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Growth Trend and Prospects of Horticulture Crops Among the Border Districts of Arunachal Pradesh

Mr. Alipso Pul

Ph.D Scholar, Rajiv Gandhi University

Abstract

Arunachal Pradesh being situated on the easternmost part of the country shares three important international borders with China on the north and northeast, Myanmar on the East and southeast and, Bhutan on the west, making the state a strategically important for the country from the security perspective. Considering the crucial role being played by the civilians living along the border area working as eye and ear to the military personnel deployed there, the government made consistent efforts to prevent the out migration taking place to towns/cities from border villages in search of better opportunities and facilities by launching programs like Vibrant villages and Border area development. Thus, the present paper attempt to study the prospect of horticulture crops in border district in securing sustainable livelihood to local inhabitants. For these purpose, the growth trends of major horticulture crops in border districts were analysed. Moreover, the growth trend and instability of overall horticulture crops in these districts were also analysed. Study reveals that districts have great potential to grow wide varieties of temperate and sub-tropical horticulture crops due to due favoring physiographic and climatic conditions. However, analysis showed that all districts witnessed substantial decline in majority of horticulture crops they produced. The overall horticulture crops performance was also found to be concerning among the districts. The instability was also found to be very high for all the districts. The findings highlight the need for appropriate policy intervention to make the sector remunerative and boosting income for local farmers of border districts.

Keyword: Horticulture crops, Instability, Climatic Conditions, Sustainable livelihood, Border District, Temperate crops, Local Inhabitants.

Introduction

Arunachal Pradesh being situated on the easternmost part of the country shares three important international borders with China on the north and northeast, Myanmar on the East and southeast and, Bhutan on the west, making the state a strategically important for the country from the security perspective. Considering its strategic location, in recent years, government of India gave much emphasis on the three aspects of the development in the border area; strengthening the infrastructure development to secure national security, enhancing livelihood security of the local inhabitant of the border villages and prevent the out migration taking place. As such, under vibrant villages program, the border villages are being developed into modern village equipped with all basic facilities and amenities. The livelihood of the locals is also secured through providing mechanism creating sustainable income to prevent the out

migration taking place from border villages to towns/cities in search of better facilities and opportunities. In fact, the civilians in the border area act as eye and ears to the security personal by providing sensitive information of suspicious activities taking along the border to them. Thus, they play crucial role in safeguarding the borders of the country.

In this regard, considering the favoring agro-climatic condition for the cultivation of wide varieties of horticulture crops in the state, promotion of appropriate horticulture crop taking into account the physiographic and climatic condition of the respective bordering districts would be cornerstone in the strive to securing livelihood stability of the local inhabitants living in these area. Even more fascinating are most of the border districts falls on the northern side falling under temperate, making the districts conducive for growing high value temperate crops Kiwi, Apple, Walnut, Pears, Plum, Chestnut, and Persimmon (Agami). In addition, some district can also grows subtropical crops such Orange, Large Cardamom, Ginger and Pineapple on their lower part with mid temperate region. On demand side as well, these crops has high demand across the state and even outside the state, showing great potential of these district in cultivation of wide range of horticulture crops providing sustainable livelihood to the local inhabitants of border area. However, it has been found that Arunachal Pradesh witnessed considerable decline in the cultivation of horticulture crops in the state during the last decade (Yami and Anup, 2022, Wangphek and Pul, 2025, Mishra al et. 2020). The available data also indicates the declining trend of horticulture sectors in the state (Statistical Abstract of Arunachal Pradesh).Taking these into account, present paper attempt to explore the prospect of horticulture crops in the border districts of Arunachal Pradesh. For these purpose, the growth trend of major horticulture crops of the respective border districts were analysed. Further, paper also analyses the growth trend and instability of overall horticulture crops in these districts and compares with the state as a whole.

Materials and Methods

Thought there are 16 districts in Arunachal Pradesh out of total 28 districts that shares international border stretching over 1680 kms, 6 districts were selected on the basis of length share with international border. These districts; Anjaw, Changlang, Dibang Valley,Upper Siang , Upper Subansiri and Tawang extensively share international border with China, Bhutan and Myanmar. The data of horticulture crops for the districts were collected from the secondary sources including directorate of horticultural department (Government Arunachal Pradesh), Statistical abstract of Arunachal Pradesh and other published articles. However, there is gap of two periods particularly 2016-17 and 2017-18 in the table subjected to non availability of data with the department.

To analyse the growth trend in area, production and yield of the cops, the CAGR was calculated by using the exponential growth function.

$$Y = ab^t$$

$$\text{Log}Y = \text{Log } a + t \text{ Log } b$$

$$\text{CAGR} = (\text{Antilog of } b - 1) \times 100$$

Where,

Y = area or production or yield

a = constant

b = regression coefficient

t = time variable

To analyse the instability in area, production and productivity of the horticulture crops among the border districts, the coefficient of variations were calculated using given formulae

CV (%) = $\frac{\sigma}{\bar{x}} \times 100$

Where,

CV= coefficient of variation

$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x-\bar{x})^2}{n-1}}$

$\bar{X}$= Mean (Average) of the data (Area, production and productivity) of n years

In addition, other mathematical operations and statistical tools such as percentage, graphs and tables were also used for comparative analysis.

Results and Discussions

The analysis reveals that the borders district in the Arunachal Pradesh witnessed considerable decline the production of majority of horticulture crops they produced during 2015-16 to 2023-24. The overall horticulture crops performance in these districts showed decreasing trends. The instability in area, production and productivity of horticulture crops was found to be high to very high. The details are explained below with the help of tables and figures.

Table 1: Area and production of major horticulture crops in border districts of Arunachal Pradesh during 2015-16 to 2023-24

districts	Crops Name	2015-16		2023-24		CAGR A (%)	CAGR (%)
		A	P	A	P		
Anjaw	Orange	370	1700	455	1100	2.6	-5.3
	kiwi	32	5	66.5	10.85	9.6	10.2
	Apple	15	0.1	0.45	0.001	-35.5	-43.8
	Pineapple	3	4	4	1.85	3.7	-9.2
	Ginger	5.4	6.3	6.05	45.08	1.4	27.9
	L/Cardamom	2325	640	107.5	55.5	-31.9	-26.3
Upper siang	Orange	630	2800	547	450	-1.8	-20.4
	kiwi	55	15	25	11.8	-9.4	-3
	Banana	191	682	119	500	-5.7	-3.8
	Pineapple	390	971	228	15	-6.5	-40.6
	Ginger	100	100	49	26	-8.5	-15.5
	L/Cardamom	204	15	194	50	-0.6	16.2
	Turmeric	200	3000	0	0	-100	-100
Upper Subansiri	Orange	2110	3250	3178.42	265	5.3	-26.9
	kiwi	5	0.45	19.31	2.52	18.4	24
	Banana	75	330	342	279.4	20.9	-2.1
	Pineapple	730	320	243	142.6	-12.8	-9.6

	Guava	66.05	84.31	66.1	84.43	0	0
	Pears	48.62	2.52	48.64	44.52	0	43.2
	L/Cardamom	159.31	26.77	298	0.21	8.1	-45.4
	Ginger	170.21	253.85	180.4	264	0.7	0.5
Dibang Valley	Orange	275	530	176.23	75.02	-5.4	-21.7
	kiwi	1160	90	166.88	28.92	-21.5	-13.2
	Apple	957	13.6	20	2	-38.3	-21.3
	Banana	10	80	6.92	11.14	-4.5	-21.8
	Pineapple	40	120	0	0	-100	-100
	Guava	1.2	3.1	5.8	5.28	21.8	6.9
	Walnut	600	18	0	0	-100	-100
	Pears	40	10.5	35.82	11.65	-1.4	1.3
	L/Cardamom	32	5	30.02	30.02	-0.8	25.1
	Ginger	6.5	8	9.6	12.98	5	6.2
Changlang	Orange	334	1950	301	1926	-1.3	-0.2
	Banana	165	1000	129	417	-3	-10.4
	Pineapple	180	2700	98	2552	-7.3	-0.7
	Guava	14.25	50	15	46.51	0.6	-0.9
	L/Cardamom	730	65	965	297	3.6	20.9
	Ginger	3.5	3.5	253	1787.2	70.8	118
Tawang	Orange	50	330	15	7	-14	-38.2
	kiwi	52	500	860	22	42	-32.3
	Apple	110	600	0	0	-100	-100
	Guava	10	16	13	12	3.3	-3.5
	Walnut	18	40	19.1	8	0.7	-18.2

Source: Directorate of horticulture department, AP

Table 1 depicts that Anjaw district showed great potential for producing high value horticulture crops including Orange, Kiwi, Large Cardamom, Apple, Pineapple and Ginger. However, district witnessed considerable decline both in area and production of apple and Large Cardamom. Kiwi is the only growth that showed prominent increasing trend both in area and production during study period.

In the Upper Siang district as well, crops including Orange, Kiwi, Large Cardamom, Apple, Pineapple, Ginger and turmeric are extensively grown. However, over the study period, all these crops showed decreasing trend except Large Cardamom which showed positive growth in production despite decline in area slightly. The decline is severe in the crops such as Turmeric, Pineapple and Orange.

In Upper Subansiri District, the crops widely produced are Orange, Kiwi, Large Cardamom, Pineapple, Ginger, Banana, Guava and Pears. Out of these crops, Kiwi and Pears have shown robust growth trend during study period. In contrary, crops such as Orange, Pineapple and Large Cardamom have shown substantial decline.

Dibang Valley showed potential to grow crops are; Orange, Kiwi, Large Cardamom, Pineapple, Ginger, Banana, Guava, Pears and Walnut. However, all these crops showed substantial decline during the study

period except Guava and Ginger. Even more worse is that Walnut and Pineapple fell to zero both in area and production.

Changlang is showed conducive for the production of sub-tropical horticulture crops such as Orange, Pineapple, Guava, Large Cardamom and Ginger. Out of these crops, Large Cardamom and Ginger only have showed strong positive growth with ginger CAGR surpass even 100 percent in production.

In Tawang, five horticulture crops are majorly produced which are; Orange, Kiwi, Apple, Guava and Walnut. Same as in the case of other districts, Tawang also experienced significant decline in the production of these crops with apple being fell to zero both in area and production during study period.

Table 2: Growth trend in area of horticulture crops among border districts of Arunachal Pradesh during 2015-16 to 2023-24 (Area in Hectare)

Year	Anjaw	Changlang	Dibang Valley	Tawang	Upper Siang	Upper Subansiri	Arunachal Pradesh
2015-16	2761.5	2460.75	3201.1	694.5	1422.9	3992.81	83230
2018-19	2786	2247	3028.75	310	1774.12	4018.02	63160
2019-20	2374.38	1877.05	2824.49	252.25	1583	3993.23	66680
2020-21	2598.95	1947.75	2836.18	52.2	1583	4603.25	67530
2021-22	2594.85	2143	2273.1	379.36	1553	4504.11	46880
2022-23	646.85	1861	1435.24	1044	1183	4573.57	45050
2023-24	669.55	2203.22	451.26	1318.25	1162	4404.65	42570
CAGR	-16.23	-1.37	-21.72	8.34	-2.50	1.23	-8.04

Source: Directorate of horticulture department, AP

Table 2 depicts that Dibang Valley witnessed highest declining trend in area under horticulture crops during 2015-16 to 2023-24 with the negative CAGR value of 21.72 percent, followed by Anjaw (-16.23 percent), Upper Subansiri(-2.50 percent) and Changlang (-1.37 percent). In contrast, only Tawang showed positive growth trend with GAGR of 8.35 Percent. The steep decline in area under horticulture crops in Dibbang Valley can be attributed to the complete abundant of crops including Walnut and Pineapple. Apart from these, the crop including Kiwi, Apple, Banana and Orange also witnessed considerable decline. State as a whole also experienced declining trend with -8.04 percent, which is in confirmation with previous studies (Melo & Das 22, Rangpang and Pul, 2025). In case of Anjaw, decline is majorly caused by sharp fall in the cultivation of Large Cardamom.

Table 3: Growth trend in Production of horticulture crops among border districts of Arunachal Pradesh (Production in Tonne)

Year	Anjaw	Changlang	Dibang Valley	Tawang	Upper Siang	Upper Subansiri	Arunachal Pradesh
2015-16	2405.84	1464.17	1639.75	7486	11144	516.71	417410
2018-19	703.1	1259.94	1242.25	1837	6898.5	868.3	173170
2019-20	4886.39	4648.18	419.78	29.27	3525	993.88	172940
2020-21	4868	4548.18	456.28	29.35	3516	1051.11	17680
2021-22	4868.59	4967	267.7	54	2518.89	983.58	181520

2022-23	128.61	9629	249.21	169	2458.9	983.38	177540
2023-24	249.11	11549	177.43	296.5	1052.8	1083.98	198130
CAGR	-24.68	29.46	-24.27	-33.21	-25.54	9.70	-8.89

Source: Directorate of horticulture department, AP

Table depicts 3 that as in the case of area, in the production as well the majority of districts witnessed substantial decline during study period except Changlang and Upper Subansiri. Among them, Tawang witnessed the steepest decline in production with negative CAGR of 33.21 percent which is exact contrary to area. Anjaw, Dibang and Upper also showed much higher decline in production than area showing worsening productivity. On the other hand, Changlang with a slight fall in area showed significant increase in production with the CAGR of 29.46 percent during 2015-6 to 2023-24. Upper Subansiri also showed growth in production is far ahead than area showing improvement in productivity of horticulture crops in these two districts among the selected districts. At level, as in the case of area, Arunachal Pradesh underwent declining growth trend with negative CAGR of 8.89 percent during same period.

Table showed the growth trend in productivity of horticulture crops among the border districts during 2015-16 to 2023-24.

Table 4: Growth Trend in productivity of Horticulture crops among border districts of Arunachal Pradesh (Productivity in Tonne/Hectare)

Year	Anjaw	Changlang	Dibang Valley	Tawang	Upper Siang	Upper Subansiri	Arunachal Pradesh
2015-16	0.871208	0.59501	0.512246	10.77898	7.831893	0.12941	5.015139
2018-19	0.252369	0.560721	0.410153	5.925806	3.888407	0.216101	2.741767
2019-20	2.057965	2.476322	0.148622	0.116036	2.226785	0.248891	2.593581
2020-21	1.873064	2.335094	0.160878	0.562261	2.221099	0.228341	2.618096
2021-22	1.876251	2.317779	0.117769	0.142345	1.621951	0.218374	3.872014
2022-23	0.198825	5.1741	0.173636	0.161877	2.078529	0.215014	3.940954
2023-24	0.372056	5.241873	0.393188	0.224919	0.906024	0.246099	4.654217
CAGR	-10.09	31.26	-3.25	-38.35	-23.63	8.37	-0.93

Source: Directorate of horticulture department, AP

Table 4 depicts that Changlang and Upper Subansiri significant improvement in the productivity of horticulture crops durimg 2015-16 2023-24. In contrast, Tawang witnessed sharp decline in productivity with negative CAGR of 38.35 percent, followed by Upper Siang, Anjaw and Dibang Valley. The state as whole also showed slight decline in productivity with negative CAGR of 0.93 percent.

Table 5 depicts the coefficient variation values of area, production and productivity of horticulture crops among border districts during 2015-16 to 2023-24

Table 5: Instability of Horticulture crops among border districts of Arunachal Pradesh

District	Area	Production	Productivity
Anjaw	46.96	87.56	78.30

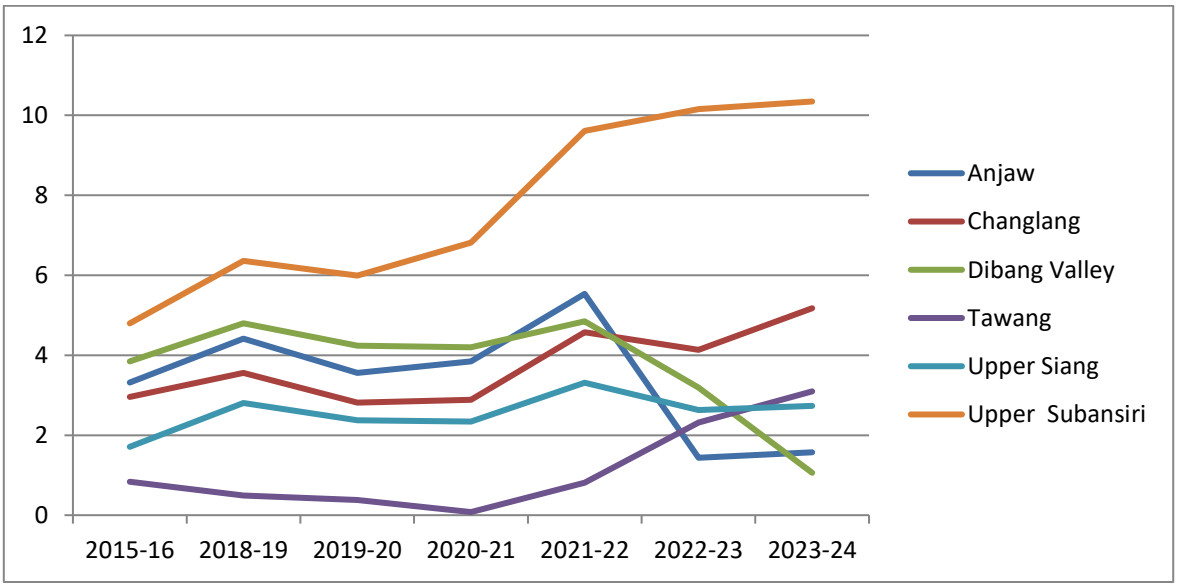
Changlang	10.51	71.14	71.53
Dibang Valley	43.87	89.62	58.23
Tawang	79.59	194.76	164.17
Upper Siang	15.36	77.81	78.38
Upper Subansiri	6.63	20.81	18.67
Arunachal Pradesh	25.27	42.13	27.54

Sources; Authors Calculation from data of Directorate of horticulture department, AP

Tables 5 shows all districts witnessed high instable in area, production and productivity of horticulture crops among all districts except upper Subansiri which instability was found to be somehow low comparatively. In Tawang, coefficient value in production and Productivity even crossed 150 percent, showing extremely high instability. The state as whole also showed moderate to high instability in all three parameters, indicating lack of protective measure against fragile climatic condition of the states, unstable price of the crops and outdated farming technique.

Figure 1 depicts the trend in the percentage share of border districts to total area under horticulture crops during 2015-16 to 2023-24. It can be noticed from the figure that share of upper Subansiri district is highest with increasing trend throughout the study period. Changlang, Upper Siang and Tawang also showed increasing trend in their percentage share to total area under horticulture crops in the state with some variation during specific period. On Contrary, Dibang valley showed steepest decline in percentage share during the study period along with Anjaw.

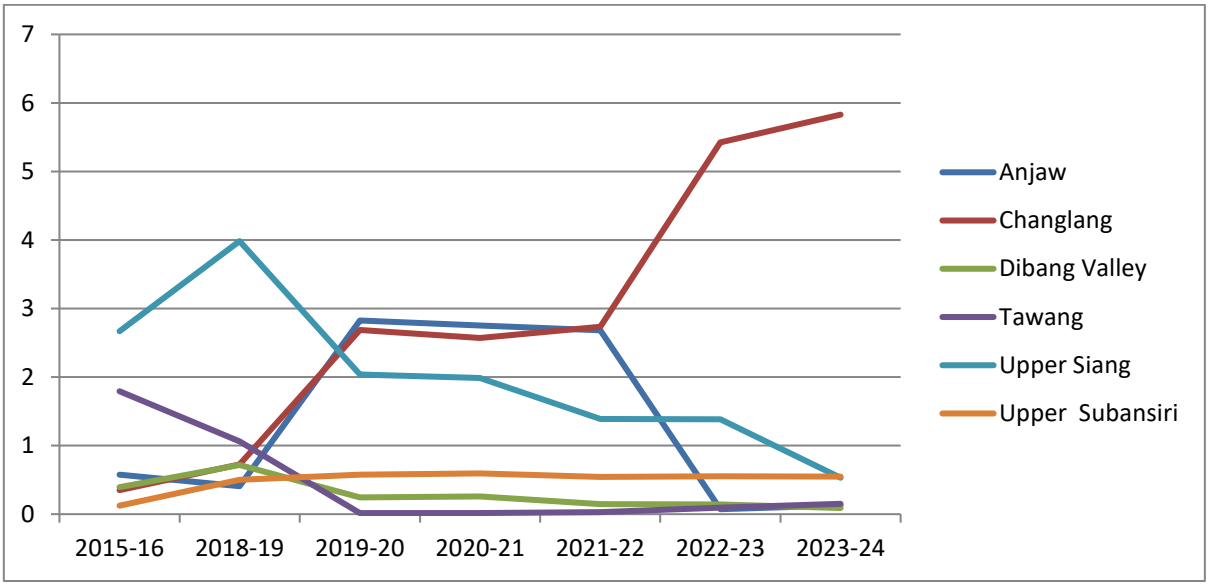
Figure 1: Trend in the percentage share of border districts to total area under horticulture crops during 2015-16 to 2023-24



Source: Directorate of horticulture department, AP

Figure 2 depicts the trend in percentage share of border districts in production of horticulture crops during 2015-16 to 2023-24

Figure 2: Trend in the percentage share of border districts to total production of horticulture crops during 2015-16 to 2023-24



Source: Directorate of horticulture department, AP

Figure 2 shows that unlike in share of area wherein Upper Subansiri percentage share was found to be highest, the share of Upper Siang was found to be highest during 2015-16 but its share decrease consistently during study period while the percentage share of Changlang increase consistently during same period surpassing the Upper Siang and became district with highest percentage share to total production of horticulture crops in Arunachal Pradesh since 2021-22 among the districts. Tawang and Anjaw also witnessed considerable decline in their shares. The share of Subansiri remains to be consistent with slight increase during the study period.

Conclusion

Paper attempted to analyse the prospects of horticulture crops in providing sustainable livelihood to the local inhabitants of border districts in Arunachal Pradesh in the light of government's consistent effort to provide secured livelihood and better facilities with the aims to prevent the out migration taking place from there to towns/cities in search of better opportunities and facilities. Study found that border districts in the state has great potential to produce wide varieties of high value horticulture crops including Kiwi, Apple, Walnut, Orange, Large Cardamom, Pineapple Ginger etc. However, the growth trend in area and production of major horticulture crops among the districts is concerning one. Almost all district witnessed decreasing trends in production of majority of crops they produced during the study period. In addition, the overall horticulture crops in these district is also showing decreasing trend. The instability in area and production of horticulture crops is also high to very high among the districts. The factors including tough terrain, fragile climatic condition, poor market access and infrastructure, lack of connectivity and lack of awareness can be attributed to decline and high instability. Thus paper call for targeted, crop specific and area specific policy intervention designed to tackle the issues of different crops in the respective districts taking the physiographic and climatic condition into consideration. In addition, the extension services also need to be strengthening to educate the ignorant farmers about the modern techniques of cultivation and farm management, and marketing facilities and channels are to be

improved.

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