

Growth, Instability and Decomposition in Area, Production, and Productivity of Horticultural Crops in North-East India

Avdhesh Sharma^{1*}, Anwasha Dey¹, Devegowda, S.R.¹, Yash Gautam² and Kumareswaran, T.¹

¹Department of Agricultural Economics, Banaras Hindu University, Varanasi, Uttar Pradesh, India

²Department of Agricultural Economics, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

*Corresponding author: avdhesh.sharma2@bhu.ac.in

Received: 18-01-2022

Revised: 20-04-2022

Accepted: 27-05-2022

ABSTRACT

Growth and instability in the area, production, and productivity of total horticultural crops have always been the subject of intense debate. In this study, trends in the growth and instability of horticultural crops in India for the last 15 years, from 2003-04 to 2017-18, have been examined. In agriculture, instability is a very aspect that indicates the variation in data. Indian agriculture is primarily dependent on the monsoon. If the monsoon fails, Indian agriculture faces significant loss and variations, especially in production over time. Cuddy Della Valle Index has been used for estimating instability in the area, production, and productivity of horticultural crops. Several fluctuations in the growth pattern and instability of the area, production, and productivity of the crops in north-eastern states over the period were observed in the study. Production of horticulture crops increased in the northeastern state due to an increase in area.

Keywords: Cuddy Della Valle index, growth, instability, North East India

The North-Eastern region of India comprises eight states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim has vast physiographical variations, which have been represented in 6 agro-climatic zones. Horticulture has been identified as the main activity for development in the North Eastern region (Government of India Planning Commission, 2001). Horticultural crops account for only 33.30% of total agricultural production in India. This share is highest in Assam (2017-18) followed by Tripura, Nagaland, Meghalaya, Manipur, Mizoram, Sikkim, and Arunachal Pradesh (National Housing Bank, 2019; Planning Commission, 2001; Roy *et al.* 2015).

Horticulture is an important sector for potential diversification and value addition in the agriculture sector. The northeast region is more diversified in the cultivation of different crops, *i.e.* various kinds of fruits, vegetables, spices, ornamental plants and also medicinal and aromatic plants (Kumar *et al.* 2021).

The region offers enormous scope for the cultivation of a wide variety of horticultural crops such as fruits, vegetables, flowers, tuber, and

How to cite this article: Sharma, A., Dey, A., Devegowda, S.R., Gautam, Y. and Kumareswaran, T. (2022). Growth, Instability and Decomposition in Area, Production, and Productivity of Horticultural Crops in North-East India. *Agro Economist - An International Journal*, 09(02): 133-137.

Source of Support: None; **Conflict of Interest:** None



rhizomatous crops and spices because of its diversity in topography, altitude, and conditions (Sarmah & Deka, 2012). Agricultural growth and instability have remained the subject of intense debate in agricultural economics (Chand, 2017; Indian Council of Agricultural Research, 2019). With the inception of the Green Revolution, the productivity of some cereal crops increased significantly, and India became self-sufficient in them (Gautam *et al.* 2020). However, Horticultural crops are one of those parts of agriculture that have the potential to generate significant income for farmers. While the need for increasing horticultural production is obvious, the increasing instability of horticultural production is considered adverse for several reasons.

So, the risks become high, which directly affects the farmer's decision to adopt highly remunerative technologies and other investments in farming (Shabana Anjum, Madhulika, 2018). Instability in production affects the price and the consumer's purchasing pattern. It increases the vulnerability of low-income households to the market. Instability in agricultural and food production is also vital for food management and macroeconomic stability (Chand and Raju, 2009). Instability in agricultural and horticulture production is rising due to several factors in India, such as irregular rainfall patterns, low irrigation coverage, and an increase in the frequency and severity of natural disasters. Instability is an essential characteristic of agriculture. This study aims to estimate the growth and instability in the area, production, and productivity of horticultural crops in the northeast region of India (FAO, 2017; Gornall *et al.* 2010).

METHODOLOGY

The study is based on secondary data collected from various published sources. Data on the area, production, and productivity of the horticultural crops were collected from different annual reports of the National Horticultural Board, India, and indiastat.com.

Estimation of growth rates and instability

The Compound annual growth rate is measured by using the formula;

$$CAGR(r) = [\text{Antilog}(\log \log b) - 1] \times 100$$

Where,

b = Regression co-efficient

r = compound growth rate.

Instability can be measured by different methods, such as:

1. Coefficient of variation (CV)
2. Cuddy Della Valle Index (CDI)
3. Coppock Instability index, etc.

The present study uses the Cuddy Della Valle Index to measure instability. Cuddy Della Valle index gives a clear direction about the instability. The use of coefficient of variation as a measure to show the instability in any time series data has some limitations (Krishan & Chanchal, 2014). If the time series data exhibit any trend, the variation can be measured by Coefficient of Variation, which can be over-estimated, i.e. the region at a constant rate will score high in instability if the CV is applied for measuring instability (Devegowda *et al.* 2019; Prasad Babu *et al.* 2021) as against that, the Cuddy-Della Valle index is used.

If the value of the index is low, then that particular state has low instability in area or production or productivity and vice versa. This index was developed by Cuddy and Valle (1978) to measure the instability in time-series data that is characterized by trends. The formula for the estimation of instability by using the Cuddy-Della Valle index is as above:

$$CDVI = CV * (1 - R^2)^{0.5}$$

Where,

CV = coefficient of variation in percent, and

R^2 = coefficient of determination from time-trend regression adjusted by the degree of freedom.

Decomposition of analysis

To estimate the contribution of area, productivity and interaction of the two in total production, the following additive scheme of decomposition can be used (Gautam and Singh, 2018; Devegowda *et al.* 2019):

$$P = A_0(Y_n - Y_0) + Y_0(A_n - A_0) + \Delta A \Delta Y$$

$$1 = [(Y \Delta A)/P] [(A \Delta Y)/P] [(\Delta A \Delta Y)/P]$$

Where,

P = Change in production

A_0 = Area in the base year

A_n = Area in the current year

Y_0 = Yield in the base year

Y_n = Yield in the current year

ΔA = Change in the area ($A_n - A_0$)

ΔY = Change in yield ($Y_n - Y_0$)

RESULTS AND DISCUSSION

Growth and instability in the area of horticultural crops

The compound annual growth rate of the area of different states for 15 years (2003-2018) has been examined and presented in table 1. Sikkim is the highest area covered under horticultural crops (Chandra De, 2017). According to the table, the annual growth rate of the area was highest in Mizoram with 13.80 percent, followed by Nagaland, which was 12.2 percent. These two states have higher growth rates, and other states have less than 6 percent, nearly half of them. The growth rate of Arunachal Pradesh was much lower than other states, and the lowest economic returns also recorded in Arunachal Pradesh (SFAC, 2011).

Instability in north-eastern states under total horticultural crops from the period of 2013-18 was found to be higher in three states i.e., Arunachal Pradesh (19.17%), Nagaland (18.99%) and Mizoram (18.22%). It means these three depicted high variation in the area of horticultural crops than other states. States showing relatively lower variation were Meghalaya, Sikkim, and Assam with 5.07%, 7.41%, and 8.04 %, respectively.

Growth and instability in the production of horticultural crops

The annual growth rate of the states in the production of horticultural crops is given in table 1. During the study period, Nagaland exhibited the highest growth in the production of horticultural crops followed by Mizoram. The rest of the states have less than 7 percent or nearly 7 percent growth rate. The growth rate of Arunachal Pradesh is lesser. Deka's 2018 study confirmed that Arunachal Pradesh showed a significant negative growth trend from 2000 to 2014.

Instability in north-eastern states of India under total horticultural crops from the period of 2013-18 was found to be highest in Arunachal Pradesh (45.65%) followed by Mizoram (28.62%), Nagaland (26.32%), and Assam (15.53%) while it was found to be lowest in Meghalaya (6.79). Instability in production was also lower in the case of Sikkim (10.71%) and Manipur (11.39%). The results were confirmatory with the study of Sharma *et al.* (2018).

Table 1: CAGR and instability in the area, production, and productivity of horticultural crops in North-East states of India

States	Area		Production		Productivity	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Arunachal Pradesh	0.001 ^{NS}	19.17	4.4 ^{NS}	45.65	4.3*	27.22
Assam	3.4**	8.04	4.9*	15.53	1.2 ^{NS}	14.43
Manipur	3.6*	15.94	7.2**	11.39	3.1*	12.75
Meghalaya	2.8**	5.07	5**	6.79	2.1**	4.24
Mizoram	13.8**	18.22	16.5**	28.62	2.4 ^{NS}	31.17
Nagaland	12.2**	18.94	19.4**	26.32	6.3**	13.45
Sikkim	2.7**	7.41	6.7**	10.71	4.2**	12.18

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India. **Note:** indicating *, ** - 5 percent and 1 percent level of significance, respectively.

Growth and instability in the productivity of horticultural crops

Growth in productivity of different states is given in table 1, which shows that Nagaland (6.3%) had the highest growth rate from the year 2003-18 followed by Arunachal Pradesh (4.3 percent) and Sikkim (4.2). Tripura showed a negative and lowest growth rate in productivity (-0.2%). The growth rate of Assam (1.2%), Meghalaya (2.1%), Mizoram (2.4%), and Manipur (3.1%) was higher than Tripura.

Table 1 shows instability in productivity of horticultural crops during the period 2003 to 2018. Most of the states of the northeast showed more instability. Mizoram (31.17%) showed high instability in the case of productivity, followed by Arunachal Pradesh (27.22%). The lowest instability was of Meghalaya (4.24%) followed by Tripura (5.03%), Sikkim (12.18%), Manipur (12.75%), Nagaland (13.45%), and Assam (14.43%). Manipur, Sikkim, Nagaland, and Assam differ very little in instability from each other.

Decomposition of horticultural crops

To estimate the percentage contribution of area, productivity and the interaction of area and productivity in increasing production of pulses, a decomposition analysis was carried out and presented in Table 2 for the period i.e., 2003-2018. The results presented in Table 2 indicate that from 2003-to 2018, all the three effects were positive, and the area effect is very high, accounting for 56.04%, productivity effect 25.53%, and 18.42% of an interaction effect, respectively.

Table 2: Percentage decompositions of area, productivity and their interaction towards increasing production of horticulture crops

Effect/Year	Period (2003 to 2018)
Productivity Effect	25.53%
Area Effect	56.04%
Interaction Effect	18.42%

Production in the northeastern state increased for the period 2003-2018 due to an increase in area by more than half, followed by productivity and interaction effect.

CONCLUSION

This study analyzed the compound annual growth pattern and the instability of the total horticultural crops of North-East states of India, measured by the Cuddy Della Valle index. There were several fluctuations in the growth pattern of the area, production, and productivity of the horticultural crops. While the growth rate of the area showed, a much lower percentage for Arunachal Pradesh and the higher growth rates were observed for the area in Mizoram and Nagaland. Instability in the area under horticultural crops is lowest in Meghalaya, while Arunachal Pradesh showed the highest instability. The production growth rate showed fluctuations in the states considered in this study. The growth rate of Nagaland and Mizoram was highest for horticultural production. While Arunachal Pradesh has the lowest growth rate in production. Instability in production of the Arunachal Pradesh was highest. The growth rate of productivity of horticultural crops in Tripura showed a negative growth rate, followed by Assam, Meghalaya, and Mizoram. Nagaland was at the top in the productivity growth rate followed by Arunachal Pradesh, Sikkim, and Manipur. Instability in productivity was highest for Mizoram, followed by Arunachal Pradesh. Meghalaya followed by Tripura showed the lowest instability. Production of horticultural crops in the northeastern state increased due to an increase in the area rather than productivity.

ACKNOWLEDGMENTS

The authors are thankful to the Department of Agricultural Economics, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India, for providing us necessary guidance to undertake the studies.

REFERENCES

- Anjum, S. & Madhulika. 2018. Growth and instability analysis in Indian agriculture. *Int. J. Multidis. Res. Dev.*, 5(11): 119-125.
- Chand, R. and Raju, S.S. 2009. Instability in Indian agriculture during different phases of technology and policy. *Indian J. Agric. Econ.*, 64(902-2016-67296).
- Chand, R. 2017. *Doubling Farmers Income*. New Delhi.
- Chandra De, L. 2017. Horticulture Scenario in NE Region of India. *Int. J. Agric. Sci. Res.*, 7(2): 243-254.
- Deka, S. 2018. Growth and Instability of Fruits in North

- Eastern Region of India. *Journal Homepage: Int. J. Res. Soc. Sci.*, **8**(6): 2249-2496.
- Devegowda, S.R., Singh, O.P., Kushwaha, S. and Nagaveni, M. 2019. Analysis of variability on pulses in India. *Pharma Innov. J.*, **8**(4): 440-444.
- Devegowda, S.R., Singh, O.P., Yarazari, Shivananda P. and Kushwaha, S. 2019. Effect of area and yield on the production of pulses in India. *Pharma. Innov. J.*, **8**(4): 436-439.
- FAO. 2017. *The impact of disasters and crises on agriculture and food security*.
- Gautam, Y. and Singh, P.K. 2018. Economic analysis of sorghum in Maharashtra, India. *Int. J. Agric. Stat. Sci.*, **14**(2): 601-606.
- Gautam, Y., Singh, O.P. and Singh, P.K. 2020. Economic and Environmental Benefits of Replacing Diesel Pumps with Solar Irrigation Pumps in Jaipur, Rajasthan. *IJAEB*, **13**(4): 469-474.
- Gornall, J., Betts, R., Burke, E., Clark, R., Camp, J., Willett, K. and Wiltshire, A. 2010. Implications of climate change for agricultural productivity in the early twenty-first century. *Philosophical Transactions of the Royal Society B: Biol. Sci.*, **365**(1554): 2973-2989.
- Government of India Planning Commission. 2001. *The Working Group on Horticulture Development (Fruits, Vegetables, Tuber Crops, Floriculture, Medicinal & Aromatic Plants, Spices, Plantation Crops Including Tea, Coffee and Rubber). Tuber Crops, Floriculture, Medicinal & Aromatic Plant*. New Delhi
- Indian Council of Agricultural Research. 2019. *State Specific Strategies for Doubling farmers income-2022*. New Delhi.
- Krishan, B. and Chanchal, A. 2014. Agricultural Growth and Instability in Western Himalayan Region: An Analysis of Himachal Pradesh, India. *J. Agric. Life Sci.*, **1**(1): 21-27.
- Kumar, A., Mahapatra, S.K. and Surya, J.N. 2021. Soil Suitability of Some Major Fruit Crops for Sustainable Production in the IGP Region of India-A Case Study. *Biol. Forum Int. J.*, **13**(1): 200-210.
- National Housing Bank. 2019. *Annual Report 2018-19*. New Delhi.
- Planning Commission. 2001. *The Working Group on Agricultural Development in Eastern & North Eastern India for the Formulation of the Tenth Five Year Plan Government of India Planning Commission*.
- Prasad Babu, G., Srinivas, T., Sridhar, T.V. and Muralikrishna, T. 2021. Impact of DBT Biotech Kisan Hub Project on Production, Productivity and Socio Economic Variables of Pulse and Oilseeds Growing Farmers of Rayalaseema Region of Andhra Pradesh. *Biol Forum-An. Int. J.*, **13**(1): 662-671.
- Roy, A., Das, S.K., Tripathi, A.K., Singh, N.U. and Barman, H.K. 2015. Biodiversity in North East India and Their Conservation. *Prog. Agric.*, **15**(2): 182-189.
- Sarmah, D. and Deka, P.K. 2012. Horticulture in north-east India : Strengths and prospects the horticulture: A Case Study. *Asian J. Hortic.*, **7**(1): 221-228.
- SFAC. 2011. *Horticulture Mission for North East and Himalayan States*. New Delhi.
- Sharma, A., Badal, P.S. and Choudhary, H. 2018. Growth rate of agricultural GSDP and its forecasting – A case study of developing India. *Bioved.*, **29**(2): 41-45.

