

Horticulture Crops in Arunachal Pradesh: Growth, Contribution to State Economy and Decomposition Analysis

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Abstract

Based on secondary data, the paper examines the growth of horticulture crops cultivated in Arunachal Pradesh along with its contribution to the State economy and use decomposition analysis to identify the drivers of change of growth of such crops. Our study depicts negative growth of area, production and productivity of horticulture crops in the State. Moreover, during 2010-11 to 2020-21, there has been a decline in the percentage share area of the State to the total area and production of horticulture crops in the country. However, despite the declining trends in growth of horticulture sector in Arunachal Pradesh and in its share in country's total area and production, this sector has a significant contribution to State economy in terms of value addition. Decomposition analysis depicts that except in case of vegetables, the major driving force of production change in horticultural crops is the yield effect. For vegetable, area effect is playing the prime role in its production change. Further, it is found that there is instability in area, production and productivity of horticultural crops in the State.

Introduction

Being an important source of nutrition and alternative source of livelihood, horticulture is widely promoted. The diversification towards horticulture sector contributes to rural income and has great potential to generate revenue to the farmers, improves socio-economic status of the people and their living standard (Sony and Upreti, 2017; Gautam and Handa 2012; Gopalakrishnan, 1991; Devi & Kumar, 2020). Further, socio-economic development along with the preservation of nature is indeed a difficult task, at least for the economic interest. Considering the worst effects of human developmental activities, the world is very concerned and the goal set to achieve sustainable development. The

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target set is not easy to achieve but it is also not difficult to follow, if every stakeholder feels the necessity and embrace the sustainable goal as their basic duty. Horticulture can play an important role in achieving sustainable development as it has great potential to maintain the ecological balance. According to Ravichandra, (2018)³, increasing population, changes in global income, lifestyle and food habits resulted in the increase in demand for horticulture products worldwide which further provides the scope for extensive practice of horticulture and grab the economic opportunities in this sector. Thus, horticulture cultivation assumes importance not only from the economic point of view but also for preserving environment and in achieving sustainable development.

Arunachal Pradesh has dense natural resources, be it a forest, water, or other resources. Available resources are still not harnessed at its best and have high potential for development through the proper utilization of these resources. Development without considering the natural environment is very susceptible from the sustainable point of view. In Arunachal Pradesh, shifting cultivation is practiced and the burden on this type of cultivation is also increasing with increasing population. In fact, the gap between one shifting cycle and the fallow cycle has also been shortened (Government of Arunachal Pradesh, 2004). Moreover, the practice of shifting cultivation is environmentally harmful. Under such circumstances, the practice of horticulture is one of the good options for the State to improve the socio-economic condition of the people as well as to improve the economic health of the State and to maintain the ecological balance (Gopalakrishnana, 1991). It is being warned that staple food may face the production challenges (Mayes et al., 2012) and the cultivation of horticulture crops may further contribute to the food security. Furthermore, plantation of horticulture crops is important for the State as it is difficult to cultivate the permanent staple crops in hilly areas. In the Arunachal Pradesh, growth of population is more than the growth of food production which may cause food insecurity. According to Barah (2006), the North East Region produces five million tons of food grains and there is excess demand of 6.7 million tons. In addressing the problem of food product deficiency, horticulture sector can play a significant role and thereby contribute to the supply of food product within the region. This also enlarges the scope for development of horticulture in the region.

The practice of horticulture was in existence in Arunachal Pradesh since long back but basically for self consumption. As there is potential and suitable climate for the promotion and cultivation of various horticulture crops in Arunachal Pradesh, State government of Arunachal Pradesh has been promoting horticulture crops cultivation. Arunachal Pradesh is the second highest producer of fruits in the North Eastern Region after Assam (Gautam and Handa, 2012). The development of horticulture in the State is, to a great extent, because of the concern posed by age old shifting agriculture practice. The practice of horticulture is an alternative activity to reduce the burden of shifting cultivation. According to Gopalakrishnan (1991), the emphasis on

³ Ravichandra, N.G. (2018): "Horticultural Nematology", Springer India, ISBN 978-81-322-2962-9, DOI 10.1007/97881-322-1841-8, Springer New Delhi Heidelberg New York Dordrenched London.

eco balance agricultural practices have been promoted as other alternative practices and one among such practices are the development of horticulture and promotion of crops like coffee, tea, rubber etc.

According to Reddy et al., (2010), investment in horticulture crops, especially fruits are more remunerative than sericulture but in terms of investment, it needs higher amount of initial investment. The horticulture sector contributes to rural economy and innovation, and this provide sustainable wage and employment avenues. According to Gautam and Handa (2012), horticulture contributes about 30.4 per cent in agriculture and provides employment to about 19 per cent people of India. The authors in their study have further shown that the demand for horticulture crops, especially fruits was increasing at 3.34 per cent growth rate annually. Increase in the contribution of horticulture was mostly due to the expansion in the area under horticulture crops (Government of India, 2017). The contribution in growth is also because of the improvement in land productivity along with the area expansion (Singha et al., 2014). According to Singha et al. (2014), this high growth generates employment, enhances export, provides nutrition security and improves the economic status of people.

Presently many horticulture crops are cultivated in Arunachal Pradesh and its production is improving over the year but there are many challenges like poor transport and communication facilities, lack of adequate networking with consumers of other region etc. While, various horticulture crops are cultivated in Arunachal Pradesh and the sector has both advantages and disadvantages which can affect the extent and growth of the sector, it becomes important to see the extent and growth of the horticulture sector in Arunachal Pradesh in recent time. However, as there is no such study on the horticulture sector in Arunachal Pradesh in recent time, the present paper aims to see the growth of horticulture crops in Arunachal Pradesh and its contribution in the State economy. Further, an attempt has been made to carry out decomposition analysis to identify the major contributor to its output growth.

Data Source and Analytical Framework

The paper is based exclusively on secondary data. Secondary data for the country are collected from the website of Ministry of Agriculture, Department of Agriculture and Cooperation and National Horticulture Board, Ministry of Agriculture. For Arunachal Pradesh, secondary data are collected from Statistical Abstracts of Arunachal Pradesh, Department of Economics & Statistics, Government of Arunachal Pradesh. Data from various articles and reports available online have also been used in the study.

To ascertain the objective of the study, apart from calculating descriptive statistics, Compound Annual growth rate (CAGR) is calculated using MS excel as per the formula given below.

$$\text{CAGR} = (E_A/B_A)^{1/n} - 1$$

Where,

E_A = Ending Value

B_A = Beginning value

n = number of years

The growth trend of horticulture production can be decomposed into three effects, namely, yield effect, area effect and interaction effect as used by Afrin and Umesh (2021). Such decomposition helps in understanding the sources of growth of horticulture output. As per the decomposition model,

$P_0 = A_0 Y_0$ and $P_i = A_i Y_i$ where P, Y and A represent production, yield and area respectively of base year (0) and i^{th} year.

Now,

Therefore, $P_i = A_i Y_i$

Or $P_0 = (A_0 + Y_0 +$

Or $P_0 = A_0 Y_0 + A_0 + Y_0 +$

Or $A_0 + Y_0$ as $P_0 = A_0 Y_0$

Or $1 = + +$

Thus,

Changes in production = yield effect + area effect + interaction effect

In order to examine the variability in area, production and productivity of crops in the State, Coefficient of Variation (CV) was calculated by using formula $CV =$ as used by Kumar et al., (2019). Moreover, correlation of coefficient is also calculated to examine the degree of relationship between area and production of the State's horticulture crops.

Results and Discussion

Area under Horticulture

During the period 2010-11 to 2020-21, the area under fruit crops was highest in Arunachal Pradesh followed by spices, vegetables and other crops respectively while area under vegetables is the highest for the country (Table 1).

Table 1: Area under Horticulture*Area in '000 Ha*

Year	Fruits		Vegetables		Spices		Others		Total	
	AP	India	AP	India	AP	India	AP	India	AP	India
2010-11	72 (82.29)	6383 (29.25)	4.2 (4.80)	8495 (38.92)	10.1 (11.54)	2940 (13.47)	1.2 (1.37)	4007 (18.36)	87.5 (100)	21825 (100)
2011-12	85.1 (82.86)	6705 (28.85)	6.3 (6.13)	8989 (38.67)	10.1 (9.83)	3212 (13.82)	1.2 (1.17)	4337 (18.66)	102.7 (100)	23243 (100)
2012-13	86.9 (83.76)	6982 (29.47)	1.5 (1.45)	9205 (38.85)	10.2 (9.83)	3076 (12.98)	5.15 (4.96)	4431 (18.70)	103.75 (100)	23694 (100)
2013-14	89.09 (83.40)	7216 (29.82)	1.4 (1.31)	9396 (38.83)	10.17 (9.52)	3163 (13.07)	6.17 (5.77)	4423 (18.28)	106.83 (100)	24198 (100)
2014-15	90 (84.08)	6110 (26.10)	1.7 (1.59)	9542 (40.76)	10.17 (9.50)	3317 (14.17)	5.17 (4.83)	4442 (18.97)	107.04 (100)	23411 (100)
2015-16	66.21 (79.56)	6301 (25.75)	4 (4.81)	10106 (41.29)	11.44 (13.75)	3474 (14.2)	1.57 (1.89)	4592 (18.76)	83.22 (100)	24473 (100)
2016-17	48.71 (78.00)	6373 (25.65)	1.75 (2.80)	10238 (41.20)	11.44 (18.32)	3671 (14.77)	0.55 (0.88)	4568 (18.38)	62.45 (100)	24850 (100)
2017-18	48.13 (77.17)	6506 (25.58)	2.58 (4.14)	10259 (40.34)	11.4 (18.28)	3878 (15.25)	0.26 (0.42)	4788 (18.83)	62.37 (100)	25431 (100)
2018-19	48.14 (76.21)	6597.41 (25.63)	2.62 (4.15)	10072.91 (39.14)	12.1 (19.15)	4067.03 (15.80)	0.31 (0.49)	4999.36 (19.43)	63.17 (100)	25736.71 (100)
2019-20	48.14 (72.18)	6760.115 (25.61)	2.62 (3.93)	10239.71 (38.80)	15.62 (23.42)	4350.836 (16.49)	0.31 (0.46)	5041.67 (19.10)	66.69 (100)	26392.33 (100)
2020-21	48.14 (71.29)	6929.729 (25.22)	2.62 (3.88)	10859.42 (39.52)	13.86 (20.52)	4456.935 (16.22)	2.39 (4.31)	5230.016 (19.03)	67.53 (100)	27476.1 (100)
CAGR (%)	-3.59	0.075	-4.20	2.26	2.92	3.85	8.39	2.45	-2.33	2.12

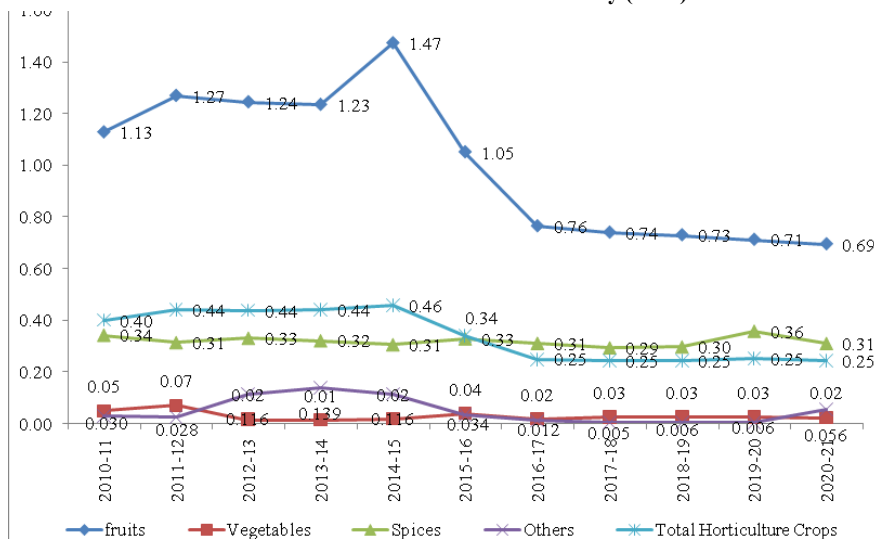
Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India(2022)

Figures in parenthesis are per cent value

Thus, the composition of horticulture crops in terms of area for Arunachal Pradesh is not same with that of the country as a whole. In the State, the area under horticulture crops has declined during 2010-11 to 2020-21 while it has increased for the country as a whole which is evident from the values of compounded annual growth rate (CAGR). Crop group-wise, during the study period it is found that for Arunachal Pradesh, CAGR of area under fruits and vegetables are negative while it is positive in case of spices and other crops. It reflects the compositional change in the basket of horticulture crops grown in the State. For the country as a whole, CAGR is positive for all the crops by their broad categories.

During 2010-11 to 2020-21, the State’s share of total cultivated area for horticulture crops in the country has gone down from 0.40 per cent to 0.25 per cent (Figure 1). Crop group-wise the percentage share of Arunachal Pradesh in total area of the country has declined in case of fruits, vegetables and spices. The State’s percentage share of area under fruits in the country’s area has declined from 1.13 per cent in 2010-2011 to 0.69 in 2020-21. During the same period, the percentage of area under spices in Arunachal Pradesh in total area under spices of the country decreased from 0.34 per cent to 0.31 per cent. In case of vegetables, the percentage share of the State has declined from 0.05 per cent to 0.02 per cent in the reference period. However, the percentage of area under ‘other crops’ of the State in total area under it of the country has increased from 0.03 per cent in 2010-11 to 0.06 per cent in 2020-21.

Figure 1: Share of Area under Horticulture of Arunachal Pradesh in the Total Horticulture cultivated Area of the country (in %)



Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

Production of Horticulture

Table-2: Total Production of Horticulture Crops

In 000 mt

Year	Fruits		Vegetables		Spices		Others		Total	
	AP	India	AP	India	AP	India	AP	India	AP	India
2010-11	107.9 (51.88)	74878 (31.22)	38.5 (18.51)	146554 (61.11)	61.6 (29.62)	5350 (2.23)	-	13643 (5.67)	208 (100)	239820 (100)
2011-12	308.9 (68.04)	76424 (29.77)	83.5 (18.39)	156325 (60.90)	61.6 (13.57)	5951 (2.32)	-	18577 (7.22)	454 (100)	256711 (100)
2012-13	312.2 (75.39)	81285 (30.34)	37.6 (9.08)	162187 (60.53)	64.3 (15.53)	5744 (2.14)	-	19632 (7.30)	414.1 (100)	267930 (100)
2013-14	321.26 (60.37)	88977 (31.40)	35 (6.58)	169897 (59.95)	64.24 (12.07)	5908 (2.08)	111.61 (20.97)	19493 (7.03)	532.11 (100)	283380 (100)
2014-15	331.4 (60.51)	86602 (30.94)	41 (7.49)	169478 (60.55)	64.27 (11.73)	6108 (2.18)	111.05 (20.27)	18718 (6.66)	547.72 (100)	279905.9 (100)
2015-16	306.27 (73.38)	90183 (31.63)	33.01 (7.91)	169064 (59.30)	68.72 (16.46)	6988 (2.45)	9.4 (2.25)	19864 (6.94)	417.39 (100)	285076.9 (100)
2016-17	124.38 (59.62)	92918 (30.09)	14.42 (6.91)	178172 (59.61)	68.72 (32.94)	8122 (2.72)	1.1 (0.53)	21336 (7.10)	208.62 (100)	298883.4 (100)
2017-18	125.7 (59.48)	97358 (31.41)	16.58 (7.85)	184394 (59.50)	68.7 (32.51)	8124 (2.62)	0.34 (0.16)	21733 (6.97)	211.24 (100)	309920 (100)
2018-19	125.84 (72.71)	97966.66 (31.57)	17.39 (10.05)	183169.6 (59.03)	29.47 (17.03)	9499.74 (3.06)	0.37 (0.16)	19649.75 (6.33)	173.07 (100)	310285.8 (100)
2019-20	125.84 (72.82)	102006.9 (31.96)	17.39 (10.06)	188132.1 (58.94)	29.21 (16.90)	10297.86 (3.23)	0.37 (0.21)	18736.12 (5.87)	172.81 (100)	319173 (100)
2020-21	125.84 (71.23)	102481.2 (30.72)	17.41 (9.86)	200445.2 (60.08)	21.49 (12.16)	11117.34 (3.33)	11.92 (0.21)	19605.88 (5.88)	176.66 (100)	333649.6 (100)
CAGR (%)	1.41	2.89	-6.96	2.89	-9.13	6.88	-24.39*	3.78	-1.47	3.05

Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

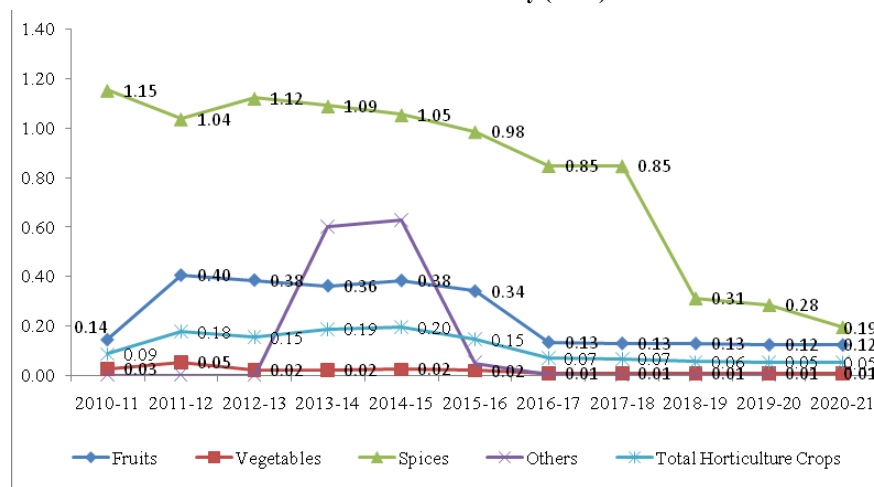
Note: *CAGR of other crops for A.P is calculated from 2013-14 to 2020-21 due to non availability of data from 2010-11*

Figures in parenthesis are per cent value

The pattern of production of horticulture crops in Arunachal Pradesh is similar with the area allocated to those crops. Table 2 shows that fruit crops constitute the highest among the horticultural crops produced in the State during the years 2010-11 to 2020-21. Spices production constitutes the second highest over these years, except for the year 2011-12, followed by vegetables except in 2013-14 and 2014-15. In India, vegetable production constitutes the highest during 2011-12 to 2020-21 followed by fruit crops (around 30 per cent during these years) as showed in Table 2. In the State, CAGR of horticultural production was -1.47 per cent for horticulture production depicting decline in production of such crops whereas it was positive for the country as a whole. Crop-wise, the CAGR of fruits production was positive but negative for vegetables and spices over the period from 2010-2011 to 2020-2021 in Arunachal Pradesh.

In area under horticulture crops, Arunachal Pradesh is experiencing a decline in the share of production of such crops in total production of the county. As per Figure 2, the share of total horticultural production of Arunachal Pradesh in the country’s horticulture production has declined slightly from 0.09 per cent in 2010-11 to 0.05 percent in 2020-21. Of course, the decline in the share of production of horticulture crops of Arunachal Pradesh in the country’s total production of such crops is due to both declines in State’s production as well as of increase of country’s production. It is interesting to note that the percentage of area under horticulture in Arunachal Pradesh to the total horticulture cultivated area in the country is more than that of production which shows the overall low productivity of the sector as compared to the country’s average.

Figure 2: Share of Horticultural Output of Arunachal Pradesh in the Horticulture Production of the country (in %)



Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

Productivity of Horticulture

Looking in to the productivity of horticulture crops in Arunachal Pradesh, it is found that except fruits, other types have experienced a decline in last few years. As per Table 3, the productivity of fruits has increased from 1.50 MT per hectare in 2010-11 to 2.61 MT per hectare in 2020-2021 with CAGR of 5.19 per cent. On the other hand, during 2010-11 to 2020-2021, the CAGR of productivity of vegetables and spices are found to be negative depicting a decline in their productivity. The productivity of vegetables and spices declined from 9.17 MT per hectare and 6.10 MT per hectare respectively in 2010-11 to 6.65 MT per hectare and 1.55 MT per hectare respectively in 2020-21. The productivity of other horticulture crops in Arunachal Pradesh declined from 18.10 MT per hectare in 2012-13 to 4.10 MT per hectare in 2020-2021 with CAGR of -16.94 per cent from the year 2012-13 to 2020-21. However, for the country as a whole, during 2010-11 to 2020-2021, there was improvement in the productivity of all types of horticulture crops. Further, as compared to country average, the productivity of fruits in Arunachal Pradesh was lower during 2010-11 to 2020-21 while it was reverse in case of spices except in 2019-20 and 2020-21.

Table 3: Productivity of Different Crops (MT/Hectare)

Area in 000ha, production in 000mt

Year	Fruit		Vegetables		Spices		Others	
	A.P	India	A.P	India	A.P	India	A.P	India
2010-11	1.50	11.73	9.17	17.25	6.10	1.82	-	3.25
2011-12	3.63	11.40	13.25	17.39	6.10	1.85	-	4.15
2012-13	3.59	11.64	25.07	17.62	6.30	1.87	-	4.22
2013-14	3.61	12.33	25.00	18.08	6.32	1.87	18.10	4.20
2014-15	3.68	14.17	24.12	17.76	6.32	1.84	21.48	3.99
2015-16	4.63	14.31	8.25	16.73	6.01	2.01	5.99	4.10
2016-17	2.55	14.58	8.24	17.40	6.01	2.21	2.00	4.31
2017-18	2.61	14.96	6.43	17.97	6.03	2.09	1.31	4.19
2018-19	2.61	14.85	6.64	18.18	2.44	2.34	1.19	3.93
2019-20	2.61	15.09	6.64	18.37	1.87	2.37	1.19	3.72
2020-21	2.61	14.79	6.65	18.46	1.55	2.49	4.10	3.75
CAGR (%)	5.19	2.13	-2.88	0.62	-11.71	2.91	-16.94*	1.30

Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

**CAGR of other crops for A.P is started from 2013-14 to 2020-21 due to non availability of data from 2010-11.*

In case of vegetables and other horticultural crops, Arunachal Pradesh has experienced higher productivity than the country in some years but not throughout the period of study. By 2021, as compared to the country average, Arunachal Pradesh has higher productivity in other crops but lower productivity in vegetables.

Contribution of Horticulture Sector in Gross State Value Added (GSVA)

Table 4 represents the percentage contribution of total output value of horticulture in the total value of primary sector at 2011-12 constant prices and current prices respectively. From the table it is seen that over the period of 2011-12 to 2014-15, the percentage contribution in the total primary sector output was around 30 to 33 per cent at constant prices. However, in the year 2015-16, its contribution declined to around 26 per cent. Similarly, in terms of current prices, the trend in contribution of horticulture in the primary sector were similar over the same period but declined to around 24 per cent in the year 2015-16 as shown in Table 4.

Table 4: Contribution of Horticulture in the Total Value of Primary Sector of the State at 2011-12 prices

Rs. In Lakhs

Year	Total Horticulture Value		Primary Sector Value	
	Constant	Current	Constant	Current
2011-12	151746 (31.71)	151746 (31.71)	478527 (100)	478527 (100)
2012-13	167235 (33.09)	191762 (33.04)	505409 (100)	580430 (100)
2013-14	170270 (32.21)	218646 (33.79)	528543 (100)	647114 (100)
2014-15	174032 (30.32)	234946 (30.69)	573926 (100)	765612 (100)
2015-16	142324 (25.85)	188345 (24.04)	550516 (100)	783550 (100)

Source: Government of Arunachal Pradesh (2019)

**Figures in bracket shows percentage to the total primary sector output*

The contribution of horticulture sector to the economy in terms of share in the GSVA of the State at 2011-12 prices was found to range from around 11 per cent to 15 per cent over the period of 2011-12 to 2015-16. Highest was during the year 2011-13 (14.97) and lowest was during the year 2015-16 (10.41) as depicted in Table 5. Similarly, the percentage contribution of horticulture sector at current prices, highest was in the year 2012-13 (15.46) and lowest in the year 2015-16 (10.49).

Table 5: Percentage Contribution of Horticulture in the total Value of GVA of the State at 2011-12 prices

(Rs. In Lakhs)

Year	Total Horticulture Value		Total GVA at basic price	
	Constant	Current	Constant	Current
2011-12	151746 (13.98)	151746 (13.98)	1085470 (100)	1085470 (100)
2012-13	167235 (14.97)	191762 (15.46)	1116835 (100)	1240357 (100)
2013-14	170270 (14.10)	218646 (15.31)	1207948 (100)	1427735 (100)
2014-15	174032 (12.41)	234946 (13.40)	1402885 (100)	1753815 (100)
2015-16	142324 (10.41)	188345 (10.49)	1366916 (100)	1795539 (100)

Source: Government of Arunachal Pradesh, 2019

*Figures in bracket shows percentage to the GVA

Table 6 shows the percentage contribution of State's horticulture output to the country's total horticulture output in terms of 2011-12 constant prices and current prices respectively. The table clearly shows that the State's contribution was less than one per cent over the period 2011-12 to 2015-16.

Table 6: Percentage Contribution of State's Horticulture Value in the Total Horticulture Value of India at 2011-12 prices

Rs. In Lakhs

Year	A.P.		India	
	Constant	Current	Constant	Current
2011-12	151746 (0.57)	151746 (0.57)	26622955 (100)	26622955 (100)
2012-13	167235 (0.53)	191762 (0.69)	31583752 (100)	27960119 (100)
2013-14	170270 (0.44)	218646 (0.75)	38802993 (100)	29319151 (100)
2014-15	174032 (0.39)	234946 (0.77)	45164889 (100)	30455140 (100)
2015-16	142324 (0.32)	188345 (0.60)	45169344 (100)	31209536 (100)

Source: Computed from 1. Government of Arunachal Pradesh-2019 2. Government of India (2018)

*Figures in bracket shows percentage of GVA to the GVA

Decomposition of Output Growth of Horticulture in Arunachal Pradesh

Table 7 presents the decomposition of output growth of horticulture crops in Arunachal Pradesh and India during 2010-2011 to 2020-2021⁴. In case of fruits in Arunachal Pradesh, yield effect is positive but area effect and interaction effect are negative. Yield effect is found to be major driving force of changes in production of fruits in the State. In case of vegetables in Arunachal Pradesh, both yield effect and area effect are positive

⁴ In case of other crops for Arunachal Pradesh due to non-availability of data, the time period considered for decomposition analysis is 2012-13 to 2020-21.

but interaction effect is negative and among them area effect is dominant. Regarding Spices in Arunachal Pradesh, yield effect and interaction effect are positive but area effect is negative. Yield effect has the greatest role in the production change of spices in the State. In case of other horticultural crops, yield effect and area effect are positive but interaction effect is negative and yield effect is more influential among them.

For the country as a whole all the three effects are found to be positive. Further, in case of fruits yield effect is dominant among the three effects while area effect is dominant for vegetables, spices and other crops in the country as whole.

Table 7: Decomposition of Horticulture Output Growth (2010-11 to 2020-21)

Crops	Yield effect (%)		Area effect (%)		Interaction effect (%)	
	A.P.	India	A.P.	India	A.P.	India
Fruits	447.66	70.71	-199.31	23.23	-148.35	6.06
Vegetables	50.22	19.02	68.67	75.69	-18.89	5.29
Spices	114.53	34.39	-57.17	47.86	42.64	17.75
Others*	86.61	30.19	59.14	60.59	-45.75	9.22

Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

The value of coefficient of variation (CV) has been calculated as a measure of instability in area, production and productivity of horticulture crops of Arunachal Pradesh. Table 8 shows that the value of CV of area, production and productivity of all horticultural crops are 23.27 per cent, 47.83 per cent and 28.80 per cent respectively. This shows that there are some amount of instability in area, production and productivity of horticulture crops in Arunachal Pradesh during the study period. The instability is found to be highest in production followed by productivity and area. Crop-wise, it is found that the value of CV of area, production and productivity of fruits are 28.25 per cent, 48.15 per cent and 27.82 per cent respectively. For vegetables, the value of CV of area, production and productivity are 51.83 per cent, 62.56 per cent and 62.94 per cent respectively. The value of CV of area, production and productivity of spices are 15.56 per cent, 33.42 per cent and 39.44 per cent respectively and 98.96 per cent, 197.39 per cent and 150.22 per cent respectively in case of others. Thus, it is found that there is instability in area under different horticulture crops and it is more in case of horticulture crops under the category 'others'.

Table 8: Coefficient of Variation over the period of 2010-11 to 2020-21

	Area	Production	Productivity
Fruit	28.25	48.15	27.82
Vegetables	51.83	62.56	62.94
Spices	15.56	33.42	39.44
Others	98.96	197.39	150.22
Arunachal Pradesh	23.27	47.83	28.80

Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

The correlation coefficient has been estimated to examine the relation between area under horticulture crops and production. It is found that there is a positive and statistically significant correlation between area under horticulture crops and its production for the State as a whole (Table 9). Crop-wise too we have found a positive and statistically significant correlation coefficient between area and production in case of fruits, vegetables and others. However, in case of spices, the coefficient of correlation between area and production is found to be negative and statistically significant at one per cent.

Table 9: Relationship between area and production of horticulture crops (2010-11 to 2020-21 period)

Crop	Coefficient of correlation	P (t<1) 2 tail, type 2
Fruits	0.8629***	0.0006
Vegetables	0.6743**	0.0229
Spices	-0.7899***	0.0038
Others	0.7692***	0.0057
A.P	0.9042***	0.0001

Source: Data for 2010-11 to 2012-13 are taken from Government of India (2013), for 2013-14 to 2017-18 taken from Government of India (2018) and for 2018-19 to 2020-21 taken from Ministry of Farmers Welfare Government of India (2022)

*Note: *** and ** represent significant at 1 per cent and 5 per cent respectively*

Conclusion

The paper made an attempt to assess the growth of horticulture crops in Arunachal Pradesh and its contribution to the State economy. It is found that during the study period, the growth of area, production and productivity of horticulture crops in the State was negative while it was positive for the country as whole. In Arunachal Pradesh, fruits are the major horticultural crops. Crop-wise, there is a positive growth of area under spices and horticultural crops under others category but negative growth for rest of the horticultural crops. Regarding production and productivity, growth rate is

positive for fruits and negative for all other horticultural crops in the State. Moreover, Arunachal Pradesh has been experiencing a decline in the percentage share to total of area and production of horticultural crops in the country as a whole during 2010-11 to 2020-21. Despite the negative growth in area, production and productivity of horticultural sector, this sector is found to have a significant contribution to State economy in terms of value addition. Decomposition analysis depicts that except in case of vegetables, yield effect is the major driving force of production change in horticultural crops. In case of vegetable, area effect is the prime contributor to its production change. Our study also reveals the instability in area, production and productivity of horticultural crops.

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