Trends on Rice Production and Productivity in India and the North East Region : Issues and Challenges

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Abstract

The study highlighted the trends in area, production, and productivity of rice cultivation in India and the North East Region and tried to investigate the major issues and challenges of rice cultivation. The data from the years 1997 - 98 to 2015 - 16 were collected from sources such as *Handbook of Statistics*, Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India and The North Eastern Development Finance Corporation Ltd. (*NEDFi*) databank. The study revealed that the area, production, and productivity in India witnessed an increasing trend at a lower rate of about 0.99%, 1.24%, and 5.94%, respectively. However, in case of the North East Region, there was an increasing trend in area and productivity by about 0.18% and 1.07%, which was much lower than the national average, while production was 2.05%. The study showed that there was a fluctuating trend in area, production, and productivity in India and the North East Region over this period. Lack of advanced machinery, floods, infestation by weeds and pests, non - availability of HYV seeds, discouraging price conditions are some limiting factors for the rice growers, weaning them away from rice cultivation in India in general and the North East Region in particular.

Keywords : **rice, land, production, productivity trends and determinants, North East Region**

JEL Classification : E23, J24, Q15

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Agriculture is the backbone of the Indian economy, and it is the major source of income and livelihood which provides the basic ingredients to mankind and provides raw material for industrialization. In recent years, the agricultural sector has registered rapid progress in the production and productivity of cereals, horticulture, oil seeds, animal husbandry, etc. Though in terms of percentage of GDP, agriculture has shown a decreasing trend over the past 60 years, however, agriculture still occupies the center stage of India's social security and overall economic welfare. In the North East region, a considerable progress has been achieved in agricultural production and productivity by adoption of advanced technology, but the rate of growth in farming has not reached the expected level (Sashimatsung & Giribabu, 2016). Being one of the world's largest agrarian economies, the Indian agriculture accounted for 17.1% of national GDP and employed about 50% of the country's total workforce as in 2016-17. As the Indian economy has diversified and is registering dramatic progress in national accounts, the agriculture sector is still the single largest contributor and plays a significant role in the overall socioeconomic development of the rural sector.

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Rice is perhaps the world's most important food crop, being the staple food of over 50% of the world population, particularly in India, China, and a number of other countries in Africa and Asia. India is the second largest producer of rice (first is China) and brown rice, accounting for 20% of the entire world's rice production. Rice is the major source of energy in the human diet of entire Asia, parts of Africa, and Latin America (Chandrasekaran, Annadurai, & Kavimani, 2007). About 22% of the world's supplies of calories and 17% of the proteins come from rice. More than 3 billion people depend on rice as their major source of calories, out of which 90% of the world's area and production are concentrated in Asia. Considering its important position, the United Nations designated the year 2004 as the "International Year of Rice." India has the largest area under rice cultivation covering 41.92 million hectares with annual production of 89.09MT.

India holds one-third of the world's rice cultivation in area, and the share of rice is about 35.36% of the gross cropped area and 43% of the total food grain production. The average yield of rice in India is 5686 kg per hectare, and it constitutes nearly 25% of the country's agricultural exports. The major rice producing states are Andhra Pradesh, Assam, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Odisha, Karnataka, Kerala, Tamil Nadu, and Uttar Pradesh and these states contribute about 90% of the total rice production. From this background, the main objective of the present study is to analyze the trends in area, production, and productivity of rice in India and the North-Eastern states. The study also investigates the factors influencing the production among the major rice growing states as well as all North Eastern states over a period of time.

Review of Past Studies

Kumar and Rosegrant (1994) stated that increase in yield need not imply that the potential productivity from the inputs are fully realized, but spread of inputs in the new areas where the existing level of application is relatively low has contributed to the rise in the productivity per unit of input as well as ensuring more equitable distribution of benefits. Sengupta and Kundu (2008) reported significant transition and upsurge in agricultural productivity in West Bengal since 1980s was attributed due to the establishment of the democratic Panchayati institution and the conduct of Operation Barga, which emerged as a new center of growth in the agricultural sector.

Kuotsuo, Chatterjee, Deka, Kumar, Ao, and Vikramjeet (2014) found that eradication of shifting cultivation and replacing it with an integrated farming system model may be the best for saving the environment, but it is well known that it will never be easy for someone whose occupation will change overnight radically. It suggested the idea for scientific systems of organic cultivation, which should be taught to the farmers that can give a better option to generate income in a land where fertilizers have never been used before.

Kithan (2014) highlighted the benefits of indigenous farming systems practiced by Naga farmers such as the indigenous practice of Zabo and Alder farming, which are soil and water conserving oriented and are sustainable in the long run. Hussain (2015) revealed that the level of productivity of farms was positively influenced by factors like labour, fertilizers, pesticides, irrigation, tractors, and many other related factors. The study concluded that farm level efficiency can be increased by increasing the use of inputs like labour, fertilizers, pesticides, irrigation, and tractors.

Methodology

The data were collected from secondary sources, such as, *Handbook of Statistics*, Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India and The North Eastern Development Finance Corporation Ltd (*NEDFi*) databank. For the analysis, the data on area, production, and productivity were used. Time series data from 1997-98 to 2015-16 were used to understand the trends in area, production, and productivity of rice cultivation in India and the North-Eastern states. In addition to the usual statistical measures such as percentages and compound growth rates, simple and multiple regression analysis are applied. The model may be extended by

assuming that the dependent variable Y is a linear function of a series of independent variables and an error term (Pusa & Giribabu, 2016). The multiple regression model may be specified as :

$$Y_t = \sum_{i=0}^{k} \beta_i X_{it} + \mu_t$$

where,

Y_t is the dependent variable, the X's are the independent variables, μ_t is the error term, and β_1 is the constant term.

Analysis and Results

(1) Area, Production, and Productivity of Rice : The cultivation of rice is generally dependent upon the fertility of land, climate conditions, high yielding varieties of seeds, and irrigational potentials. Therefore, the production of rice varies between state to state and even region to region. The Table 1 shows the trend in area under rice of some of the major rice producing states in India from the year 1997-98 to 2015-16. As per the compound growth rate, area under rice cultivation increased just by 0.99% over these two decades. Madhya Pradesh with a rate of -5.07% witnessed the highest fall in area under rice. The area under rice during 1997-98 was 54.27 lakh ha, which decreased to 17.08 lakh ha during 2000-01. However, the area increased to 20.20 lakh ha in 2015-16 from 16.03 lakh ha in 2010-11. On the other hand, the states of Punjab and Uttar Pradesh witnessed an increase in area under rice over the period of time and brought more land under rice cultivation. During the last two decades, the area under rice cultivation in the state of Punjab increased from 22.81 lakh ha in 1997-98 to 29.75 lakh ha in 2015-16 and in Uttar Pradesh, it increased from 56.64 lakh ha in 1997-98 to 58.62 lakh ha in 2015-16. Hence, area under rice cultivation in India and North-Eastern states has been increasing at a decreasing rate over the years.

The average size of land holdings has also come down over the decades. The reason is due to shift of farmers from rice cultivation to cultivation of more profitable crops, increase in population, and use of land for human

Table 1. Area under Rice Crop Among the Major Rice Growing States in India

(Area in Lakh Hectares)

Sl. No	States	1997-98	2000-01	2010-11	2015-16	CGR (1997-98 to 2015-16) %
1	Andhra Pradesh	35.00	42.43	47.51	32.10	-0.45
2	Bihar	51.12	36.56	28.32	32.32	-2.38
3	Karnataka	13.53	14.83	15.40	11.10	-1.04
4	Madhya Pradesh	54.27	17.08	16.03	20.20	-5.07
5	Odisha	44.97	44.34	42.25	39.41	-0.69
6	Punjab	22.81	26.11	28.31	29.75	1.41
7	Tamil Nadu	22.61	20.80	19.05	20.00	-0.64
8	Uttar Pradesh	56.64	59.07	56.57	58.62	0.18
9	West Bengal	59.00	54.35	49.44	55.24	-0.35
10	All India	434.46	447.12	428.62	434.99	0.99%

Source : Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India, *Handbook of statistics* (various years) and various sources.

CGR : Compound growth rate

Table 2. Trends in Rice Production Among the Major Rice Growing States in India

(in Lakh Tons)

Sl. No	States	1997-98	2000-01	2010-11	2015-16	CGR (1997-98 to 2015-16)
1	Andhra Pradesh	85.1	124.58	144.18	112.33	1.47
2	Bihar	71.33	54.43	31.02	68.02	-0.25
3	Karnataka	32.13	38.47	41.88	30.32	-0.32
4	Madhya Pradesh	45.28	39.82	17.72	46.6	0.15
5	Odisha	62.05	46.14	68.27	58.75	-0.29
6	Punjab	79.04	91.54	108.37	118.23	2.14
7	Tamil Nadu	68.94	73.66	57.92	75.17	0.46
8	Uttar Pradesh	121.65	116.79	119.92	125.01	0.14
9	West Bengal	132.37	124.28	130.45	159.54	0.99
10	All India	825.35	849.80	959.79	1044.07	1.24

Source : Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India, *Handbook of statistics* (various years) and various sources.

CGR : Compound growth rate

settlement and urbanization, transfer of farmers from agriculture to non-agriculture sectors, and fall in yield due to the decrease in fertility of soil, etc. Another reason for the decline in area under cultivation is uncertainty in monsoons with more than half of the gross cropped area being rain fed, failure or inadequacy of rains causes fluctuation in production and yields. Decline in fertility of soil also results in a decline in productivity, which occurs because of deforestation and unscientific agricultural practices.

Similarly, the production of rice among the major states is depicted in the Table 2, and it is indicated that the production of rice increased from 825.35 lakh tons in 1997- 98 to 1044.07 lakh tons in 2015 - 16, which increased at 1.24% annual compound growth rate over the period of time. Most of the states witnessed a positive trend in production over the study period and mainly the states of Punjab and Andhra Pradesh registered the highest increase from 79.04 lakh tons in 1997-98 to 118.23 lakh tons in 2015-16 and from 85.1 lakh tons to 112.33 lakh tons from 1997-98 to 2015-16, respectively with an average of 2.14% and 1.47%, respectively as per the compound growth rate.

In spite of the very negligible increase in area under rice, the average increase in production is much higher and is mainly attributed to the adoption of modern techniques of production like use of fertilizers, HYV seeds, irrigation, etc. However, the production is very less in India as compared to the rest of the world and the reasons for this are mainly due to the slowdown in rice yield and production, diminishing returns to modern varieties when irrigation and fertilizer uses are already high, and the fact that cereal prices have fallen relative to input costs. There is also concern that pest and disease resistance to modern pesticides decelerates yield growth, and that breeders have largely exploited the yield potential of major Green Revolution crops.

It is clear from the Table 3 that the productivity of rice witnessed an increase from 1900 kg/hectares to 5686.91 kg/hectares (1997-98 to 2015-16), which means an average of 5.94% as per the compound growth rate. All the states showed a positive trend in yield over the period of study and Bihar witnessed an increase from 1395 kg/ha to 4567 kg/ha, which is the highest followed by Odisha and Tamil Nadu from 1380 to 4729 kg/ha and 3050 to 8411 kg/ha, respectively, which stands at an average of 6.44%, 6.07%, and 5.48% as per the compound growth rate, which is higher than the national average. The positive trend in yield rate over the study period is attributed to the introduction of high yielding variety seeds, coupled with better irrigation, and increase in the use of chemical

Table 3. Productivity of Rice of the Major Rice Growing States in India

(in Kg/Hectares)

Sl. No	States	1997-98	2000-01	2010-11	2015-16	CGR (1997-98 to 2015-16)
1	Andhra Pradesh	2431	2936	3034	3148	1.37
2	Bihar	1395	1489	1095	4567	6.44
3	Karnataka	2374	2593	2719	5554	4.57
4	Madhya Pradesh	834	575	1106	1768	4.03
5	Odisha	1380	1041	1616	4729	6.07
6	Punjab	3465	3506	3828	3974	0.72
7	Tamil Nadu	3050	3541	3040	8411	5.48
8	Uttar Pradesh	2148	1977	2120	4850	4.38
9	West Bengal	2243	2287	2639	6155	5.42
10	All India	1900	1901	2239	5686.91	5.94

Source : Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India, *Handbook of statistics* (various years) and various sources.

CGR : Compound growth rate

fertilizers and pesticides. Introduction of new cultivated species and improved varieties of crop (genetically modified) ; health and nutritional value ; and building crop resilience to diseases, pest organisms, and environmental stresses are some of the reasons for accelerating the yield rate.

(2) Area and Productivity Effects with Production - Regression Analysis : To analyze the stability or instability of production in rice crop among the major rice growing states, the study tries to assess the impact by using multiple regression analysis. Production of a particular crop as a dependent variable, area and productivity as independent variables are used in order to obtain comparability. The regression analysis (Table 4) shows that the coefficient of area and yield of the country as a whole during the year from 1998 - 99 to 2015-16 shows a positive trend and is statistically significant at the 1% level. It indicates that land is positively associated with the dependent variable, and it is statistically significant, which means a 1% increase in area leads to an increase in yield by 0.047 times. The coefficient of determination (R^2) is 0.77, which signifies that 77% percent of the variation in production, respectively is explained by area as the explanatory variable. As per the data, all the states show a positive and statistically significant relation between area and yield.

The coefficient of area of all the states is positive and statistically significant at the 1% level with the dependent variable, while the coefficient of yield for the states of Karnataka and Andhra Pradesh is positive and statistically significant at the 5% level. R^2 values are .502, .771, .781, .999, .874, .892, .463, .931, .609, and .777 and can be regarded as good fit in view of the time series data since they imply that about 50.2%, 77.1%, 78.1%, 99.9%, 87.4%, 89.2%, 46.3%, 93.1%, 60.9%, and 77.7% (see Table 4) of the variations in production, respectively are explained by area and yield as the explanatory variables among the selected states.

(3) The North Eastern Region : The North Eastern Region (NER) comprises of eight states of Indian territory consisting of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura which have been gifted by nature with tremendous biodiversity and widely varying agro - climatic conditions forming 8% of the total land area and about 4% of the total population of the country. More than 70% of the total

Table 4. Factors Determining Rice Production Among the Major Rice Producing States in India - Regression Analysis

		Coefficient					
Sl. No	**States**	**Constant**	**Area**	**Yield**	R^2	***F*- Change**	***N***
1	West Bengal	35.293	1.647 (2.62)*	0.004 (3.95)*	0.502	8.07	19
2	Uttar Pradesh	-72.519	3.111 (4.72)*	0.005 (3.71)*	0.771	27.03	19
3	Andhra Pradesh	-43.601	3.242 (7.53)*	0.011 (2.20)**	0.781	28.68	19
4	Punjab	-97.709	3.761 (6.45)*	0.026 (9.05)*	0.999	78.88	19
5	Tamil Nadu	-49.176	5.156 (10.61)*	0.002 (4.51)*	0.874	63.68	19
6	Bihar	-24.911	1.686 (8.91)*	0.008 (9.49)*	0.892	66.54	19
7	Odisha	-202.250	5.651 (2.81)*	0.009 (3.69)*	0.463	6.92	19
8	Madhya Pradesh	-21.505	0.949 (12.67)*	0.022 (7.64)*	0.931	109.28	19
9	Karnataka	-24.607	4.039 (4.91)*	0.001 (2.00)**	0.609	12.46	19
10	All India	-395.179	2.723 (2.86)*	0.047 (6.77)*	0.777	27.95	19

Note. Figures in the parentheses indicate '*t*' values.

*, **, and *** indicate 1%, 5%, and 10% significance levels, respectively.

geographical area of NER is covered by hills and about 3 million hectare is estimated to be under soil erosion hazard as a result of practice of jhum cultivation. The region, by and large, is characterized by fragility, marginality, inaccessibility, cultural heterogeneity, ethnicity, and rich biodiversity (ICAR, Vision, 2025). In the North Eastern states, rice is the major food item and area, production, and productivity of rice varies substantially among the states.

The trend in area under rice farming in the North East Region registered a very low increase, from 33.65 lakh ha in 1997 - 98 to 34.79 lakh ha in 2015-16, which is an increase by just 0.18% as per the compound growth rate over the period of study (Table 5). The state wise distribution indicates that the state of Manipur accounted the highest growth in area under rice cultivation (2.16%) followed by Nagaland (1.73%) and Arunachal Pradesh (0.34%). On the contrary, the other states witnessed a fall in area under rice over the period of time, registering a negative growth in which the states of Mizoram and Sikkim witnessed the highest fall registering 3.15% and 1.95%, respectively.

Similarly, the distribution of rice production in the North - Eastern region is shown in the Table 6 and it witnessed an increasing trend registering from 48.69 lakh tones in 1997-98 to 71.57 lakh tones in 2015-16, accounting for an average growth of 2.05% over the period of time. Among the states, Meghalaya witnessed the highest growth with an average of 3.7% followed by Nagaland and Arunachal Pradesh with 2.83% and 2.40%, respectively. Increase in production in this region is mainly due to the adaption of modern means of farming, use of high yielding variety seeds, modern machines, irrigation facilities, and other training facilities given to the

Table 5. Distribution of Area Under Rice Among the North Eastern States

(in Lakh Hectares)

Sl. No	States	1997 - 98	2000 - 01	2010 - 11	2015 - 16	CGR (1997-98 to 2015-16)
1	Arunachal Pradesh	1.2	1.2	1.21	1.28	0.34
2	Assam	24.9	25.37	25.7	24.85	-0.01
3	Manipur	1.58	1.63	2.13	2.37	2.16
4	Meghalaya	1.05	1.08	1.08	1.1	0.25
5	Mizoram	0.68	0.56	0.41	0.37	-3.15
6	Nagaland	1.45	1.57	1.81	2.01	1.73
7	Sikkim	0.16	0.16	1.2	0.11	-1.95
8	Tripura	2.58	2.47	2.65	2.7	0.24
9	NER	33.65	34.04	36.19	34.79	0.18

Source : The North Eastern Development Finance Corporation Ltd. (NEDFi) databank

Table 6. Distribution of Rice Production Among the North Eastern States

(in Lakh Tons)

Sl. No	States	1997-98	2000-01	2010-11	2015-16	CGR (1997-98 to 2015-16)
1	Arunachal Pradesh	1.3	1.33	2.34	2.04	2.40%
2	Assam	33.83	39.99	47.37	51.25	2.21%
3	Manipur	3.52	3.82	5.22	3.39	-0.20%
4	Meghalaya	1.5	1.79	2.07	3.01	3.73%
5	Mizoram	1.1	1.04	0.47	0.62	-2.97%
6	Nagaland	1.87	2.3	3.81	3.18	2.83%
7	Sikkim	0.21	0.21	0.21	0.13	-2.49%
8	Tripura	5.36	5.13	7.02	7.95	2.1%
9	NER	48.69	55.65	68.51	71.57	2.05%

Source : The North Eastern Development Finance Corporation Ltd. (NEDFi) databank

farmers to make them more efficient. On the contrary, states like Mizoram, Sikkim, and Manipur registered a negative growth in production at an average of -2.97%, -2.49%, and -0.20%, respectively over the period of time by practicing indigenous farming systems, defective land distribution, lack of institutional infrastructure, etc.

Introduction of high - yield variety seeds, mechanization, modernization, efficient use of pesticides, advancement of research and development, improvement in irrigation facilities, and subsidies have brought drastic changes in productivity and helped the cultivators to intensify their cropping patterns in the North Eastern Region. The Table 7 shows that the productivity of rice indicates that there was increasing trend by about 1.07% in which the yield increased from 1555 kg per hectare in 1997-98 to 1904.8 kg per hectare in 2015-16. Among the states, Meghalaya, Assam, and Arunachal Pradesh witnessed the highest yield growth with an average of 3.47%, 2.22%, and 2.04%, respectively ; whereas, the state of Manipur and Sikkim witnessed a negative growth of 2.31% and 0.54%, respectively. However, the rice yield in this region has made significant strides as well as wide

Table 7. Distribution of Productivity of Rice Crop Among the North Eastern States

(in Kg/Hectares)

Sl. No	States	1997-98	2000-01	2010-11	2015-16	CGR (1997-98 to 2015-16)
1	Arunachal Pradesh	1079	1119	1924.8	1584	2.04
2	Assam	1359	1511	1843	2062	2.22
3	Manipur	2227	2431	2400	1429	-2.31
4	Meghalaya	1427	1679	1911	2726	3.47
5	Mizoram	1620	1998	1160	1671	0.16
6	Nagaland	1290	1533	2100	1586	1.09
7	Sikkim	1363	1408	1727	1230	-0.54
8	Tripura	2078	2129	2655	2947	1.86
9	NER	1555	1726	1965.1	1904	1.07

Source : The North Eastern Development Finance Corporation Ltd. (NEDFi) databank

variations by geographical and topographical differences.

The regression results of production in area and yield are depicted in the Table 8. The data shows that all the variables have expected signs. In case of Assam, Meghalaya, Mizoram, Nagaland, and Tripura, both area and yield are positively associated with the dependent variable and are statistically significant at the 1% level. The R^2

Table 8. Regression Analysis of Rice Production of all the North Eastern States

		Coefficient					
Sl. No	States	Constant	Area	Yield	R^2	*F*-Change	*N*
1	Arunachal Pradesh	150.33	-104.35 (0.40)	-0.009 (0.46)	0. 490	0.42	19
2	Assam	-35.51	1.435 (48.59)*	0.024 (206.81)*	0.999	26.90	
3	Manipur	-202.23	36.30 (0.41)	0.0744 (0.90)	0. 470	0.40	
4	Meghalaya	-1.80	1.645 (11.76)*	0.001 (120.07)*	0.999	13.87	
5	Mizoram	-0.924	1.82 (23.27)*	0.0005 (26.20)*	0.986	63.70	
6	Nagaland	-2.63	1.550 (8.34)*	0.001 (19.72)*	0.989	57.17	
7	Sikkim	0.14	-0.0006 (0.35)	0.00004 (1.48)	0.119	1.09	
8	Tripura	-6.20	2.439 (32.83)*	0.002 (98.20)*	0.999	30.25	
9	NER	-32.010	0.431 (1.85)***	0.041 (10.75)*	0.901	72.91	

Note. Figures in the parentheses indicate '*t*' values.

*, **, and *** indicate 1%, 5%, and 10% significance levels, respectively.

values of .999, .999, .986, .989, .599, and .901 clearly indicate that area and yield have been affected significantly over the period of time, and it implies that about 99%, 98%, 88%, and 90% of variation in production is explained by the explanatory variables. On the contrary, the coefficients of area and yield of Arunachal Pradesh and Sikkim are negative, while the coefficients of area and yield of Manipur have a positive association and are statistically insignificant. The R^2 values of .490, .470, and .119 indicate that only 49%, 47%, and 11% variation in area and yield is explained by the explanatory variables.

(4) Constraints : The constrains or challenges associated with rice crop vary from state to state, region to region, or even district to district. Fall in land under agriculture due to urbanization, increasing population, higher cost of cultivation, declining soil quality by misappropriation of chemical fertilizers and pesticides, advanced machinery utilization, salinization, water loggings, acidity, iron toxicity, sulphide injury, and other abiotic stresses by natural calamities like heavy floods, heavy infestation of weeds and insects/pests like blast and brown spot, non-availability of high yielding seeds, low capital formation/investment, low marketability, discouraging price conditions, lack of awareness about scientific methods, and other geographical and environmental diverges limit the rice growers, thereby weaning them away from rice cultivation in this region.

Research and Policy Implications

The following policy implications can be suggested to strengthen the production and productivity of rice in India :

(1) The Government should take the initiative along with the concerned Agriculture Department in training the rice growers starting from land preparation, crops establishment and harvesting etc.

(2) For improving the efficiency and effectiveness of the farmers, investment in human resource development is very important. This will make the farmers to enable themselves in adopting all the modern means of ideas and technologies and will also enable the farmers to keep themselves prepared to overcome situations like bad monsoon, drought, or any natural calamity that might affect their harvest.

(3) Good road connectivity to the rural areas assumes greater importance to sustain the agrarian based economy. A proper connectivity to the potential areas from the villages and from villages to highways and then to markets will boost the economy of the rural farmers as it enables a timely and smooth transportation of the produce.

(4) There is need for a strong and viable agricultural financial institution to cater to the financial requirements of the farmers.

(5) A well-regulated market will help to check any malpractices as well as the fluctuations in demand, supply, and price, which can be controlled and will help to protect the farmers from exploitation by middle men.

(6) Crop insurance in case of crop failure is also another important policy that the Government needs to take up to encourage farmers. Agriculture in India is highly susceptible to risks like droughts and floods and it is necessary to protect the farmers from natural calamities and to ensure their credit eligibility for the next season.

Conclusion

Rice is the most staple food for the people of India, especially for South India and the North Eastern region. The study reveals that the area, production, and productivity has seen an increasing trend at a lower rate about 0.99%, 1.24%, and 5.94%, respectively. The fluctuating trend in yield and production in this region is caused by geographical, topographical, infrastructural, and structural bottlenecks. Promoting the accessibility to farm and

crop insurance and expanding infrastructure and institutional development will encourage the farmers to take up cultivation seriously and without any fear of facing losses, which will have a positive impact on production and productivity. An intervention and affirmative action plan on the part of the government is requisite in order to ensure food security for the growing population and formulate appropriate policies to conserve existing natural resources for implementing sustainable agricultural policies for future generations in India in general and the North East region in particular.

The study is believed to be different from other research studies done on rice because it specifically covers the trend in area, production, and productivity of all the major rice producing states of India and the North Eastern region, especially as macro studies are very meager. This paper can be used as an addition to the existing data on indicator of the potentiality and the prospect of rice production in the North East region.

Limitations of the Study and Scope for Further Research

The results cannot be generalized for every state since only the data of major rice producing states in India and the North Eastern states is taken into account. However, efforts were made to cross check the collected data in order to minimize the errors despite the limitations.

Further research on trend in production and productivity can also be extended to other food crops to get an idea and knowledge on the scenario of other crops in India and the North Eastern states. Further research can also be carried out for minimizing the cost of production and for increasing productivity so that the problems of shortage of rice can be tackled and also for attaining self sufficiency.

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