11	Credit available (Lakh Rs.)	NC-11	22	9776.77	58.44	15559	10.586	**
12	Area under HYV (00 ha)	NC-12	22	3552.36	40.15	3936	6.316	**

Note: \*, \*\*, NS indicated significant at 5% level, 1% level and NS for non-significant, respectively

**Table 5. Correlation coefficient between indicators and value at current and constant**

Sr. No.	Non-Crop Indicator	Composite Index based on A+P+Y (Y1)	Gross output values at MSP (Y2)
1	Net sown area (in 00 ha)	-0.1523	0.3673
2	Net irrigated area (in 00 ha)	0.0308	0.7278**
3	Total fertilizer consumption (MT)	0.0284	0.7991**
4	Number of Tractors in use	0.0599	0.8309**
5	Number of Electric and Diesel pumps in use	-0.3677	-0.2043
6	Number of Sprayers and Dusters in use	-0.1616	0.8906**
7	Population Density (Population Sq. <sup>-1</sup> Km)	0.0915	0.7520**
8	Agricultural Labor	-0.2050	0.3624
9	Per cent Literacy in rural areas	0.1900	0.6868**
10	Mean area served per regulated market (Km)	0.1568	0.2427
11	Credit available (Lakh Rs.)	-0.0159	0.8356**
12	Area under HYV (00 ha)	-0.2900	0.7524**

Table 6. Multiple linear regression analysis

Sr. No.	Indicators		Composite Index based on A+P+Y (Y1)	Gross output values at MSP (Y2)
	Intercept ->	a	1.502789771	-15180555.07
1	Net sown area (in 00 ha)	b1	-0.0000830592	3964.56267**
2	Net irrigated area (in 00 ha)	b2	-7.70798E-05	-1285.015761
3	Total fertilizer consumption (MT)	b3	0.0000002174	28.30858019
4	Number of Tractors in use	b4	0.000137821	-308.2319132
5	Number of Electric and Diesel pumps in use	b5	0.0000417038	-159.0340743
6	Number of Sprayers and Dusters in use	b6	-0.0000293656	398.7286466
7	Population Density (Population Sq. <sup>-1</sup> Km)	b7	0.006198827	-20299.03582
8	Agricultural Labor	b8	-0.0000002.54511	-30.09234301
9	Per cent Literacy in rural areas	b9	-0.015297656	-35590.0543
10	Average area served per regulated market(Km)	b10	0.0000889133	2048.215276
11	Credit available (Lakh Rs.)	b11	0.0000122111	-49.91822317
12	Area under HYV (00 ha)	b12	-0.0000326895	977.7922528**
13	Coefficient of Determination	R <sup>2</sup>	0.773569131 <sup>NS</sup>	0.876766469**

Table7. Values of composite index based on crop area, production, yield and other indicators of Amaravati district

Years	Composite Index
1984-85	0.8000511
1985-86	0.7792877
1986-87	0.8182528
1987-88	0.7058135
1988-89	0.6668796
1989-90	0.6058495
1990-91	0.6792472
1991-92	0.8303054
1992-93	0.6707321
1993-94	0.598868
1994-95	0.6369763
1995-96	0.5853983
1996-97	0.5857566
1997-98	0.7115371
1998-99	0.617498
1999-2000	0.618108
2000-2001	0.6812325
2001-2002	0.6740883
2002-2003	0.6526503
2003-2004	0.6390075
2004-2005	0.7564694
2005-2006	0.6566023
<b>CGR %</b>	<b>-0.6438*</b>

**Table 8. Agriculture growth as per three different methods**

	Agricultural growth as per different approach					Value of Production
	Composite index based on					
	Area	Production	Yield	All (A + P + Y)	All 72 Indicators	
CGR %	<b>-0.39**</b>	<b>-0.40**</b>	<b>-1.75**</b>	<b>-0.73**</b>	<b>-0.6438*</b>	<b>5.72**</b>

between these indicators and composite index based on A+P+Y was non-significant for all indicators.

Multiple linear regression analysis of these 12 indicators had performed with crop production based on MSP (Y1) and composite index based on all crop indicators i.e. (A+P+Y) (Y2). The results are presented in table 6.

It is observed from table 6 that coefficient of determination values ( $R^2$ ) with Y1 and Y2 were 0.7735<sup>NS</sup> and 0.8767\*\*, respectively. It indicated that all 12 indicators were able to explain more than 87% variation present in Y2. In other words these 12 indicators were having strong relationship with Y2 and had non-significant relationship with Y1.

It is clear from the above discussion that these 12 indicators had notable impact in agricultural growth. It is not proper to ignore their role in agriculture growth, only because their contribution is not possible to measure in terms of rupees.

Composite index was constructed as per the methodology developed by Narain *et al.* (1991) on the basis of 72 indicators (60 indicators of A/P/Y of 20 crops + 12 other indicators). This composite index was independent of measuring unit. Twenty three values of composite index were calculated for 23 years. The results are presented in table 7.

It can opined from table 7 that agriculture growth of Amravati district based on composite index considering all the 72 indicators was -0.6438\*. In other words, agricultural growth is decreasing @ of 0.634 % on an average year<sup>-1</sup> of Amravati district.

In the present study, three different approaches were used to measure agricultural growth of Amravati district. The results obtained due to these three different approaches are presented in table 8.

Study concluded that agriculture growth of

Amravati district in case of area, production, productivity, overall (A+P+Y) and considering all 72 indicators were observed -0.39\*\*, -0.40\*\*, -1.75\*\*, -0.73\*\* and -0.6438\*, respectively. All CGR values were negative and significant. However, Agriculture growth of Amaravati district based on value of crop production was 5.72\*\* which was positive and significant at 1% level.

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