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Growth trend and potential of horticulture in Northeast India

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ABSTRACT

The Northeast region of India is endowed with diverse soil and agro-climatic conditions that are conducive to the growth of a large variety of temperate and tropical horticultural crops. Fruits, vegetables, and spices of the region are highly nutritious and have a market within and outside the country. The paper is an attempt to assess the potential of horticulture in the region. To gauge the state-wise and regional growth trend and variability in area and production of these crops during the period 2009-2019, Compound Annual Growth rates and Instability Index have been computed from secondary data. The study reveals a rising regional growth trend with low instability for the production of fruits and vegetables and moderate instability for spices. This indicates the possibility of sustainable development of horticulture in all the Northeast states through strategic planning. Fruits and spices of the region also have a market in Middle-East and neighbouring countries. However, lack of commercialisation, poor market intelligence, and linkages are impeding the growth of exports. To unleash the true potential of horticulture, it is imperative to develop infrastructure, modernise farming and establish seamless value chains with greater market integration.

Keywords: Export, GI tag, horticulture, linkages, sustainable development.

INTRODUCTION

The Northeast (NE) region of India is rich in biodiversity and home to a large variety of flora and fauna. The region, being a part of the Indo-Myanmar biodiversity hotspot (Myers *et al.*, 2000), is one of the four hotspots present in the country. The states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura comprising the North-eastern region lie in the Eastern Himalayan Agro-climatic zone. The tropical and sub-tropical climate and the alluvial soil of the Brahmaputra and Barak plains and the temperate climate of the hills that have laterite and sandy soil, support a wide variety of plants in the region. The dense forest cover that spreads across 67.05% of the total geographical area (Aggarwal, 2020) generates large quantities of humus that add to the fertility of the soil. Out of approximately 15,000 species of flowering plants available in India, the Northeast region alone accounts for about 8,000 species and six out of the nine important vegetation types found in India (Hegde, 2000). The region enjoys a comparative advantage in terms of climate and soil.

The diverse climatic conditions of the region are conducive to the growth of a wide variety of tropical and temperate horticulture crops that are high on nutritional value (Sarmah and Deka, 2012). The good quality spices especially ginger and chilli of the region not only have high domestic demand but also have export potential especially in South and Southeast Asian countries (Das, 2016). Since demand for fruits and vegetables is highly income dependent, they account for a significant proportion of the total consumption expenditure of middle and high-income groups. Due to the enlargement of the market for these crops in recent years, the horticulture sector is fast emerging as an important sector providing lucrative income and employment to the farm sector and supporting a large number of agro-based industries (Nabi and Bagalkoti, 2017). Hence, the farm sector is witnessing a gradual shift in cropping pattern in favour of horticulture.

In 2014-15, ten horticulture products from the Northeast were given the GI registration, granting the region exclusive rights to produce them. These include Arunachal orange, Khasi mandarin, Tezpur litchi,



Kachai lemon, Indian wild orange popularly known as 'Memang narang', Tripura queen pineapple, Naga tree tomato, Assam Karbi Anglong ginger, Mizo Chilli, and Sikkim large cardamom (Kashyap, 2015).

Depending on the climate, altitude, and physiographic difference of land, the major fruits, vegetables and spices that are cultivated in different North-eastern states are:

State	Fruits	Vegetables	Spices
Arunachal Pradesh	Apple, Banana, Guava, Kiwi, Orange, Pear, Pineapple, Walnut	Bean, Bitter gourd, Brinjal, Cucumber, Muskmelon, Potato, Pumpkin, Radish, Sweet Potato, Tomato	Ginger, Large Cardamom
Assam	Banana, Guava, Jack fruit, Lemon, Litchi, Mandarin Orange, Mango, Papaya, Pineapple, Sapota	Bean, Brinjal, Broccoli, Cabbage, Capsicum, Carrot, Cauliflower, Colocassia, Cucumber, Gourds (different types), Knol-khol, Muskmelon, Pea, Potato, Pumpkin, Radish, Spinach, Sweet potato, Tapioca, Tomato, Yam	Black cumin, Black pepper, Chillies, Coriander, Cumin, Fennel, Fenugreek, Garlic, Ginger, Mint, Onion, Turmeric
Manipur	Banana, Lemon, Orange, Passion fruit, Peach, Pear, Pineapple, Plum	Bean, Cabbage, Cauliflower, Cucumber, Muskmelon, Pea, Potato, Tomato	Chillies, Garlic, Ginger, Hatkora, Onion, Turmeric
Meghalaya	Banana, Guava, Lemon, Mandarin Orange, Pear, Pineapple, Plum	Broccoli, Cabbage, Capsicum, Carrot, Cauliflower, Colocasia, Potato, Radish, Squash, Sweet potato, Tapioca, Tomato, Turnip	Bay leaf, Black pepper, Chillies, Ginger, Turmeric
Mizoram	Banana, Hatkora, Orange, Papaya, Passion fruit, Pineapple	Bean, Brinjal, Broccoli, Cabbage, Capsicum, Carrot, Cauliflower, Chow-chow, Cucumber, different types of Gourds, Knol-khol, Ladies finger, Muskmelon, Pea, Potato, Pumpkin, Radish, Tomato	Chillies, Ginger, Turmeric
Nagaland	Banana, Guava, Jack fruit, Lemon, Litchi, Mandarin Orange, Mango, Papaya, Pineapple, Plum, Pomegranate	Brinjal, Cabbage, Carrot, Cauliflower, Chow-chow, Colocasia, Ladies finger, Pea, Potato, Radish, Sweet Potato, Tomato	Black pepper, Cardamom, Chillies, Garlic, Ginger, Turmeric
Sikkim	Banana, Kiwi, Mandarin Orange, Papaya, Passion fruit, Pear	Bean, Broccoli, Cabbage, Cauliflower, Cucumber, Pea, Radish, Tomato, Turnip	Cherry pepper, Ginger, Large cardamom, Turmeric
Tripura	Banana, Ber, Guava, Jack fruit, Lemon, Litchi, Mango, Musambi, Orange, Papaya, Pineapple, Sapota	Bean, Cabbage, Capsicum, Carrot, Cauliflower, Cucumber, different types of Gourds, Parmal, Potato, Pumpkin, Radish, Sweet potato, Potato, Tapioca, Tomato	Black Pepper, Betel vine, Chillies, Ginger, Onion

MATERIALS AND METHODS

The study is an attempt to assess the performance of horticulture crops, i.e., fruits, vegetables, and spices of the NE region during the period 2009-10 to 2018-19. For this purpose, data pertaining to area and

production of fruits, vegetables, and spices that are cultivated in the different Northeast states have been considered. The relevant data and information have been gleaned from the Indian Horticulture database of the National Horticulture Board (www.nhb.org.in), Agricultural Processed and Export Development

Agency (apeda.gov.in), annual reports of Horticulture Mission for Northeast and Himalayan States, Directorate of Horticulture of the Northeast states, published journals and newspapers.

Data collected has been analysed to estimate descriptive statistics such as mean and standard deviation and regression coefficients of the function $Y = ab^t + u$, where Y represents the growth rate under study, a is the intercept; b is the regression coefficient; t is the time variable and u is the error term. The estimates have been used to compute the compound growth rates (CAGR) and Instability Index (II) which is used to examine the variability in area and production of agricultural crops. Since the Cuddy-Della Valle index (1978) corrects the coefficient of variation for overestimation of instability in long-term trends of time series data, it has been used in the present study.

Instability Index = $CV \times \sqrt{1 - r^2}$, where CV is the coefficient of variation in percent and $r^2 = \text{RSS}/\text{TSS}$, i.e. the coefficient of determination of the trend regression that best fits the time series data.

The ranges of instability have been categorised as low instability = 0 to 15; medium instability = greater than 15 but less than 30; and high instability = greater than 30 (Sihmar, 2014). The data was analysed using the statistical software, SPSS 20.

RESULTS AND DISCUSSION

Trend analysis in area and production of fruits, vegetables, and spices for the period under study has been made using Compound Annual Growth Rate. Tables 1 (a) and (b) reveal that fruit cultivation can be adopted as a sustainable occupation in Assam, Manipur, and Meghalaya. These states have recorded a more than proportionate increase in the annual growth rates of production, as compared to the area under cultivation, with low instability indices. The success may be attributed to favourable soil and climatic conditions, use of high-quality seeds, better usage of technical know-how, and farm practices. For example, the per annum production growth rates of the major fruit crops during the period 2010-11 to 2017-18, such as banana in Assam (3%), mandarin in Manipur (6.7%), and pineapple in Meghalaya (6.3%) and the corresponding low instability index

of 3.72%, 9.6%, and 5.87% respectively reflect the success of the strategies adopted in these states (Table 2).

Sikkim and Nagaland have registered 10.1% and 8% annual growth rates in the production with relatively lesser annual increase in land for growing fruits, production has been observed to be moderately unstable during the period. On the other hand, a 3.3% annual increase in the production in Mizoram and a 1.4% decline in the production in Tripura have been observed despite more land being brought under fruit cultivation. It can be opined that erratic climatic conditions and limited use of modern techniques of production may be the main reasons for the sluggish growth in fruit production in Mizoram, while lack of drip irrigation system and absence of farm mechanisation may be the factors responsible for poor production in Tripura.

A negative annual growth rate of production with high instability index of 48.03% indicates that fruit cultivation is risky in Arunachal Pradesh. Uncertain weather conditions, inadequate irrigation facilities, vagaries of monsoon, inferior farm inputs, and practices have resulted in severe fluctuations in the production of fruits. However, due to the recent surge in demand for kiwi, orange, and apple of the state, more land is being brought under cultivation and farmers are being induced to produce these crops.

During the period under study, the annual growth rate in fruit production has been almost double the growth rate in the area under cultivation in the region as a whole. Since the instability index for the entire region is 8.38% and 8.55% for area and production respectively, it may be inferred that barring Arunachal Pradesh, fruit cultivation is relatively stable and may be encouraged to augment employment and income in the farm sector.

Tables 3 (a) and (b) display the growth trend and instability index of vegetables during the period of study. The annual rate of growth of production of vegetables is found to be higher than that of the per annum growth rate in the area under cultivation in the states of Meghalaya, Nagaland, Sikkim, and Tripura. While the areas under cultivation and production are relatively stable in Meghalaya and Tripura, they are found to be moderately stable in Nagaland and Sikkim. Favourable agro-climatic conditions in Meghalaya and Tripura offer tremendous scope for the cultivation of

Table 1 (a) : State wise area in '000 hectares and production in '000 M Tonnes of fruit crops

Year	Arunachal Pradesh		Assam		Manipur		Meghalaya	
	A	P	A	P	A	P	A	P
2009-2010	72	107.9	117.3	1575.5	38.4	281.9	32.9	294.8
2010- 2011	72	107.9	137.5	1763.5	68.7	286.3	30.2	241.9
2011- 2012	85.1	308.9	142.8	1851.8	49.5	405.9	32.3	300.4
2012- 2013	86.86	312.24	150.71	2073.82	51.93	440.59	33.15	316.57
2013- 2014	89.09	321.26	144.68	2007.8	54.05	515.69	35.3	348
2014- 2015	90	331.4	155.51	2242.74	55.61	532.97	36.01	375.83
2015- 2016	66.21	306.27	145.71	2077.77	51.12	467.76	36.59	395.4
2016- 2017	48.71	124.38	142.89	2024.84	50.58	478.77	37.37	426.86
2017- 2018	48.13	125.7	147.26	2132.62	47.61	455.59	32.81	316.51
2018- 2019	48.13	125.7	167.2	2518.89	47.686	456.058	33.37	324.67
CAGR %	-5.9	-1.3	2.2	3.8	-0.3	5.4	1.1	3.2
R ²	0.49	0.006	0.54	0.75	0.004	0.501	0.24	0.35
b ₁	0.941	0.987	1.02	1.04	0.997	1.054	1.011	1.032
II	17.43	48.03	6	6.42	14.83	14.1	5.71	13.08

A: area; P: production

Table 1 (b) : State wise area in '000 hectares and production in '000 M Tonnes of fruit crops

Year	Mizoram		Nagaland		Sikkim		Tripura		North East	
	A	P	A	P	A	P	A	P	A	P
2009-2010	27.1	328.3	30.8	223.7	12.2	18.5	36.9	573.8	367.6	3404.4
2010- 2011	27	211.5	18.2	151.3	17.5	25.8	40.8	643.9	411.9	3432.1
2011- 2012	43.7	257.7	33.7	347.7	13.4	22.5	54.5	644.4	455	4139.3
2012- 2013	49.68	292.95	37.23	275.95	14.65	24.02	60.12	697.87	484.33	4434.01
2013- 2014	57.55	343.9	40.56	411	16.02	24.05	63.38	786.35	500.63	4758.05
2014- 2015	66.14	386.62	40.56	411	17.59	26.42	67.27	563.5	528.69	4870.48
2015- 2016	55.01	330.28	37.05	374.13	17.53	23.48	75.74	854.05	484.96	4829.14
2016- 2017	62.56	339.05	39.19	388.49	18.55	25.56	57.84	559.92	457.69	4367.87
2017- 2018	63.19	340.51	39.19	380.52	19.36	54.9	53.75	547.52	451.3	4353.87
2018- 2019	62.911	335.6	39.5	380.52	19.55	55.45	51.39	525.42	469.74	4722.31
CAGR %	10	3.3	5.2	8	4.5	10.1	3.7	-1.4	1.8	3.2
R ²	0.73	0.32	0.39	0.51	0.69	0.61	0.25	0.07	0.27	0.52
b ₁	1.1	1.033	1.052	1.08	1.045	1.101	1.037	0.986	1.018	1.032
II	14.73	12.94	15.05	18.45	8.44	27.67	18	16.51	8.38	8.55

A: area; P: production

Table 2 : State wise area in ‘000 hectares and production in ‘000 M Tonnes of select fruit crops

Year	Assam (Banana)		Manipur (Mandarin)		Meghalaya (Pineapple)	
	A	P	A	P	A	P
2010- 2011	47.6	723.6	3.5	27.7	9.7	86
2011- 2012	49.1	745.3	4.7	28.7	10.6	112.9
2012- 2013	51.51	837.02	5.02	32.64	10.82	109.39
2013- 2014	50.81	857.72	5.2	41.2	11.31	117.77
2014- 2015	51.28	865.67	5.35	43.06	11.59	124.6
2015- 2016	51.1	882.71	4.91	43.34	11.58	123.13
2016- 2017	49.27	854.85	4.81	42.91	12.16	140.95
2017- 2018	53.08	913.27	4.46	39.89	12.37	144.73
CAGR %	0.9	3	2.1	6.7	3.2	6.3
R ²	0.427	0.781	0.152	0.706	0.93	0.855
b ₁	1.009	1.03	1.021	1.067	1.032	1.063
II	2.59	3.72	11.06	9.6	2	5.87

A: area; P: production

a wide variety of vegetables throughout the year. Improvement in irrigation facilities through the introduction of drip irrigation and sprinkler irrigation, protected cultivation of vegetables, provision of modern farm implements and tools, and other facilities to the farmers under the Technology Mission for Integrated Development of Horticulture have enabled the states to make remarkable progress in the production of vegetables. For instance, the low instability index of 0.38% for potato production in Meghalaya and 6.11% for brinjal production in Tripura over the period 2013-14 to 2017-18 indicates the success of the strategies applied in stabilising the production of the crops grown in the states. On the other hand, peas production in Sikkim has been moderately unstable, though the annual rate of growth has been an impressive 15.4% (Table 4). Hence, to stabilise production a re-engineering of the strategies adopted is required with greater farm support to the cultivators.

Despite a decline in the annual growth rate in the area under production by 0.65% in Arunachal Pradesh, the state has recorded an increase of 6.1% per annum in the production of vegetables. Improvement in irrigation facilities, expansion of protected cultivation system to avert the impact of harsh weather conditions, and adoption of organic farming to maintain soil fertility are some of the measures that may be undertaken to

secure higher stability in both the area under cultivation and production of vegetables.

Assam, Manipur, and Mizoram have been found to have brought more land under cultivation of vegetables but have not been able to increase production commensurately. Among these three states, Mizoram’s vegetable production has been the least, growing at 2.7% per annum compared to an 11.1% annual increase in the growth rate of the area under cultivation. Moderate instability has also been observed in both the area under cultivation and production. To accelerate growth in the production of vegetables, a more integrated approach has been adopted by the government. Farmers are being encouraged to adopt commercial farming of focus crops such as tomato and cabbage. High yielding variety seeds, superior quality of farm inputs, modern tools and implements, irrigation facilities, and facilities for post harvest handling of produce are being made available for the purpose. The slow growth of production in comparison to the area under cultivation in Manipur may be attributed to the use of inferior quality seeds and other farm inputs, lack of irrigation facilities, and incidence of pests and diseases.

Though Assam is the major vegetable producing state in the region with low instability (5.5%) in the area under cultivation, yet the state has recorded a

negligible per annum increase of 0.6% in production with moderate instability (17.29%) during the period. The small-sized scattered holdings in the state are a major hindrance in adopting large-scale production using modern technology. Frequent floods, use of low-yielding variety seeds, and other planting materials are also some of the factors that are impeding the growth of vegetable production.

The region as a whole has witnessed 4.4 % and 2.9% annual growth rates in area and production of vegetables respectively with a low instability index. Except for Arunachal Pradesh, more land is being brought under the cultivation of vegetables and there has been an increase in production as well. This is an encouraging trend as farmers can diversify and adopt multi-cropping which will yield sustained income throughout the year besides making the region self-sufficient.

It can be observed in Tables 5 (a) and (b) that Arunachal Pradesh and Sikkim have recorded stable growth in the area under cultivation and production of spices during the period. Spice cultivation, thus, appears to be a viable alternative in the farm sector and should be encouraged in these states. For example,

one of the major spices of Sikkim is ginger. Table 6 reveals that ginger production has registered a 2.1% per annum growth rate during the period 2013-14 to 2017-18 with a low instability index of 1.37%.

Spice cultivation also appears to have very good prospects in Assam. The state has recorded 9.1% per annum growth in the area under spice cultivation and a 19% annual growth rate in production. The average yield of the major spices, i.e., ginger, turmeric, chilli, and black pepper has increased over the years in the state (Borah, 2020). However, the instability index of 20.29% and 27.86% for the area under cultivation and production respectively indicate moderate instability which can be mitigated through strategic planning and correct policy interventions. For instance, the soil and climatic conditions of the eastern part of Assam are conducive for black pepper farming. Hence, the cultivation of the spice may be extended to the tea gardens of the area as well to augment production and secure stability.

While production has been moderately stable in Manipur and Tripura at 19.88% and 18.54% respectively, it has been relatively high in Nagaland (36.96%). On the other hand, fluctuations in climatic conditions, inferior planting materials, and plant

Table 3 (a) : State wise area in '000 hectares and production in '000 M Tonnes of vegetables

Year	Arunachal Pradesh		Assam		Manipur		Meghalaya	
	A	P	A	P	A	P	A	P
2009-2010	4.2	38.5	255.2	4569.9	19.9	221.8	44.3	415.8
2010- 2011	4.2	38.5	260.1	2925.5	22.2	236.5	41.8	356.5
2011- 2012	6.3	83.5	266	3045.6	20.8	200.3	39.5	385
2012- 2013	1.5	37.6	278.7	3415.1	21.7	219.8	40.5	403.4
2013- 2014	1.4	35	281.4	3031.9	25.2	271	43.6	515.3
2014- 2015	1.7	41	337.94	4647.79	27.58	288.44	44.6	534
2015- 2016	4	33.01	317.51	3821.71	34.36	316.51	47.5	494.88
2016- 2017	1.75	14.42	300.75	3329.58	59.4	369.86	49.5	523.42
2017- 2018	2.58	16.68	300.17	3292.88	45.3	342.11	49.11	519.67
2018- 2019	2.58	16.58	324.13	4060.14	45.281	341.692	49.84	531.88
CAGR %	-0.65	6.1	2.7	0.6	12.3	6.7	2.3	4.4
R ²	0.152	0.684	0.676	0.011	0.814	0.817	0.681	0.693
b ₁	0.935	1.061	1.027	1.006	12.3	1.067	1.023	1.044
II	48.74	11.22	5.55	17.29	18.1	6.7	4.73	8.16

A: area; P: production

Table 3 (b) : State wise area in ‘000 hectares and production in ‘000 M Tonnes of vegetables

Year	Mizoram		Nagaland		Sikkim		Tripura		North East	
	A	P	A	P	A	P	A	P	A	P
2009-2010	10.6	179.1	10.4	78.3	28.7	147.7	32.5	446.9	405.8	6098
2010- 2011	17.4	115.6	10.7	79.4	23.9	120.9	36	532.3	416.3	4405.2
2011- 2012	37.4	221.1	33	222.6	25	127.7	34.2	552.6	462.5	4796.4
2012- 2013	39.3	236.68	26	207.7	25.6	132.5	45.1	754.1	478.4	5406.88
2013- 2014	42.87	260.16	38.6	492.4	26.1	134.5	47.7	780.5	506.87	5520.76
2014- 2015	44.1	273.74	38.55	492.37	26.12	134.92	35.57	606.08	556.16	7018.34
2015- 2016	45.1	272.5	43.53	494.61	20.25	106.94	46.48	793.24	558.73	6333.4
2016- 2017	47.02	283.84	47.17	464.62	25.54	190.72	46.68	817.94	577.81	5994.4
2017- 2018	36.2	171.01	46.21	561.61	38.42	229.1	45.94	795.68	563.93	5928.74
2018- 2019	34.6	177.16	46.21	561.61	38.8	231.39	45.53	791.13	586.971	6711.582
CAGR %	11.1	2.7	17.8	25.7	3.4	6.2	3.8	6.1	4.4	2.9
R ²	0.429	0.078	0.722	0.782	0.242	0.455	0.53	0.684	0.913	0.366
b ₁	1.111	1.027	1.178	1.257	1.034	1.062	1.038	1.061	1.044	1.029
II	25.95	24.62	21.83	25.19	18.94	21.38	10.18	11.22	3.82	1.112

A: area; P: production

Table 4 : State wise area in ‘000 hectares and production in ‘000 M Tonnes of select vegetables

Year	Meghalaya (Potato)		Sikkim (Peas)		Tripura (Brinjal)	
	A	P	A	P	A	P
2013- 2014	18.43	3.52	2.02	9.27	3.52	53.56
2014- 2015	18.47	3.71	2.02	9.27	3.71	56.25
2015- 2016	18.56	3.65	2.05	8.85	3.65	70.87
2016- 2017	18.9	3.68	2.46	10.62	3.68	79.8
2017- 2018	18.91	3.62	4.1	17.7	3.62	77.88
CAGR %	0.7	0.5	17.5	15.4	0.5	11.6
R ²	0.883	0.14	0.701	0.618	0.14	0.881
b ₁	1.007	1.005	1.175	1.154	1.005	1.116
II	0.42	1.86	19.56	18.65	1.86	6.11

A: area; P: production

diseases may be some of the factors responsible for the negligible (0.7%) annual growth rate in the production in Mizoram.

Despite a decline of 6.8% in the annual growth rate of the area under cultivation in Meghalaya, production has increased at the rate of 12.2% per annum. But both the area under cultivation and production has recorded high instability. However, production of two

of the major spice crops i.e., turmeric and chilli cultivated in Meghalaya and Nagaland respectively have registered positive per annum growth rates in production during 2013-14 to 2017-18. The instability index for turmeric is 3.72% for the area under cultivation and 6.10% for production, while that of chilli is 3.97% and 3.61% respectively (Table 6). The low instability indices of the two crops suggest that

with the use of climate and disease resilient planting materials, better irrigation facilities, and adoption of organic farming and modern technology stable production of spices can be achieved in these states.

The region as a whole has witnessed a lower annual growth rate in production (3.4%) compared to the area under cultivation (7.6%). Spice production is found to be moderately unstable at 20.17%. This indicates that the region is yet to realise its true potential in Spice production. However, the organically produced spices of the region, namely, the Lakadong turmeric having high curcumin content, the less fibrous Nadia ginger, and the highly pungent Bird's eye chilli and King chilli have niche markets both within and outside the country. With the recent interventions by the Spices Board and the implementation of various development schemes of the Horticulture Mission for North East and Himalayan Region (HMHEH), the region is poised to become the organic 'spice hub' of the country and generate huge exportable surplus.

Export potential

Being strategically located with an international boundary of 5182 kilometers, the Northeast region is the gateway to India's connectivity with South - East Asia and ASEAN countries. Despite the

presence of lucrative markets in the neighbouring countries of Bangladesh, Nepal, Bhutan, and Myanmar, the region has a negligible share in the total horticulture exports from India. Khasi mandarins, pineapples, gingers, and chillies grown in the region have a good market in Middle East countries like Saudi Arabia, UAE, Qatar, Oman, and Bahrain (APEDA, 2016). Tables 7 (a) and (b) indicate that during the period 2011-12 to 2015-16, fruits and spices have predominantly been exported from the region. Tomato is the only vegetable that has been exported every year with occasional inclusion of peas, cabbage, radish, etc. It is observed that though orange and ginger constitute the major share of the export basket of Assam, the share of tomato has also increased over the years. On the other hand, ginger and betel nut have fetched higher foreign exchange for Meghalaya during the period. However, Tripura's exports have been mainly fruits and that of Manipur have been vegetables. With the increase in the number of commodities exported from the region in 2015-16, it may be inferred that horticulture exports are gradually picking up. The major exports during the year were ginger, orange, and apple for Assam, dry chilli for Manipur, and orange for Tripura. Though

Table 5 (a) : State wise area in '000 hectares and production in '000 M Tonnes of spices

Year	Arunachal Pradesh		Assam		Manipur		Meghalaya	
	A	P	A	P	A	P	A	P
2009-2010	7.63	43.34	27.37	18.55	8.89	7.84	17.41	72.01
2010- 2011	10.1	61.6	89.2	222.1	10.5	24.1	16.8	71.4
2011- 2012	10.1	61.6	93	261.6	10.5	24.1	74.8	16.85
2012- 2013	10.17	64.27	96.66	287.5	10.47	24.14	74.81	17.5
2013- 2014	10.17	64.27	93.08	279.14	10.47	24.14	83.88	17.5
2014- 2015	10.17	64.27	98.6	321.03	10.47	24.14	17.5	83.88
2015- 2016	11.44	68.72	100.53	333.69	10.47	24.14	18.37	90.26
2016- 2017	11.44	68.72	119.99	291.3	10.47	23.14	18.61	92.16
2017- 2018	11.44	68.72	101.6	302	10.5	23.1	18.7	92
2018- 2019	11.64	71.29	103.24	312.61	10.61	23.99	18.18	91.7
CAGR %	3.5	3.7	9.1	19	1	6	-6.8	12.2
R ²	0.696	0.605	0.4	0.362	0.302	0.248	0.09	0.203
b ₁	1.035	1.037	1.091	1.19	1.01	1.06	0.932	1.122
II	6.28	7.79	20.29	27.86	4.14	19.88	76.82	46.19

A: area; P: production

Table 5 (b) : State wise area in ‘000 hectares and production in ‘000 M Tonnes of spices

Year	Mizoram		Nagaland		Sikkim		Tripura		North East	
	A	P	A	P	A	P	A	P	A	P
2009-2010	22.67	80.63	7.22	38.62	26.58	41.73	3.96	12.1	121.73	314.82
2010- 2011	21.4	110.5	7.5	38.5	24.4	52.4	5.8	18.1	185.7	598.7
2011- 2012	20.6	115	9.8	39.2	24.4	54.4	5.7	18	248.9	590.75
2012- 2013	22.47	59.62	9.77	39.16	26.56	60.08	5.69	18.04	256.6	570.31
2013- 2014	22.47	59.62	9.77	39.16	32.06	55.8	5.69	18.04	267.59	557.67
2014- 2015	23.3	65.72	9.77	39.16	34.08	61.14	5.69	18.04	209.58	677.38
2015- 2016	24.57	68.89	15	119.25	29.46	64.78	5.69	18.04	215.53	787.77
2016- 2017	24.81	97.2	15.69	105	32.25	66.58	5.69	18.04	238.95	762.14
2017- 2018	27.7	100.9	9.9	64.8	32.3	66.6	6.6	32.4	218.74	750.52
2018- 2019	27.66	100.93	9.95	67.26	32.54	69.05	6.15	30.22	219.97	767.05
CAGR %	3	0.7	5.3	10.8	3.4	4.7	3	7.8	7.6	3.4
R ²	0.789	0.006	0.391	0.484	0.636	0.829	0.451	0.64	0.654	0.2
b ₁	1.03	1.007	1.053	1.108	1.034	1.047	1.03	1.078	1.076	1.034
II	4.68	24.89	20.77	36.96	7.48	5.78	8.75	18.54	11.3	20.17

A: area; P: production

Table 6 : State wise area in ‘000 hectares and production in ‘000 M Tonnes of select spices

Year	Meghalaya (Turmeric)		Nagaland (Chilli)		Sikkim (Ginger)	
	A	P	A	P	A	P
2013- 2014	2.17	12.53	5.82	41.9	9.3	52.11
2014- 2015	2.17	12.53	5.82	41.9	9.3	52.11
2015- 2016	2.54	15.86	5.4	40.08	10.03	54.99
2016- 2017	2.61	16.63	6.01	44.86	12.3	55.9
2017- 2018	2.65	16.5	5.98	44.5	12.3	55.9
CAGR %	6	8.7	0.9	1.9	8.7	2.1
R ²	0.852	0.814	0.102	0.403	0.864	0.852
b ₁	1.060	1.087	1.009	1.019	1.087	1.021
II	3.72	6.10	3.97	3.61	5.35	1.37

A: area; P: production

ginger, betel leaf, and betel nut were the major exports from Meghalaya, lesser quantities of tomato, bay leaf, and orange fetched higher revenue in the international markets. This reflects the high export potential of commodities produced in the region. With the availability of better market intelligence and export linkages, the marketable surplus of horticulture crops of the region can fetch higher revenue in terms of foreign currencies.

SWOT analysis

Strength

The Northeast region produces a large variety of temperate and tropical fruits, vegetables, and spices that are of good quality and high on nutrition. The region exhibits a rising trend in growth rates with low instability in area and production of fruits and vegetables and moderate instability in spice

Table7 (a) : Export of horticultural commodities through various land custom stations (LCS) in NER (2011-2012 to 2015-16)

State	Commodity	2011-2012		2012-2013		2013-2014	
		Quantity (MT)	Value in INR	Quantity (MT)	Value in INR	Quantity (MT)	Value in INR
Assam	Ginger	5040.29	83754578	16655	220796080	-	-
	Tomato	2.99	35976	6.596	98986	25.9	322000
	Onion	-	-	-	-	612	17252000
	Orange	6297.144	139224050	257186	89176570	1230.7	16307000
	Apple	-	-	-	-	-	-
	Mango	-	-	-	-	110	1548000
	Banana	-	-	-	-	-	-
	Pomegranate	-	-	-	-	-	-
	Grapes	-	-	-	-	4.25	112000
	Citrus	117.96	1307629	157.863	2132166	840.35	14424000
	Betel leaf	88.38	3109925	60.481	2927246	-	-
	Betel Nut	-	-	337	2304937	-	-
Manipur	Dry Chilli	-	-	-	-	-	-
	Peas	-	-	-	-	620	22315000
	Other Vegetables	-	-	-	-	81.41	5633000
	Dry Grapes	-	-	-	-	-	-
	Betel Nut	-	-	48	1728000	-	-
Meghalaya	Betel leaf	-	-	-	-	-	-
	Ginger	-	-	852	11458575	-	-
	Bay leaf	-	-	-	-	-	-
	Tomato	-	-	-	-	13.17	5000
	Cabbage	-	-	-	-	-	-
	Radish	-	-	-	-	-	-
	Orange	-	-	-	-	-	-
	Betel Nut	144	973742	337	2304937	10	103000
Tripura	Banana	11.44	49538	6	30229	4	24000
	Apple	-	-	-	-	-	-
	Pomegranate	-	-	-	-	-	-
	Orange	0.11048	132577	44.148933	-	-	-
	Citrus	0.4651	533548	-	2457024	-	-
	Litchi	-	-	-	-	-	-
	Grapes	-	-	7.781	-	-	-
	Ginger	5.51	201821	-	34364	-	-
	Vegetable seeds	-	-	-	-	-	-

Data Source: APEDA

Table 7 (b) : Export of horticultural commodities through various land custom stations (LCS) in NER (2011-2012 to 2015-2016)

State	Commodity	2014-2015		2015-2016	
		Quantity (MT)	Value in INR	Quantity (MT)	Value in INR
Assam	Ginger	6770.044	112944962	5239.693	94137239
	Tomato	35.534	498000	36.13	686880
	Onion	-	-	-	-
	Orange	811.732	10151500	1774.495	29642547
	Apple	-	-	401.421	10094384
	Mango	6.784	115000	17.996	354428
	Banana	-	-	3	16456
	Pomegranate	-	-	16.23	391059
	Grapes	-	-	2.763	69075
	Citrus	1.82	27000	-	-
	Betel leaf	11.244	592000	26.403	1401851
	Betel Nut	-	-	-	-
Manipur	Dry Chilli	-	-	448	33600000
	Peas	200	74	-	-
	Other Vegetables	-	-	-	-
	Dry Grapes	-	-	-	-
	Betel Nut	-	-	268.14	44243100
Meghalaya	Betel leaf	-	-	844.87	197543.55
	Ginger	1589.5	283.77146	1413.08	25820237.07
	Bay leaf	-	-	48.98	186105.86
	Tomato	-	-	175.23	1282832.68
	Cabbage	-	-	4.25	24545.88
	Radish	-	-	1.9	12250.5
	Orange	-	-	18.7	181844.39
	Betel Nut	36.5	4.10676	763	9348646
Tripura	Banana	21	109000	2.50	14723
	Apple	-	-	22.09	568783
	Pomegranate	-	-	5.5	115444
	Orange	-	-	388.826	7782638
	Citrus	-	-	-	-
	Litchi	0.5	8100	-	-
	Grapes	0.5	8700	-	-
	Ginger	-	-	-	-
	Vegetable seeds	-	-	0.15	76645.43

Data Source: APEDA

production. This indicates that the horticulture sector offers high scope for expansion and sustainable development. Majority of the crops that can have a good market in the neighbouring countries of Bangladesh, Nepal, Bhutan, and Myanmar, can be commercially produced for export. A large number of highly nutritious fruits and vegetables that are exclusive to the region can also be promoted. If farmers are given incentives to diversify into the production of horticulture crops through dissemination of modern farming techniques, provision of irrigation facilities, cheap credit, storage, and marketing facilities, then the hitherto underutilized sector can generate higher employment and income, both in domestic and foreign currencies, for the region.

Weakness

Despite the comparative advantage the region has in terms of soil and climate, yet the sector awaits commercialization. Traditional methods of cultivation with excessive dependence on monsoon result in less than the optimum yield of many horticulture crops, thereby generating a less marketable surplus. Table 8 shows the poor availability of storage and packaging facilities in the region. The absence of such facilities reduces the waiting time significantly and farmers are forced to sell their produce in the domestic markets at a lower price. Establishment of large number of cold storages, setting up of modernized cold chains,

establishment of integrated packaging houses and processing units, greater market linkages will induce farmers to diversify to horticulture to reap higher returns.

Opportunity

Close proximity to South and South-East Asia opens up opportunities of not only trade in primary horticultural products but also offers a market for processed products that will generate higher foreign revenue. The existing market for horticulture produce especially in the Middle East can be leveraged to enter into markets of the developed countries of the West. Hence, all efforts should be made to expand the market by increasing the production of both primary and processed horticulture products that comply with international quality standards and have a competitive edge in the export market. Development of the horticulture sector in the region will boost the volume of trade and accelerate the growth and development of the predominantly agrarian economy.

Threat

If cold storages and food processing units are not established across the region, then the neighbouring countries, especially the rapidly developing Bangladesh, will import the fruits, vegetables, and spices from the region and make value additions by processing them to produce a large range of products

Table 8 : Available infrastructure in Northern as on 31.03.2018

State	Cold Storage		Cold Chain Projects		Pack House	
	Number	Capacity (MT)	Number	Capacity (MT)	On Farm Pack House	Integrated Pack House
Arunachal Pradesh	2	6000	1	3983	16	0
Assam	37	163258	31	160250	25	0
Manipur	3	7100	1	1600	187	7
Meghalaya	4	8200	1	5000	459	0
Mizoram	3	3971	1	3471	82	0
Nagaland	4	7350	1	5000	437	1
Sikkim	2	2100	1	100	134	2
Tripura	14	45477	5	24027	7	0

Data Source: National Horticulture Board, National Horticulture Mission, Directorate of Marketing and Inspection (DMI) up to 2009, Ministry of Food Processing Industries (MOFPI), MIDH

that will have a lucrative market in South-East Asia and the ASEAN. To augment export demand and expand the market share, it is imperative to increase productivity, establish processing units that can produce a wide range of customized processed products based on market demands and quickly upgrade the value chain to take full advantage of early entry into the export market.

CONCLUSION

The Northeast region is strategic for greater integration with South - East Asia and ASEAN countries. The development of the economic corridor will boost the volume of trade and flow of foreign exchange into the country. Horticulture crops of the region being highly nutritious, rich in minerals, vitamins, and dietary fibers can constitute a significant part of the agro-based export basket and propel the growth of the region. Being a labour-intensive activity, horticulture has huge potential to provide gainful employment opportunities in the agrarian sector and improve livelihood. Development of the sector will generate backward and forward linkages that will encourage investments in food processing units, cold storages, and packaging units thereby yielding higher income via the multiplier effect. To unleash the true potential of the sector, the state governments of the region should develop rural infrastructure, adopt a development strategy that is more resilient to variations in climate and pests, organize capacity building programs on scientific methods of cultivation and provide farm inputs at subsidized rates to induce cultivators to adopt horticulture on a commercial basis. The establishment of a seamless value chain with efficient market linkages can transform the sector into a driver of growth for the region.

REFERENCES

- Aggarwal, M. 2020. India's forest cover is rising but northeast and tribal areas lose. <https://india.mongabay.com/2020/01/indias-forest-cover-is-rising-but-northeast-and-tribals-lose/>
- APEDA, 2016. Comprehensive master plan for tapping the export potentials of North Eastern states. http://apeda.gov.in/apeda-website/Announcements/APEDA_NER_Final_Project_Report_Compr.pdf
- Borah, R.K. 2020. Present status of Spice Crops farming in Assam. www.researchgate.net
- Cuddy, J.D.A. and Della Valle, P.A. 1978. Measuring the instability of time series data. *Oxford B. Econ. Stat.*, **40**(10): 79-84.
- Das, K. 2016. Production conditions of spices in Northeast India: Cases of ginger and chilli. Discussion Paper No.51, National Research Programme on Plantation Development, Centre for Development Studies, Trivandrum. www.cds.edu
- Hegde, S.N., 2000. Conservation of North East Flora. *Arunachal Forest News*, **18**(1), p.2.
- Kashyap, S.G. 2015. 10 Northeast Horticulture products get coveted GI tag. In: The Indian Express, 22 May, 2015. <https://indianexpress.com/article/india/india-others/10-northeast-horticultural-products-get-coveted-gi-tag/>.
- Myres, N, Mittermeier, R.A, Mittermeier, C.G, Da Fonseca, G.A. and Kent, J. 2000. Biodiversity 'Hotspots' for conservation priorities. *Nature.*, **403**: 853-858.
- Nabi, T and Bagalkoti, S.T. 2017. Growth Trends of Horticulture Crops in India. *International J. Multidiscip. Res. Dev.*, **4**(3): 158-164.
- Sarmah, D and Deka, P. K. 2012. Horticulture in North-East India: strengths and Prospects. *Asian J. Hort.*, **7**(1): 221-228.
- Sihmar, R. 2014. Growth and Instability in Agricultural Production in Haryana: A District level Analysis. *Int. J. Sci. Res. Publ.*, **4**(7): 1-12.

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