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Dynamics of Cereals Production in the States of North Eastern Region of India: An Interstate Comparative Study

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ABSTRACT

This paper investigates the temporal variations in area, production and yield of cereals in the states of north eastern India. The study period is from 1966-67 to 2014-15 and it has been divided into five periods: 1966-67 to 1974-75, 1975-76 to 1984-85, 1985-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 to have an understanding of decadal performance among the states. Growth rate performance of the period 2005-06 to 2014-15 may be regarded as the best among the five study periods. The comparison of production growth rates in all the periods reveals that Nagaland exhibits better performance followed by Arunachal Pradesh. Decomposition analysis reveals that sources of output growth in the states of the region are due to yield improvements (64%) followed by area expansion (36%). Variance analysis depicts that yield varies slowly over each study period with a large variability among the states suggesting the identifiable state specific factors. Despite area, production and productivity of cereals have shown a steady upward trend in every period of the study the region still has a deficit of 207 thousand tons of cereals against the requirement of the last census year. Though the projected figure of the year 2021 is surplus (0.7%) in the region; if the current scenario continuous, except Arunachal Pradesh, Nagaland and Tripura, all other states of the region will be deficit in cereals requirements in 2021. Considering that cereals are irreplaceable staple of the region and states like Mizoram and Sikkim showing decreasing growth rates in area under cereals during the last decade, the scope of meeting the cereal requirement of the region depend highly on productivity improvement.

1. Introduction

The term cereal is a derivative from Latin word 'cereal' meaning 'grain' which is botanically, a type of fruit called a caryopsis, composed of the endosperm, germ, and bran. The cereals are annual common grass members of the grass family (a monocot family Poaceae, also known as Gramineae), which usually have long, thin stalks, such as wheat, rice, maize, sorghum, millet, barley and rye, whose starchy grains are used as food. India is the world's second largest producer of rice, wheat and other cereals. The huge demand for cereals in the global market is creating an excellent environment for the export of Indian

cereal products. Household food and nutritional security of North-eastern states of India predominantly depends on cereals specially rice. Rice is the principal cereal crop of the North Eastern hilly ecosystem followed by maize. In the region, cereals occupies 3714 thousand hectares which accounts for around 60 per cent of the total cropped area of the region and 3.7 per cent of the total cereal area in India while its share in national cereals production is 3.2 per cent as per triennium ending 2015. The total cereal production of NE region is 7719 thousand tones with average productivity of 2077 Kg/ha, which is much below the national average of 2414 Kg/ha as per triennium ending 2015 (GOI, 2016). During the post-green revolution period due to introduction of improved varieties, the rice yield in NEH region has been

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enhanced up to 40% (RKMP, DRR) that plays a pivotal role in increasing the productivity of cereals. Cultivation of Rice and maize in the NEH region, the two main cereal crops of the region is exposed to different biotic and abiotic stresses that include extreme temperatures at the time of flowering and grain filling stages thus resulting a very dismal figure in rice productivity and production of the region which in turn reflects a lower per capita consumption as well. With the above background and with broad objective of analyzing the growth rates of domestic cereals production, the present study was taken up with the specific objective to analyze the temporal dynamics of growth rate, decomposition of source of output growth and variability between the states over the study years in a state wise comparative mode.

2. Data and Methodology

Secondary data on area, production and productivity of cereals from department of economics and statistics, Ministry of agriculture were compiled. According to the availability of data the study was made from 1966-67 to 2014-15 and in turn the entire period was decomposed into five periods viz. 1966-67 to 1974-75, 1975-76 to 1984-85, 1985-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 to have an understanding of decadal performance.

2.1 Growth rate Estimation

The growth rate was measured following the popular procedure adopted by various authors, Mohamed Elamin Abd Ellatif Mahir *et al.* (2010), J. S. Sonnad *et al.* (2011), Abhey Singh Godara *et al.* (2013), Edwin Kenamu *et al.* (2014), and many others and the steps followed are presented below.

By taking time as the independent variable and the area, production and productivity of the concerned crop cereals as the dependent variable, the compound growth rates were estimated by using the formula:

$$Y = A (1 + r)^t$$

Where,

Y = Dependent variables like area, production and productivity in the year 't' for which growth rate is estimated

A = Constant

r = Rate of annual increment

The significance of growth rate was tested by applying student 't' test statistic.

2.2 Decomposition of Growth Components

To measure the relative contribution of area and yield towards the total production change with respect of the

crop, the technique of decomposition has been adopted. Similar technique was also employed by Cavery (1991), Sharma and Kalita (2004) and N Uttam Sing *et al.* (2015). The change in the production of crop between any time periods can be expressed as

$$\text{Change in production} = \text{Yield effect} + \text{Area effect} + \text{Interaction effect}$$

Thus, the total change in production is attributed due to area and yield that can be decomposed into three effects viz. yield, area and interaction effects.

2.3 Variation types

In panel data analysis we find three variation types viz. overall, between and within variations. These variations are inspected to have an idea of variation across the individuals over time. [Gelman, Andrew (2005), Anscombe, F. J. (1948), Bailey, R. A. (2008.)

N = number of individuals.

T = number of time periods.

$$\text{Individual mean } \bar{x}_i = \frac{1}{T} \sum_t x_{it}$$

$$\text{Overall mean } \bar{x} = \frac{1}{NT} \sum_i \sum_t x_{it}$$

$$\text{Overall variance } s_O^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x})^2$$

$$\text{Between variance } s_B^2 = \frac{1}{N-1} \sum_i (\bar{x}_i - \bar{x})^2$$

$$\text{Within variance } s_W^2 = \frac{1}{NT-N} \sum_i \sum_t (x_{it} - \bar{x}_i)^2 = \frac{1}{NT-1} \sum_i \sum_t (x_{it} - \bar{x}_i + \bar{x})^2$$

The overall variation can be decomposed into between variation and within variation.

$$s_O^2 \approx s_B^2 + s_W^2$$

To test hypothesis that population means from the individuals are equal (and any differences are due to natural variation), F

test is used where $F = \frac{s_B^2}{s_W^2}$. F is distributed with N-1 and N

(T-1) degrees of freedom.

3. Result and Discussion

3.1 Growth rates of area, production and productivity

To estimate the growth performance of area, production and yield of cereals in state wise comparative mode during the period 1966-67 to 2014-15, time series data on area, production and productivity were analyzed. The whole period was divided into five decades to understand the decadal performance. The periods 1966-67 to 1974-75, 1975-76 to 1984-85, 1985-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 have been referred to as period 1, period 2, period3, period 4 and period 5 respectively from here onwards. When table 2 is looked period-wise across the states the following discussions can be drawn.

Period 1 (1966-67 to 1974-75)

In this period Meghalaya and Mizoram had only five data points from 1970-71 and Sikkim with no data. Highest growth in area (39.08%) and production (29.46%) were observed in Mizoram while highest yield (11.38%) was achieved by Nagaland. Manipur had the lowest area expansion with negative production and Mizoram was found with highest negative growth in yield. None of the growth rates figures were significant in this period. When considered NER and India; the growth of area, production and yield were found at the increasing rate with significant area growth in NER.

Period 2 (1975-76 to 1984-85)

Growth rates of Sikkim were calculated on only four data points and the state was found highest growth in production (11.68%) followed by Arunachal Pradesh. Highest area growth was found in Arunachal Pradesh (5.22%) followed by Sikkim while highest yield was achieved by Mizoram. But Mizoram was also found the highest negative significant growth rates in area (29.25%) and production (24.28%). Nagaland showed negative growth in area, production and yield. For NER and India growth of area, production and yield were found at the increasing rate though insignificant.

Period 3 (1985-86 to 1994-95)

Mizoram and Nagaland changed the scenario in this period where these two states had the highest growth in area production and yield. Meghalaya, Manipur and Tripura had negative growths in area while Arunachal Pradesh showed negative in yield growth. In NER area, production and yield were all positive and significant while production and yield of India also became positively significant.

Period 4 (1995-96 to 2004-05)

Highest area, production and yield growths were achieved by Nagaland in this period too, with significant figures of area and production. Nagaland was followed by Meghalaya with all the growths of area, production and yield were positively significant. Assam, Mizoram, Sikkim and Tripura had declining growth in area. For NER all are positive but only yield was significant while India had positive growths except in area.

Period 5 (2005-06 to 2014-15)

All the states except Mizoram and Sikkim registered

positive growth of area where only Meghalaya (0.75%) had significant growth in area. Production and yield of all the states showed positive growths except yield growth of Manipur. Statistically significant production growths were observed in Arunachal Pradesh, Assam, Meghalaya and Tripura. For NER, all the figures were positive with significant growth of production and yield while India had significant positive growths except in area. Hence, in this period best performance in area growth was shown by Nagaland, production and yield growths by Arunachal Pradesh while lowest performance in area growth was shown by Sikkim and; production and yield growth by Manipur.

Entire period (1966-67 to 2014-15)

Among the states Nagaland registered the highest significant growth in area (3.45%) production (6.87%) and yield (3.30%) followed by Arunachal Pradesh. In the entire period all the states registered positive and almost significant figures in area except Sikkim and Tripura. Production and yield growth were all positive and almost significant except Mizoram and Sikkim. NER and national figure were significantly positive growth in area, production and yield except the negative growth of area in all India figure. In the region, among the five periods, period 1 achieved the highest growth in area followed by period 3. Lowest growth in area was observed in period 4 followed by period 2. Highest significant growth in production and yield were achieved by period 5 followed by period 3. Lowest growth in production and yield were observed in period 2 followed by period 4. In the entire period the growth performance of yield of all the states were highly significantly accelerating except Mizoram.

3.2 Relative contribution of area, productivity and their interaction to the change of production growth

The growth analysis (area, production and yield) of cereal revealed the general pattern of growth and direction of changes in yield and area. But this analysis does not evaluate the contribution of area and yield towards the production growth. So, it is necessary to examine the sources of output growth. To appraise the sources of output growth, the change in production was divided in to three effects *i.e.* area effect, yield effect and interaction effect. With the help of this additive decomposition model the relative contribution of area, productivity and their interaction on cereals production in the states of NER for different periods (1966-67 to 1974-75, 1975-76 to 1984-85, 1985-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 and overall period 1966-676 to 2014-15) had been estimated and presented in table 3. Table 3 can be viewed in two distinct parts. First part is Period 1 and 2 where the major contribution to the change of

Table 2. Compound growth rate of area, production and yield of Cereals in the states of NER during the decades 1966-67 to 1974-74, 1975-76 to 1984-85, 185-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 and overall period 1966-67 to 2014-15

	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	NER	India
Period 1: 1966-67 to 1974-75										
AREA	3.68	0.23	0.46	0.96	39.08	-9.57			2.42***	1.12
PRDN	3.44	1.37	-2.13	0.91	29.46	0.72			6.06	2.59
YIELD	-0.23	1.14	-2.58	-0.05	-6.92	11.38			3.56	1.46
Period 2: 1975-76 to 1984-85										
AREA	5.22	0.69	-1.28	1.01	-29.25**	-15.78*	4.48	-0.97	0.38	0.22
PRDN	6.87**	1.92	-0.49	1.61*	-24.28**	-16.98*	11.68	0.94	1.68	2.83
YIELD	1.58	1.22	0.80	0.59	7.03	-1.43	6.90	1.92	1.30	2.60
Period 3: 1985-86 to 1994-95										
AREA	2.23	0.62	-0.88	-0.80**	18.62	15.41	-0.26	-0.70	0.88*	-0.30
PRDN	0.88	3.31	3.61	0.00	23.73	23.78	1.03	2.00	3.50**	3.36**
YIELD	-1.33	2.67*	4.52	0.81	4.31	7.25	1.29	2.71	2.60*	3.67***
Period 4: 1995-96 to 2004-05										
AREA	0.94	-0.19	0.16	0.23*	-1.91	2.82***	-0.85	-0.21	0.02	-0.39
PRDN	2.04	1.25	1.32	4.69**	0.41	7.82*	-0.52	4.39	1.93	0.64
YIELD	1.09	1.44	1.16	4.45**	2.36	4.87	0.33	4.61	1.92**	1.04
Period 5: 2005-06 to 2014-15										
AREA	0.72	0.77	4.35	0.75**	-7.66	1.33	-1.76**	0.82	0.86	-0.03
PRDN	6.95***	6.00**	1.00	5.56**	1.00	5.61	0.23	2.99**	5.19**	2.39*
YIELD	6.18	5.19**	-3.21	4.78*	9.37	4.22	2.03**	2.14**	4.30***	2.42**
Entire Period: 1966-67 to 2014-15										
AREA	2.73***	0.42***	0.27	0.13	1.06	3.45**	-0.34	-0.28*	0.64***	-0.04
PRDN	3.96***	1.96***	1.47***	1.88***	2.66	6.87***	0.73	2.36***	2.28***	2.38***
YIELD	1.20***	1.53***	1.19***	1.75***	1.58	3.30***	1.08***	2.65***	1.62***	2.42***

* p<0.10, ** p<0.05, *** p<0.01, NA: Not applicable

cereals production is dominated almost equally by area effect and yield effect though area effect is little more dominating. Second part is period 3, 4 and 5 where yield effect is the major contribution to the change of cereals production. Hence change in output production of cereals in period 1 was due to area expansion in Arunachal Pradesh, Manipur, Meghalaya, and Mizoram while it was yield effect in Assam, Nagaland and Tripura.

In period 2 area effect was more dominating, only Manipur Sikkim and Tripura had yield effect as main contribution to the change in output growth. In period 3, all the entries except Mizoram and Nagaland registered yield effect as the major contributor to the change in cereals production. In period 4 except Sikkim all other entries showed yield effect as dominating contributory to the change in output production. In period 5 also, all the states, NER and India showed yield effect as major contributor except Manipur and Mizoram where the effect was due to area expansion. In the entire period Assam, Meghalaya, Nagaland, Tripura, NER and India had yield effect as main contributor and that of Manipur, Mizoram and Sikkim were area effect while Arunachal Pradesh had interaction effect as their main effect to the change of production of cereals. When table 3 is viewed state wise over the five periods, it is observed that yield effect is more contributory in all the states except in Mizoram in which period 4 is the only period in which yield effect is dominating. The distribution of these effects with reference to table 3 are: yield effect: 64% and area effect: 36%. Hence production in the region has increased as a result of yield improvements followed by area expansion.

3.3 Variation of yield across the individual states over the years

Growth rate and decomposition analysis of area, production and yield of cereal gives the direction of growth, and source of output growth. But these do not convey the variation of area, production and yield across the states over the period of time. So, variance analysis was carried out to measure the average degree to which each point differs from the average across the individual states over the sequence of five consecutive decades. By inspection through the time series cross sectional data used in the study it is vivid there is large variation in area and production among the states while yield being the ratio of the two is more stationery and proportionate; and hence, variation analysis on yield, rather than area and production, is more meaningful. Here, three variation types *viz.* overall, between and within variations are discussed. Overall variation refers to variation over the years and individual states. Between variations examines the variation that exists between

individual states that may be caused by specific identifiable factors. Within variation is a measure of how much an individual state in the sample tends to change (or vary) over time. In other words, within variation is the mean of the change for the average individual case in the sample. These variations are presented along with their mean, maximum and minimum values of all the periods as given in table 4.

Referring table 4, in all the five periods as well as the entire period yield has shown more between variations than within variation. Overall variation of yield across the individual states over each period of years is quite less than that of the between variation as the within variation is comparatively lower. This indicates the existence of identifiable state specific factors that causes the variation in a large scale. The probable state specific factors may be government policies, agriculture input technologies, topography, soil fertility, natural resources, agriculture functionaries, *etc.* Focusing on period 5 (2005-06 to 2014-15) being the most recent past decade, the average yield of Mizoram, by inspection, is 1236 kg per ha being the lowest among the states while that of Tripura is 2623 kg per ha being the highest. The year 2007 has the lowest average (1610 kg per ha) and the year 2015 has the highest average (2067 kg per ha) yield when we look time wise during the period. However, in this period the average yield of an individual state over the years is between 264.5 kg per ha (Mizoram in 2008) to 22875.2 kg per ha (Tripura in 2015) and varies by 1363.8 across the states (between variation), but varies by 306 for each individual state over time (within variation). Smaller within variation indicates that for every state, on an average the yield does not vary much as compared to overall and between variations during this period. Similar pattern was observed in rest of the periods as well as in the entire period *i.e.* yield has more between variations than within variation as shown in table 4. This means the yield varies slowly over each study period with a large variability among the states. It was observed that overall and between variance exhibits gradual increase over the period 1 to period 5 and within variance fluctuates during this five consecutive periods. This means that state specific factors are becoming more specific resulting the variability larger among the states in the course of time. If the between variance is smaller than the within variance, then the means are really close to each other and we will fail to reject the claim that they are all equal.

3.4 Requirement Analysis (Surplus and Deficit)

To have an idea whether the cereals production in the states of the region will be sufficient or not in feeding the increasing population of the year 2021, requirement was estimated by

Table 3. Relative percentage contribution of area, yield and their Interaction in the change of cereals production during the decades 1966-67 to 1974-74, 1975-76 to 1984-85, 185-86 to 1994-95, 1995-96 to 2004-05 and 2005-06 to 2014-15 and overall period 1966-67 to 2014-15

State	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	NER	India
Period 1: 1966-67 to 1974-75										
ΔP	100	100	100	100	100	100	NA	100	100	100
$A_0\Delta Y$	15	56	-791	-97	-12	574	NA	57	44	78
$Y_0\Delta A$	75	40	990	200	147	-240	NA	32	50	17
$\Delta A\Delta Y$	10	4	-99	-3	-34	-234		11	6	5
Period 2: 1975-76 to 2014-15										
ΔP	100	100	100	100	100	100	100	100	100	100
$A_0\Delta Y$	22	22	171	41	-27	13	57	1077	56	99
$Y_0\Delta A$	65	76	-57	55	103	98	36	-855	41	1
$\Delta A\Delta Y$	13	2	-14	4	24	-11	7	-122	2	0
Period 3: 1985-86 to 1994-95										
ΔP	100	100	100	100	100	100	100	100	100	100
$A_0\Delta Y$	4438	108	115	60	1	3	96	165	68	112
$Y_0\Delta A$	-6245	-7	-10	43	84	67	4	-54	28	-9
$\Delta A\Delta Y$	1907	-1	-5	-4	15	30	0	-12	4	-3
Period 4: 1995-96 to 2004-05										
ΔP	100	100	100	100	100	100	100	100	100	100
$A_0\Delta Y$	52	517	47	92	801	52	-65	70	125	116
$Y_0\Delta A$	46	-387	46	5	-578	35	162	27	-22	-14
$\Delta A\Delta Y$	3	-30	7	3	-123	12	3	3	-3	-2
Period 5: 2005-06 to 2014-15										
ΔP	100	100	100	100	100	100	100	100	100	100
$A_0\Delta Y$	83	93	-2843	83	23	55	763	79	83	91
$Y_0\Delta A$	11	5	4348	10	85	34	-563	16	12	8
$\Delta A\Delta Y$	6	2	-1405	7	-9	11	-100	4	4	1
Overall Period : 1975-76 to 2014-15										
ΔP	100	100	100	100	100	100	100	100	100	100

$A_0\Delta Y$	16	68	-27	84	20	54	-1103	94	57	90
$Y_0\Delta A$	36	13	140	6	48	7	68	2	18	3
$\Delta A\Delta Y$	48	18	-14	10	32	39	46	4	25	7

NA: Not applicable

Table 4. Variation of yield across the individual states over the years

Variable	Variation	Mean	Standard deviation	Minimum	Maximum
Period 1: 1966-67 to 1974-75					
Yield	Overall	960.3	319.3	251.9	1826.4
	Between		808.3	774.3	1208.9
	Within		181.7	533.7	1459.1
Period 2: 1975-76 to 1984-85					
Yield	Overall	1094.9	284.4	322.3	1997.7
	Between		806.9	899.7	1275.4
	Within		143.0	680.1	1585.7
Period 3: 1985-86 to 1994-95					
Yield	Overall	1340.8	357.1	636.6	2990.8
	Between		982.7	1092.3	1656.6
	Within		214.6	981.3	1964.2
Period 4: 1995-96 to 2004-05					
Yield	Overall	1633.9	414.8	992.4	2478.0
	Between		1247.7	1308.0	1825.4
	Within		193.5	1132.3	2336.8
Period 5: 2005-06 to 2014-15					
Yield	Overall	1831.7	500.1	264.5	2875.2
	Between		1363.8	1349.5	2219.4
	Within		306.0	1146.7	2630.6
Entire Period: 1966-67 to 2014-15					
Yield	Overall	1404.7	499.8	251.9	2990.8
	Between		1919.6	731.7	2297.1
	Within		428.0	902.2	2006.2

assuming the growth rate of cereals production of each states during the last decade (2005-06 to 2014-15) to be continued and population growth rate of each state during 2001 to 2011 keeps on. Cereals production of 2020-21 for each state were estimated using growth rate of last decade *i.e.* 2005-06 to 2014-15 so also the population 2021 was estimated based on the population growth of respective states during 2001 to 2011. Requirement of cereals as per population of 2011 was also worked out with corresponding productions of TE 2010-11. ICMR recommendation of 158 Kg per person per year of cereals was used as standard to estimate the surplus and deficit. In 2021 total requirement of cereals in NER will be 8413 thousand tones to feed its increasing population of 53.25 million. Against this requirement, the estimated production in the region in 2021 will be 8476 thousand tons resulting a surplus of 63 thousand tones which is 0.7%. Despite surplus is projected for total NER, it is to remember that Meghalaya, Mizoram and Assam had been deficit in cereal requirement as per population of 2011. If the current scenario is continuing, in 2021 except Arunachal Pradesh, Nagaland and Tripura, all other remaining states will be deficit in cereals requirements (table 5).

Summary and Conclusion

Temporal analysis of five decades reveals that growth rate performance in the region, among the five periods, period 1 has achieved the highest growth in area followed by period 3. Lowest growth in area has been observed in period 4 followed by period 2. Highest significant growth in

production and yield have been achieved by period 5 followed by period 3. Lowest growth in production and yield has been observed in period 2 followed by period 4. Period 5 may be regarded as the best among the five study periods. In the entire period the growth performance of yield of all the states reveals highly significantly accelerating except in Mizoram. Among the states Nagaland has registered the highest significant growth in area (3.45%) production (6.87%) and yield (3.30%) followed by Arunachal Pradesh, Assam, Tripura and Meghalaya while Manipur, Mizoram and Sikkim are running behind. The decomposition analysis has revealed that sources of output growth in the states of the region are due to yield improvements (64%) followed by area expansion (36%). Hence production in the region has increased as a result of yield improvements followed by area expansion. In all the five periods as well as the entire period yield has more between variations than within variation. Overall variation of yield across the individual states over each period of years is quite less than that of the between variation as the within variation is comparatively lower. This indicates the existence of identifiable state specific factors that causes the variation in a large scale. The probable state specific factors may be government policies, agriculture input technologies, topography, soil fertility, natural resources, agriculture functionaries, *etc.* In 2021 total requirement of cereals in NER will be 8413 thousand tones to feed its increasing population of 53.25 million. Against this requirement, the estimated production in the region in 2021 will be 8476 thousand tons resulting a surplus of 63 thousand tones which is 0.7%. Despite surplus is projected for total NER and area, production and productivity of cereals in NER

Table 5. Requirement of cereals as per the population of 2011 and 2021 with corresponding productions of TE 2010-11 and 2020-21 along with corresponding surplus or deficit in the states of NER.

State	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	NER	India
Requirement as per census 2011										
TE Production	325	4606	514	239	60	461	100	691	6996	223977
Requirement	218	4925	430	468	172	313	96	580	7203	191211
Surplus/Deficit	107	-319	84	-230	-113	148	4	111	-207	32766
% Surplus/Deficit	32.8	-6.5	16.4	-49.0	-65.3	32.1	4.2	16.1	-2.9	14.6
Estimated requirement as per estimated census 2021										
Estimated Production	426	5709	403	364	70	646	97	778	8476	241090
Estimated Requirement	276	5772	482	600	214	311	109	667	8413	225105
Estimated Surplus/Deficit	150	-63	-79	-236	-144	335	-12	112	63	15984
% Surplus/Deficit	35.2	-1.1	-16.4	-39.3	-67.3	51.9	-11.3	14.3	0.7	6.6

+ve: surplus and -ve: deficit, All figures being in '000 tones, ICMR recommendation: 158Kg per person per year

have shown a steady upward trend in every period of the study, if the current scenario is continuing, in 2021 except Arunachal Pradesh, Nagaland and Tripura, all other remaining states will be deficit in cereals requirements. The scope of meeting this requirement of the states depends highly on productivity improvement.

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