

## **VEGETABLE CROPS IN NORTH EASTERN REGION OF INDIA: ITS GROWTH AND INSTABILITY**

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### **ABSTRACT**

The present paper analyses the growth and instability of vegetable crops in North Eastern region (NER). Different variety of vegetables are grown in NER, where the climatic condition provide opportunities for the grower to grow a diversify species of vegetables. Exponential growth equation is used to analyse the growth performance and coefficient of variation and Cuddy- Della Velle Instability index is used to measure instability. The study found that except Arunachal Pradesh and Nagaland, all the NE state reveals positive and significant growth rate and low instability.

**Keywords:** Growth Rate, Instability Index, Exponential Growth Equation.

### **1. INTRODUCTION**

Earlier various literature has demonstrate that agricultural development is the pre-condition for growth and development (Fan et al., 2005). Johnston and Mellor (1961) stated that agriculture has direct linkage to agricultural processing industry and backward linkage to input supply industries. Because of this effects, agriculture can lead to growth for many country. Moreover, Timmer (2005) stated that variation or instability in agricultural production is an important issue to be discussed because of volatility in agricultural production due to existence of external shocks. Moreover, Instability in production leads to fluctuations in supply of output and farm income (Chand and Raju, 2009). Hence a study on measuring instability along with growth is important for agricultural crop.

With the absence of major industrial development, agriculture play an important role in the economic development of North Eastern Region (NER). Moreover, being one of the biodiversity hotspot of India and existence of favorable climatic condition for growing different type of genetically varying and diverse species of vegetable, there is an immense potential for the development of vegetables in NER (Rai et al 2005). Moreover, with the introduction of Mission

for Integrated Development for North Eastern Region and Himalayan Region in 2001-02, horticulture sector in the NER has receive a tremendous boast. A wide range of vegetable crops are grown in this region, which includes solanaceous vegetables, cucurbitaceous, okra, various kinds of beans, tubers & roots crops, spices, cole crops as well as some species of leafy vegetables. Considering the significance of the vegetables crop in North Eastern region (NER) of India, present study will analyse the performance of vegetable crops in terms of growth and instability in area, production and productivity in North Eastern Region of India.

## **2. REVIEW OF LITERATURE**

There exists various literature studying various aspects of agricultural like growth in area, production, productivity of various crops, decomposition of sources of growth, measurement and sources of instability in production and area, cropping pattern etc. (Bhalla and Singh 1997; Ahluwalia, 1991). Agriculture instability has been widely discussed as a subject of intense debate in India. The literature reveals that along with growth stability is also important, since instability raises the risk involve in productions and affects income of the farmers and their decisions to invest in farming. Instability also disturbed price stability. Hence stability in production is important for food management, sustainable growth and macroeconomic stability (Chand and Raju, 2009). Paltashing and Goyari (2013) found low growth rate and increase level of instability in the post reform era. Agarwal et al. (2014) found a positive and significant growth along with high instability in production.

Roy et al (2015) analysed the performance of agriculture in terms of growth by using time series data on area, production and productivity of foodgrains in North Eastern Region. During the study period, Nagaland registered the highest significant growth in area, production and yield, followed by Arunachal Pradesh and Mizoram. All the NE states have shown positive growth rates in area, production and yield increase. Area effect dominant the yield effect as a sources of output growth.

### **2.1 Research gap**

From the above literature it is observed that an analysis of agricultural performance in terms of growth of area production and yield of a crop and their instability is important in order to know about the agricultural situation. However, to the best of researcher knowledge no such attempt has been made in NER in case of vegetable crops, which, have an immense potential to grow due to diversity of climatic condition. Considering the importance of vegetable crops in NER, present study is a humble attempt to fill this gap.

### **3. METHODOLOGY**

#### **3.1. Coverage**

Coverage of the study is the North Eastern Region of India. Time period for the study is from 2000-01 to 2014-15. This period is selected because during 2001-02, Mission for Integrated Development of Horticulture for NE states and Himalayan region has been adopted for the development of horticultural crop like vegetables, fruits etc. in NER.

#### **3.2. Data**

The study is based on only secondary data. Secondary data has been collected from the Ministry of Agriculture, Government of India, [www.indiastat.com](http://www.indiastat.com), Horticultural Statistical Year Book India, 2017. Data on area, production and average yield for the whole region and each state has been collected for vegetables. Data on different type of vegetables are also collected for meaningful analysis. After that data has been analyzed by using software package SPSS, percentage, graphs etc.

#### **3.3. Method**

*Exponential Trend Equation:* Compound growth rate is calculated for the growth pattern in area, production, and average yield of rice using the exponential trend equation of following form.

$$Y_t = ab^t$$

$$\log Y_t = \log a + t \log b$$

$$r = (\text{antilog } 'b' - 1) \times 100$$

Where,  $Y_t$  = area, production or yield of rice in year 't', t = year (rank was given to year concerned; ranking of the year was done in their ascending order as per case), a and b = parameter to be estimated, r = compound growth rate.

In order to make a comparison among state percentage method and pie diagram has been used.

*Instability Index:*

Present study will use coefficient of variation and Cuddy- Della Velle Index of Instability to examine the instability in area, production and productivity of fruits and vegetables.

$$\text{Instability Index} = CV * (1-R^2)^{1/2}$$

Where, CV is coefficient of variation,  $R^2$  is coefficient of determination from a time trend regression.

#### 4. RESULTS AND DISCUSSIONS

##### 4.1. Comparison of NER with India

**Table 1: Percentage share of NER in total production and area under vegetable in India**

		2000-01	2014-15	% change
vegetables	Area	7.4	5.8	-21
	Production	4.1	4.4	7

Source: Authors calculation ([www.indiastat.com](http://www.indiastat.com)), Horticultural Statistical Year Book India, 2017)  
 The table depicts the percentage share of NER in area and production under vegetables as a percentage of national data as a whole over the year from 2000-01 to 2014-15. The table reveals that the percentage share of area under vegetable in NER region is decreasing from 2000-01 to 2014-15, whereas that of production is increasing.

##### 4.2. Growth and variation of vegetables in NER

**Table 2: Compound Growth Rate of vegetable production North Eastern states during 2000-2015**

State	Area	production	Productivity
Arunachal Pradesh	-5.16** (6.9%)	-1.98 (3.3%)	3.35**** (3.8%)
Assam	0.90 (1.5%)	2 (2.2%)	1.10 (1.8%)
Meghalaya	1.05**** (1.1%)	1.61*** (1.3%)	0.50** (0.8%)
Nagaland	-15.29* (75.9%)	-16.89*47.4%)	-1.88* (3.1%)
Tripura	0.1 (0.8%)	1.31** (1.3%)	1.20**** (1.1%)
Sikkim	2.94**** (2.4%)	3.66**** (2.6%)	0.70**** (0.8%)
Mizoram	2.73 (7.7%)	6.07** (6.6%)	3.56 (6.1%)
Manipur	2.94**** (2.9%)	5.86**** (4.1%)	2.94**** (2.6%)
NER	0.8 (1.0%)	3.97** (3.1%)	-9.97 (74.5%)

Source: Authors calculation. ( [www.indiastat.com](http://www.indiastat.com) , Horticultural Statistical Year Book India, 2017) (Figures in the brackets indicates coefficient of variation.)

\*\*\* indicate 1% levels of significance

\*\* indicate 5% level of significance

\* indicate 10% level of significance

The above tables depicts the compound growth rate of vegetable area, production and yield in NE states between 2000-01 and 2014-15. The NER region as a whole shows a positive but insignificant growth in vegetable area and positive and significant growth in vegetable production and negative insignificant growth in yield. Other NE States, except AP and Nagaland reveals positive growth in area under vegetable. Among this Meghalaya, Sikkim and Manipur gives significant result. Growth rate is maximum in case of Manipur and Sikkim. Most of the NE states reveals low variation in area growth rate (below 3%) except AP, Mizoram and Nagaland.

Except Assam and AP, all other NE states and NER as a whole shows significant growth in vegetable production. NER reveals a growth rate of 3.97% in vegetable area. Nagaland gives significant negative growth in vegetable production. Among NE State, Mizoram registered the highest growth in vegetable production (6.07%). Meghalaya and Tripura has the lowest instability in production growth rate with Nagaland being the highest.

Similarly in case of average yield also, NER shows a negative but insignificant growth. However except Nagaland, all other state reveals positive and significant growth rate in yield. Variation in yield growth is also low among the NE states with Meghalaya and Sikkim has the lowest variation (0.8%) and Mizoram has the highest variation.

The main conclusion of table 2 is that, all the NE states, except Nagaland and Arunachal Pradesh positive and significant growth of area and production under vegetables. In terms of area, Sikkim and Manipur are revealing maximum growth and in terms of production Mizoram is showing maximum growth. Again surprisingly Arunachal Pradesh has showing highest productivity growth despite of negative growth in area and production. Except Nagaland, all other states are showing low variation in area and production.

**Table 3: Percentage share of different NE states in total area under vegetables in NER**

Year/ State	Sikkim	Tripura	Nagaland	Mizoram	Meghalaya	Manipur	Assam	Arunachal Pradesh
2000-01	3.4	8.22	6.95	2.04	9.74	2.50	61.60	5.42
2001-02	3.7	8.17	6.86	1.77	9.31	2.76	61.96	5.43
2002-03	3.9	8.80	1.86	1.19	10.61	3.23	64.64	5.71
2003-04	4.8	9.67	3.59	1.72	9.88	4.05	60.09	6.10
2004-05	5.1	9.96	3.62	1.73	9.96	4.08	59.24	6.12
2005-06	5.2	9.45	3.21	1.71	12.52	3.33	58.39	6.12
2006-07	3.8	6.79	2.00	0.36	8.97	2.55	69.31	5.01
2007-08	4.2	7.10	2.19	0.63	8.95	2.55	69.31	5.01
2008-09	5.4	6.45	2.62	3.62	11.16	4.18	60.52	5.60
2009-10	7.0	8.00	2.56	2.61	10.91	4.90	62.88	1.03
2010-11	5.7	8.64	2.56	4.20	10.03	5.33	62.46	1.00
2011-12	5.4	7.4	0.07	8	8.5	4.4	57.5	0.1
2012-13	5.3	9.2	0.05	8.4	8.6	4.5	58.2	0.01
2013-14	5.5	9.4	0.07	8.1	8.5	4.9	55.8	0.2
2014-15	5	9.1	0.07	8.3	9.4	5.2	56.2	0.03
% change	47	10	-98	306	-3	108	-8	-99

Source: Author's calculation. ( [www.indiastat.com](http://www.indiastat.com) , Horticultural Statistical Year Book India, 2017)

From the above table it can be observed that Assam occupies the largest share of area under vegetables in NER. The percentage change in the area over the period reveals that Arunachal Pradesh and Nagaland, Assam Meghalaya have negative change. Though Assam has the largest share but its share has been fall down slightly. Meghalaya and Tripura occupied the second and third position in terms of area in vegetables in both 2000-01 and 2014-15 respectively. However Manipur (108%) and Mizoram (306%) registered maximum growth in area over the period.

**Table 4: Percentage share of different NE states in total vegetable production in NER**

Year/ State	Sikki m	Tripur a	Nagalan d	Mizora m	Meghalay a	Manipu r	Assam	Arunacha l Pradesh
2000-01	1.55	8.55	6.61	1.23	7.91	1.75	70.19	2.18
2001-02	5.17	30.46	24.67	3.80	22.9	5.70	253.20	7.23
2002-03	1.69	10.33	2.25	0.91	9.72	2.06	70.68	2.33
2003-04	2.55	11.99	3.00	0.81	9.21	2.92	66.79	2.75
2004-05	2.53	12.37	2.91	0.79	8.96	2.84	66.95	2.61
2005-06	2.69	12.41	2.78	0.80	9.03	2.45	67.19	2.62
2006-07	1.45	7.46	0.80	0.56	6.20	1.64	79.89	1.97
2007-08	1.69	7.46	1.11	0.65	6.21	2.00	78.90	1.93
2008-09	2.33	7.01	1.86	2.72	9.89	4.14	69.40	2.61
2009-10	2.42	7.32	1.28	2.93	6.81	3.63	74.94	0.63
2010-11	2.74	12.03	1.80	2.62	8.09	5.36	66.41	0.87
2011-12	3.4	10.4	1.7	0.7	13.1	5.2	66.3	3.3
2012-13	2.4	13.6	3.8	4.2	7.4	4.07	64.3	0.7
2013-14	2.4	14.9	8.9	4.6	9.1	4.9	54.1	0.6
2014-15	1.8	10.6	6.1	3.7	7.2	4.06	64.8	0.55
% change	16	2	-7	200	8	132	-7	-74

Source: Author's calculation. ( [www.indiastat.com](http://www.indiastat.com), Horticultural Statistical Year Book India, 2017 )

The above table depicts that Assam has the highest share of vegetable production over the year. However its share has been decreasing slightly over the year with -7%. Mizoram shows highest positive change over the year with 200%. Tripura and Meghalaya are occupying second and third position. Nagaland and Arunachal Pradesh showing drastic fall in vegetable share. Whereas share of Sikkim, Manipur and Mizoram is increasing over the year.

The main conclusion drawn from table 3 & 4 is that In case of vegetables Assam contributes maximum amount of area and production but its share has been fluctuating and slightly decreased in terms of both area and production. In case of area, Meghalaya has the second highest area and Tripura has the second highest production but Mizoram has shown the maximum increased in percentage change in terms of both area and production.

**Table 5: Percentage Share of gross cropped area under vegetables in NE states**

Year/State	Arunachal Pradesh	Assam	Meghalaya	Mizoram	Nagaland	Tripura	Sikkim	Manipur	NE R
2000-01	7.9	5.8	12.0	0.01	21.3	33.8	3.1	3.5	0.8
2014-15	1.5	5.8	10.6	19.0	1.9	8.7	15.62	8.6	7.6
% change	-81	0	11	1899	-91	-74	403	145	850

Source: Author's calculation ([www.indiastat.com](http://www.indiastat.com), Horticultural Statistical Year Book India, 2017)

The above table gives the percentage share of area under vegetable as a percentage of gross cropped area in NE states as well as NER as a whole between 2000-01 to 2014-15. The NER as a whole reveals shows an increased in the area under vegetables over the period with a 850% increased. Except Arunachal Pradesh, Nagaland, Tripura, other NE states gives a positive increased in area under vegetables. Moreover this, Mizoram registered the highest growth of 1899% from 0.01% to 19% followed by Sikkim and Manipur. Assam's share has been remain same in the two period with a slight variation in between them. Tripura's area under vegetable, which was 33.8% in 2000-01, has been dropped to 8.7% in 2014-15. Similarly share of Nagaland has also dropped from 21.3% to 1.9. Arunachal Pradesh also reveal a dropped in area under vegetable over the said period. Mizoram, which have only a negligible percent of area under vegetable in 2000-01 has increased to 19% in 2014-15, which is highest among other NE state.

Thus it can be concluded that as a percentage share of gross cropped area, Mizoram reveals a tremendous increase for vegetable production whereas, Tripura is showing a drastic fall.

#### **4.3 Area and production of different type of vegetables in NER:**

The following two figure 1 & 2 depicts the share of different vegetables in total vegetable production in 2000-01 and 2014-15. The figure reveals that in both the year potato dominates the total area under vegetables. Where the share of brinjal and cauliflower has increased over the two period that of cabbage has been decreased.



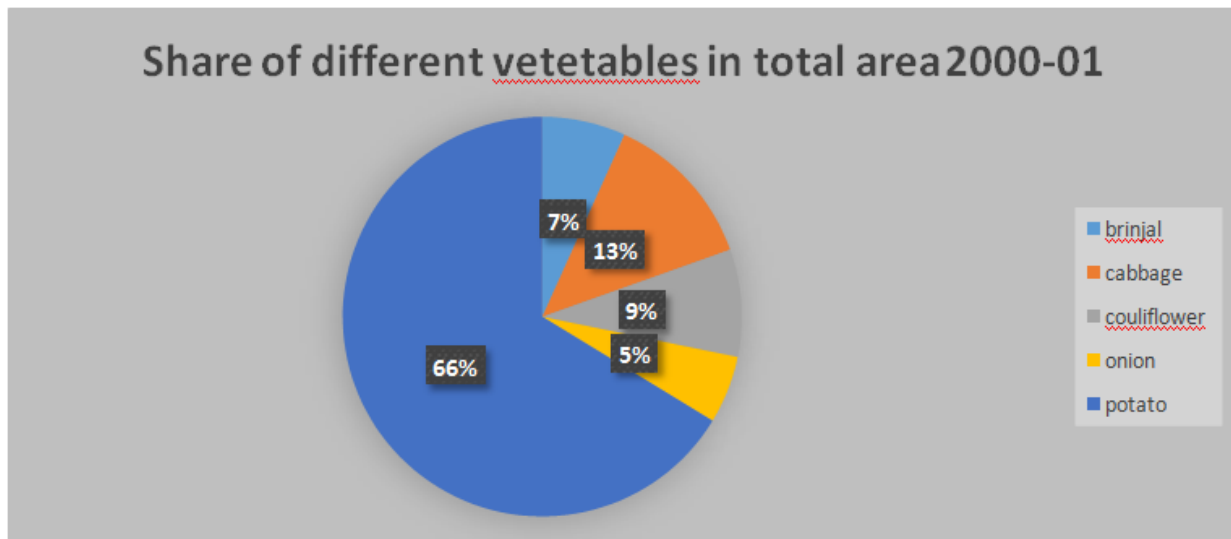


Figure 1: Share of different type of vegetables in total area under vegetable in 2000-01

Source: [www.indiastat.com](http://www.indiastat.com), Horticultural Statistical Year Book India, 2017

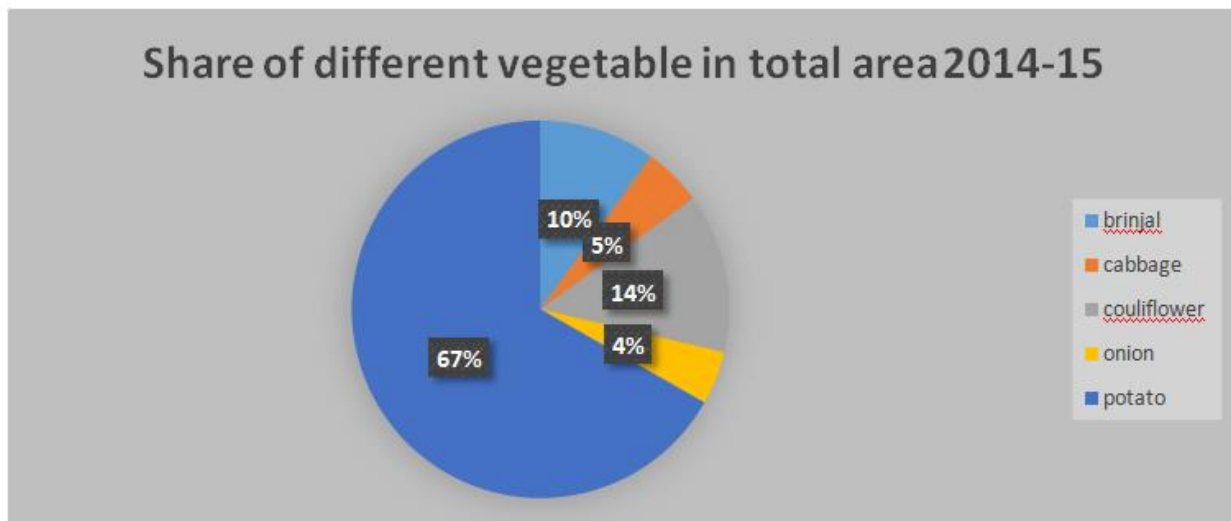
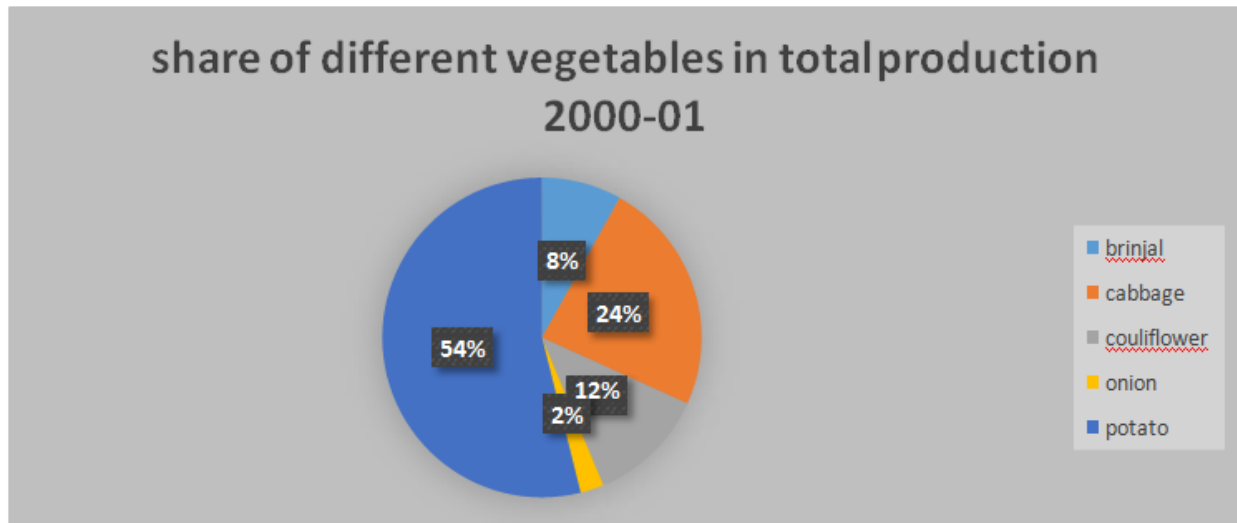


Figure 2: Share of different type of vegetables in total area under vegetable in 2014-15

Source: [www.indiastat.com](http://www.indiastat.com), Horticultural Statistical Year Book India, 2017

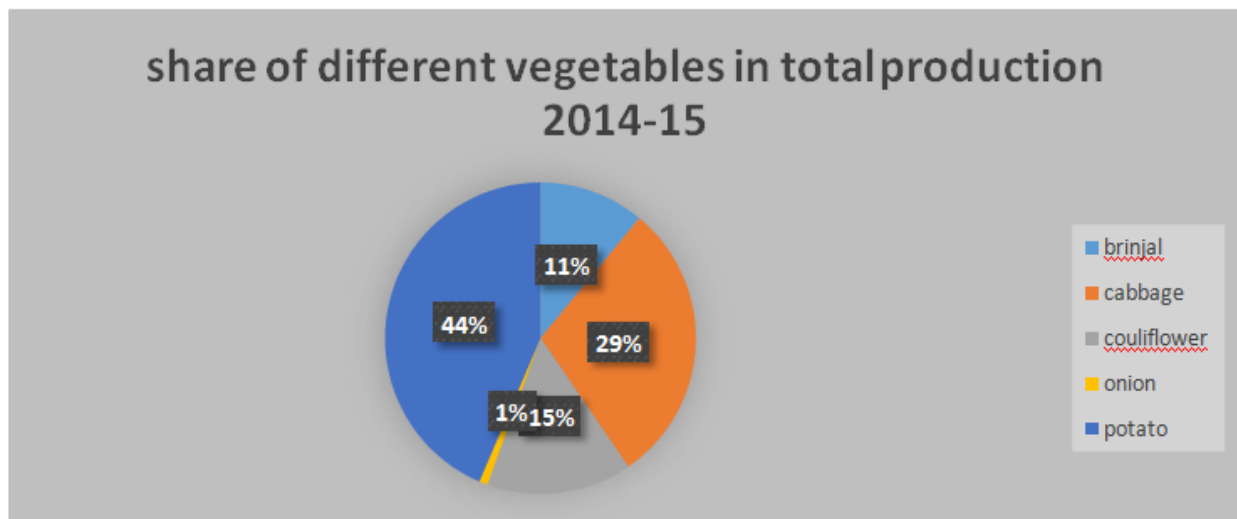
The following two figure 3 & 4 depicts the share of different vegetables in total vegetable production. The figures reveals that, like area, in production also potato occupied the dominant position. But the share of potato has slightly decreased over the year. Similarly the onion

production has also decreased but that of brinjal, cabbage and cauliflower has increase.



**Figure 3: Share of different type of vegetables in total area under vegetable production in 2000-01**

Source: [www.indiastat.com](http://www.indiastat.com) , Horticultural Statistical Year Book India, 2017



**Figure 4: Share of different type of vegetables in total area under vegetable production in 2014-15**

Source: [www.indiastat.com](http://www.indiastat.com) , Horticultural Statistical Year Book India, 2017

#### 4.4 Instability in vegetables

**Table 6: Instability Index for area production and yield of Vegetables**

	Area	Production	Yield
NER	0.88	2.3	69
Arunachal Pradesh	5.4	3	2.4
Assam	1.3	1.9	1.5
Meghalaya	0.78	0.91	0.64
Nagaland	68.4	34.1	2.6
Tripura	0.79	1	0.58
Sikkim	0.75	0.90	0.45
Mizoram	7.3	5.1	5.3
Manipur	1.7	2.4	1

Source: Authors calculation ([www.indiastat.com](http://www.indiastat.com)), Horticultural Statistical Year Book India, 2017)

The above table reveals the instability in area, production and average yield under vegetables. It is observed from the table that most of the states reveals low instability in area, production and yield under vegetables except Nagaland which gives high instability in area under vegetables and production. Sikkim reveals the lowest instability.

#### 5. CONCLUSION

From the above analysis it can be concluded that growth rate of vegetable production is increasing in the NER as a whole and for most of the NE state separately along with low instability in area, production and productivity except Nagaland. But the growth rate is very low though it is positive. States like Manipur, Mizoram, Meghalaya are showing better results. Hence a policy towards increasing the growth is desirable.

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