

	ORIGINAL RESEARCH PAPER		Agriculture
TRENDS & PROSPECTS: HORTICULTURE CROPS IN PATKAI HILLS DISTRICTS OF ARUNACHAL PRADESH		KEY WORDS: Horticulture, Perennial, Tirap, Changlang, Longding.	
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ABSTRACT	Horticulture is in its broader sense includes the cultivation of fruits, spices, flowers, honey, vegetables, and aromatic & herbal plants. Horticulture, as an emerging and rapidly expanding sector in Arunachal Pradesh has a significant economic implications for its economic development. Arunachal Pradesh has majority of its population primarily engaged in agriculture and allied activities which form the state economy as predominantly agrarian. However, the state has huge potential for growth of horticulture sector. This sector can provide a sustainable and perennial source of income if cultivation is promoted on scientific and commercial tones. Thus, this paper is an attempt to analyse the trends and prospects of horticulture sector in Arunachal Pradesh, particularly in the three Patkai Hills districts: Tirap, Changlang, & Longding. It also compares the growth patterns of these districts with that of the state as a whole. The study reveals that the major horticulture crops being produced in the region are orange, banana, pineapple, large cardamom and ginger. The study also shows that the state as a whole, as well as all three districts, underwent a declining trend in both area and production of horticulture crops during study period, with Changlang being experiencing the lowest fall. Productivity was found to be highest in the Changlang district, even surpassing the state productivity. Changlang also accounted for the highest share of the total area and production of horticulture crops in the state.		
1. INTRODUCTION			
In Arunachal Pradesh, Jhum cultivation is the predominant practice wherein rice is the dominant crop. The total cultivated area is less than 2% of the geographical area of 83,743 sq. km., characterized by per-humid ecosystem (ICAR). According to the India State of Forest Report (ISFR) 2023, Arunachal Pradesh comes under top three states having largest forest cover of 65,882 sq. km. It is preceded by the state of Madhya Pradesh (77,073 sq. km.) and followed by Chhattisgarh (55,812 sq. km.). As such, the larger proportions of the population are engaged in agriculture and allied sector, thus, this reflects that its economy is an agro-based economy. Here, majority of the population practice jhum or shifting cultivation, however, this pattern of cultivation has significantly acted as constraint to the share of agricultural productivity. Whereas, it has the second lowest NSDP at constant prices (2011-12) of Rs. 17,433 cr. in the FY 2023-24 (MoSPI), followed by the union territory of Andaman & Nicobar Islands (Rs. 7,147 cr.). To boost the economy of the state, embracing horticultural activities can be a sustainable and resilient source of income, particularly by adopting crops varieties suited to agro-climatic conditions. Horticulture sector is a branch of agriculture that engaged in the cultivation of fruits, plantation crops, spices crops, flowers, medicine & aromatic plants, vegetables, along with related activities like nursery management. It not only generates income to the economy, but also improves the standard of living of the farmers' community by providing them a surplus. This sector creates employment opportunities, acts as a catalyst for the agro-based packaging, manufacturing and processing industries. It offers a viable opportunity for high income generation compared to other agricultural sectors. As mentioned earlier, shifting cultivation is a constraint in the agriculture production. However, it has traditional and cultural values embedded with the people of Arunachal Pradesh. Traditionally, multi-cropping is practiced without the use of chemical fertilizers and pesticides, and other modern inputs, primarily for self-sustenance. As a result, the produce from cultivation is healthy for consumption. However, this practice of jhum cultivation has resulted on low productivity of agriculture produce. Consequently, the state is increasingly dependent on other states for food security. Moreover, modernisation with advancing techniques of production has undoubtedly increased the productivity. However it has			
adversely diluted the agriculture produce with much utilization of chemical fertilizers and pesticides, which in further course of time will make it unhealthy for consumption, unsustainable and less productive. Therefore, in the context of Arunachal Pradesh also, it is pertinent to critically question agrifood systems that are unsustainable neither in terms of food security nor in terms of nutritional security. "Agrifood systems cover the journey of food from farm to table – including when it is grown, fished, harvested, processed, packaged, transported, distributed, traded, bought, prepared, eaten and disposed of. They also encompass non-food products that constitute livelihoods and all of the people, activities, investments and choices that play a part in getting these food and agricultural products (FAO 2024)". "Uncovering the true cost of food is the first step in making agrifood systems more inclusive, resilient and sustainable. Agrifood systems generate significant benefits to society, including the food that nourishes us and jobs and livelihoods for over a billion people. However, their negative impacts due to unsustainable business-as-usual activities and practices are contributing to climate change, natural resource degradation and the unaffordability of healthy diets (FAO 2023)". According to FAO- the state of food and agriculture 2024 report, there is hidden costs of agrifood systems contributing the amount to 11.6 trillion at 2020 PPP dollars for 156 countries globally, of which 8.1 trillion 2020 PPP dollars i.e. 70% of global hidden costs arise from the consumption of unhealthy food items. Consequently, global populations are acquiring life threatening non-communicable diseases (NCDs) such as heart disease, stroke and diabetes, etc.			
Horticulture crops as a nutrient rich food items particularly the fruit crops can help in reducing the health hidden costs. Also, to a certain degree, it contributes to mitigating the risks associated with NCDs along with in achieving the targets of SDG 2 and SDG 3. As this sector is highly remunerative and, also considering health benefits, the Government of Arunachal Pradesh has have launch many initiatives to enhance the state's horticulture sector. AP Horticulture Policy 2025-35 is one such policy seeks to maximise and capitalize on the huge growth potential linked with this sector. It includes initiatives like Arunachal Kiwi Mission, Arunachal Spice Mission, and the Arunachal Medicinal & Aromatic Plants Mission. Horticulture activities promote crops diversification, which could become an engine of higher productivity for agriculture sector as a whole. The policy is meant to encourage to use modern techniques, and to embrace high			
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yielding seeds, benefited by the crop diversification. In addition, this policy also aims to incorporate young minds of the state to take up new ventures like contract farming and agri-startup, etc.

Arunachal Pradesh has massive opportunity by shifting its focus towards horticulture crops. It not only fetches a huge surplus to the economy, as it can also generate the possibilities of employment, thereby contributing to socio-economic enhancement. For example, Arunachal Pradesh is the largest producer of kiwi fruit producing 4,492.9 MT in the year 2022-23 (Statistical Abstract of Arunachal Pradesh 2023), and it has a bright future prospects. Likewise, oranges from Anjaw district has exquisite flavour and nutritional benefits rich in vitamin C are high on demand both from local consumers and tourists. In the year 2022-23, the production of orange in the state was 62,633.43 MT, cultivated in an area of 15,971.62 hectare. Representing a substantial boost to the state economy, oranges (khasi-mandarin species) from Dambuk in Lower Dibang Valley district were started to export with first consignment exported to Dubai in 2018. Other major horticulture crops produce are pineapple, banana, apple, pears, guava, grapes, areca nut, large cardamom, ginger, turmeric, flowers, and medicinal & aromatic plants, etc.

Floriculture is another area where the state has bright future prospects. It is a specialized branch of horticulture that immerse into the cultivation and management of flowers and ornamental plants. Arunachal Pradesh is known for its remarkable variety of orchid's species, due to which it has got the title 'Orchid State of India'. With as many as 610 species of orchids found in Arunachal, the state holds significant potential to economise this sector. According to Statistical Abstract of Arunachal Pradesh 2023, cultivated area of flowers was 20 hectare with a total production of 165 MT in the year 2022-23.

2. Materials and Analytical Tools

Three Patkai Hills districts of Arunachal Pradesh - Tirap, Changlang, and Longding - were selected as study area. These districts were previously under the Tirap administration prior to 14th November 1987, when Changlang was formally bifurcated under the Arunachal Pradesh Reorganisation of Districts Amendment Act 1987, by the Government of Arunachal Pradesh. Longding district was later carved out from Tirap district on 19th March 2012. The topography of these districts is different from the rest of the state. Situated in the Himalayan foothills, they have high altitude and rugged mountainous terrain. The Patkai Hills region is neither as elevated nor as rugged as the Himalayan Mountains; consequently, the climatic conditions of the two regions are not similar, making the regions suitable for different crops in their respective areas. Data on the horticulture crops of these districts were collected from secondary sources such as Directorate of Horticulture, Arunachal Pradesh, online news articles and other published journals. To analyze the data, compounded annual growth rate (CAGR) was calculated using the following formula in Excel:

$$CAGR = (B2/A2)^{(1/n)} - 1$$

Where,

CAGR = Compounded Annual Growth Rate

B2 = Beginning Value

A2 = Ending Value

n = Number of Years

3. RESULT AND DISCUSSION

3.1 Growth Trend in Area Under Cultivation and Production of Different Horticulture Crops in Tirap District

Table 1 depicts the growth trend of area under cultivation of different horticulture crops in Tirap district of Arunachal Pradesh during 2015-16 to 2023-24.

From above table 1, it has found that the majority of crops underwent declining trend during 2015-16 to 2023-24 in the

district. Amongst the crops, pineapple experienced highest fall followed by orange, banana and guava. On the other hand, only two crops: ginger and large cardamom, out of studied crops, showed increasing growth trend during same period. The district as a whole also experienced decreasing growth trend with negative CAGR of 10.98 percent during study period.

Table 1: Growth Trend in Area Under Cultivation of Major Horticulture Crops in Tirap District During 2015-16 to 2023-24 (Area in Hectare)

Crops	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR
Orange	1100	185	250	-	120	120	190	-19.71
Pineapple	875	72	60	76	70	80	80	-25.85
Banana	530	104	110	110	80	110	120	-16.95
Pears	13	12	10	10	8	10	10	-3.23
Guava	-	-	5	-	5	5	5	
Kiwi	2	-	4	2	-	4	4	9.05
L/Cardamom	-	310	354	352	355	300	360	3.04
Ginger	0	6	10	6	0	8	35	42.29
Turmeric			8	5		5	6	
Total	2520	779	758	630	657	750	994	-10.98

Source: Directorate of Horticultural Department, Arunachal Pradesh

Table 2 depicts the growth trend in production of different horticulture crops in Tirap district during 2015-16 to 2023-24.

Table 2: Growth Trend in Production of Different Horticulture Crops in Tirap District During 2015-16 to 2023-24 (Production in Tonne)

Crops	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR
Orange	4800	145	250	-	70	70	130	-36.31
Pineapple	2630	135	30	136	100	100	100	-33.55
Banana	2400	198	198	198	50	150	100	-32.78
Pears	45	42	30	40	30	30	30	-4.94
Guava	-	-	0.5	-	3	0.5	0.5	0.00
Kiwi	0.4	-	0.2	5	-	0.2	3	28.64
L/Cardamom	-	138	250	138	149	110	190	6.60
Ginger	-	8	6	8	-	10	20	20.11
Turmeric	-	-	5	3	-	3	4	
Total	987	709	787	536	421	750	478	-8.66

Source: Directorate of Horticultural Department, Arunachal Pradesh

From Table 2, it has observed that orange underwent highest fall in production, with negative CAGR of 36.31 percent during 2015-16 to 2023-24, followed by pineapple, banana and pears. On the other hand, kiwi showed the highest increase, with CAGR of 28.64 percent, followed by ginger and large cardamom during the same period. The district as a whole also showed a fall in the production of horticulture crops, with negative CAGR of 8.66 percent.

3.2 Growth Trend in Area Under Cultivation and Production of Different Horticulture Crops in Changlang District

Table 3 shows the growth trend in area under cultivation of different horticulture crops in Changlang districts during 2015-16 to 2023-24.

Table 3: Growth Trend in Area Under Cultivation of Major Horticulture Crops in Changlang District During 2015-16 To 2023-24

Crop	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR
Orange	334	300	118.94	125.94	300	300	301	-1.29
Pineapple	180	73	135.98	140.98	93	93	98	-7.32
Banana	165	116	214.34	223.34	126	126	129	-3.03

Guava	14.25	14	14	14	14	14	15	0.64
L/Car-damom	730	886	1171.09	1204.09	996	966	965	3.55
Ginger	3.5	230	93.86	108	230	250	253	70.76
Turmeric	-	16	18.9	18.9	16	-		
Total	2460	2247	1877	1947	2143	1861	2203	-1.37

Source: Directorate of Horticultural Department, Arunachal Pradesh

From the table 3, it can be observed that pineapple showed the highest decline in area under cultivation in the district during 2015-16 to 2023-24, with negative CAGR of 7.32 percent, followed by banana and orange. On the other hand, ginger showed the highest increase in district, with CAGR of 70.76 percent during same period. The district as a whole also underwent declining trend with negative CAGR of 1.37 percent.

Table 4 depicts the Growth trend in production of major horticulture crops in Changlang district during 2015-16 to 2023-24.

Table 4: Growth Trend in Area Production of Different Horticulture Crops in Changlang District During 2015-16 To 2023-24

Crops	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR
Orange	1950	1802	1641.6	1641.6	1802	1926	1926	-0.16
Pineapple	2700	2463	764.54	764.54	2453	2548.02	2552	-0.7
Banana	1000	410	2906.48	2806.48	410	415.01	417	-10.36
Guava	50	45	45	45	45	46.51	46.51	-0.9
L/ Cardamom	65	180	315.38	315.38	298.23	299.85	297	20.92
Ginger	3.5	2400	327.29	327.29	22.6	1785.05	1787	118.03
Turmeric	-	25	28.35	28.35	23.5	-		
Total	1464.17	1255.94	4648.18	4548.18	4967.33	9629	1154.95	-2.92

Source: Directorate of Horticultural Department, Arunachal Pradesh

From table 4, it can be seen that majority of crops experienced declining trend in production during 2015-16 to 2023-24 in the district with banana being highest with negative CAGR of 10.36 percent followed by guava, pineapple and orange. On the other hand, only two crops ginger and large cardamom showed increase in growth of production in the district during same period. The overall horticulture crops were also found to be declining in the district during same period with negative CAGR of -2.92 percent.

3.3 Growth Trend in Area Under Cultivation and Production of Horticulture Crops in Longding District

Table 5 depicts the growth trend in area under cultivation of major horticulture crops in Longding distrct of Arunachal Pradesh during 2015-16 to 2023-24.

Table 5: Growth Trend in Area Under Cultivation of Horticulture Crops in Longding District During 2015-16 to 2023-24 (Hectare) and Production (MT) of Longding District

Crops	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR
Orange	655	19	0.5	48.2	49.6	44	47	-28.06
Pineapple	420	13	15.5	19.5	15.5	16	19	-32.09
Banana	165	74	32	26	26	25	19	-23.68

Guava	65	-	-	-	2	1	5	-27.43
L/ Cardamom	-	181	640	638	540	5540	40	-26.06
Total	2475	1192	689.83	1344.9	126	1857	823	-12.86

Source: Directorate of Horticultural Department, Arunachal Pradesh

Longding produces five horticulture crops predominantly which are: orange, pineapple, banana, guava and large cardamom. Out of these crops, all five crops underwent declining growth trend in area under cultivation in the district during 2015-16 to 2023-24, with the fall found to be highest for pineapple followed by orange, guava, large cardamom and banana. The district as a whole also experienced fall in the area under cultivation of horticulture crops during period of study.

The below table 6 depicts the production of major horticulture crops in the Longding district of Arunachal Pradesh during 2015-16 and 2023-23.

Table 6: Growth Trend in Production of Horticulture Crops in Longding District During 2015-16To 2023-24

Crops	2015-16	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	CAGR (%)
Orange	3200	24	1.2	236	212	201	209	-24.36
Pineapple	1320	60.3	1.94	22.3	18	41	54	-38.68
Banana	1980	82	135.5	97.6	37.8	112	118	-23.44
Guava	50	45	45	45		46.51	20	-10.82
L/ Cardamom		85	228.5	215.2	185.80	189	6.6	-24.87
Total	9970	1141.7	392.16	2408	2337	2485	2401	-16.3

Source: Directorate of Horticultural Department, Arunachal Pradesh

As in the case of production, Longding showed declining growth trend in the production of all five major horticulture crops in the district during 2015-16 to 2023-24, with fall in the pineapple being highest followed by large cardamom, orange, large cardamom, and guava. The district in entirety also experienced declining growth trend in production of the horticulture crops during period of study.

3.4 Growth Trend in Area and Production of Horticulture Crops in Tirap, Changlang, Longding (TCL) Districts and Arunachal Pradesh During 2015-16 to 2023-24

Table 7 shows the growth trend and variability of horticulture crops in Patkai Hills districts compared to state as a whole during 2015-16 to 2023-24.

Table 7: Growth Trend of Area Under Cultivation and Production of Horticulture Crops During TCL Districts and Arunachal Pradesh During 2015-16 to 2023-24

Year	Arunachal Pradesh		Tirap		Changlang		Longding	
	A	P	A	P	A	P	A	P
2015-16	83230	417400	2520	987	2460	14641.7	2475	9970
2018-19	63160	173100	779	709	2247	12559.4	1192	1141.7
2019-20	66680	172900	758	787	1877	4648.18	689.83	392.16
2020-21	67530	176800	630	536	1947	4548.18	1344.9	2408
2021-22	46880	181500	657	421	2143	4967.33	126	2337
2022-23	45050	177500	750	750	1861	9629	1857	2485
2023-24	42570	198100	994	478	2203	11549.5	823	2401

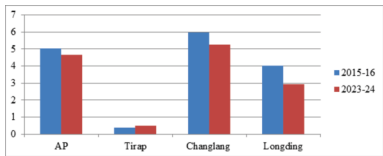
CAGR (%)	-8.04	-8.9	-10.98	-8.66	-1.37	-2.92	-12.86	-16.3
Co-efficient of variation	25.26	42.14	66.66	29.91	10.5	47.12	64.01	110.29

Source: Directorate of Horticultural Department, Arunachal Pradesh

From above table 7, it can be clearly observed that all three districts - Tirap, Changlang, and Longding - as well as the state as whole, showed a decline in the growth of both area and production of horticulture crops during 2015-16 to 2023-24. However, the decline in area and production of horticulture crops in Changlang district was much lower than that of the state and other two districts.

The coefficient of variation was also calculated to measure the variability in the growth of area and production of horticulture crops in all three districts and compared with the state as whole. As a result, it was found that in terms of growth variability of horticulture crops in area, the Tirap and Longding growth was more volatile than that of state during study period, whereas that of Changlang was found to be lower than the state. In the case of growth variability of horticulture crops in production, Longding and Changlang showed more volatility, and Tirap showed less volatility compared to the state.

The productivity of overall horticulture crops was found to be highest in Changlang, Longding and Tirap during both 2015-16 and 2023-24 (Figure 1). Compared with the state's productivity, Changlang had higher productivity than the state during both periods, while Longding and Tirap showed lower productivity than state, with Tirap's productivity being much lower. Looking at the productivity changes between two different periods, only Tirap district showed slight improvement, while Changlang and Longding, including state as a whole, showed a downward trend in productivity during 2015-16 to 2023-24.

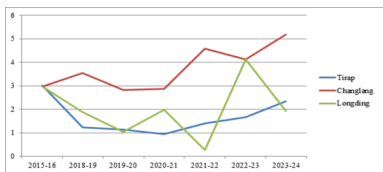


Source: Directorate of Horticultural Department, Arunachal Pradesh

Figure 1: Productivity of the TCL Districts and Arunachal Pradesh During 2015-16 and 2023-24

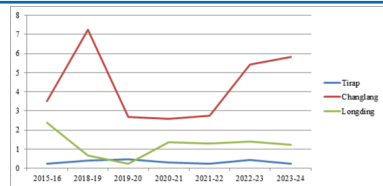
Below figure 2 depicts that among the three districts of Patkai Hills, the share of Changlang in the total area under cultivation of horticulture crops in the state is the highest throughout the period 2015-16 to 2023-24, followed by Longding, except during 2021-22, wherein Tirap exceeded Longding.

As in the case of area under cultivation, Changlang's share in the production of horticulture crops was found to be the highest throughout the study period, followed by Longding and Tirap, except for 2019-20, wherein the former exceeded the latter (Figure3).



Source: Directorate of Horticultural Department, Arunachal Pradesh

Figure 2: Growth Trend in the Share of TCL to Total Area Under Cultivation of Horticulture Crops in the State During 2015-16 and 2023-24



Source: Directorate of Horticultural Department, Arunachal Pradesh

Figure 3: Growth Trend in the Share of TCL to the Total Production of the Horticulture Crops in the State During 2015-16 to 2023-24

4. CONCLUSION

This sector demonstrates significant potential for future growth within the three districts in particular and Arunachal Pradesh as a whole. For instance, there are extensive cultivation of orange, large cardamom and pineapple in this region. The Govt. of Arunachal Pradesh (GoAP) has initiated many programmes linked to horticulture such as Atma Nirbhar Bagwani Yojana (ANBY) - a bank-linked credit subsidy scheme for farmers, AP Horticulture Policy 2025-35, Atma Nirbhar Plantation Yojana - provides plantation assistance and allied resources, and Crop Cluster Development Programme - promote organized marketing, etc. Despite all these support programmes, the three districts are lacking behind in terms of leveraging economic benefits. Therefore, planning a proper strategy for long term economic resilience with the support from government, communities, NGO's and stakeholders is required if these districts have to compete for rising demand of horticulture crops.

It is observed that large proportions of the population are living in the rural areas, majority of whom are lacking in scientific and modern technical know-how cultivation, devoid of confidence among the farmers due to inadequate road and other means of transportation, credit crunch, absence of effective APMC and mandi, void of nurseries and plant saplings facilities, etc. are contributing in hindering the growth of horticulture sector. The wrath of insurgency within the three districts is further directly or indirectly jeopardizing the conducive atmosphere retarding overall development of the sector.

Over time, people's standard of living also changes as socio-economic conditions improve. This calls for encouraging the farmers to adopt the organic cultivation methods. For this, awareness programmes under the Vibrant Villages Programme (VVP) - a Centrally Sponsored Scheme - can be conducted wherein farmers are required to enhance their knowledge on organic farming, and inputs can be distributed such as organic pesticides, bectericides, and organic granular manure. Moreover, initiatives like Mission Arun Himveer of ITBP in which farmers are assured of marketing opportunities for their surplus produce may provide additional support to the farmer's community of the three districts. In addition, the instalment of digital technologies such as deployment of drones, remote sensors, data analytics and AI are imperative in order to guide the horticulture sector with quality and improve its productivity in the study areas. The use of digital technologies in horticulture keeps farmers updated with respect to soil and crop conditions, and weather patterns, referred to as digital horticulture. As a result, farmers are able to take informed decisions on crop handling.

Therefore these districts require effective and inclusive policy implementations that involve local farmers in planning and identifying crops suited to the local climatic conditions. For sustainable growth of this sector, certain challenges such as establishment of mandi, improving road connectivity, provide nurseries to access quality seedlings, etc. need to be addressed. Workshops pertaining to various horticultural linked government schemes can be organized so as to draw the maximum benefits. In this regard, collaborative efforts

among government departments, NGO's and local beneficiaries are essential to ensure result-oriented outreach of information. Furthermore, the Department of Tirap, Changlang, and Longding (DoTCL), GoAP can play a critical role in making the horticulture activities self-sufficient tasks and eventually uplift the socio-economic conditions of the regions.

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