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Original Article**Potential of Exotic Fruit Crops in the Arunachal Himalayas****¹Thejangulie Angami*, ²Songthat William Haokip, ¹Ampee Tasung, ³Thupten Tsomu,****⁴Omi Tayeng, ⁵Oyinti Megu, ⁶Tarh Yaro, ⁷Senpon Ngomle and ¹Patu K. Zeliang**¹ICAR (Research Complex) for NEH Region, Arunachal Pradesh Centre, Basar - 791101²Dept. of Fruit Science, College of Horticulture and Forestry, CAU (I), Pasighat - 791102³Dept. of Horticulture, Rajiv Gandhi University, Rono Hills, Doimukh - 791112⁴Horticulture Development Officer, Chongkham, Dept. of Horticulture, Namsai - 792103⁵Krishi Vigyan Kendra – Geku, Upper Siang district - 791002⁶Dept. of Food Technology, Rajiv Gandhi University, Rono Hills, Doimukh - 791112⁷Dept. of Plant Pathology, College of Agriculture, CAU (I), Pasighat – 791102*Corresponding author: thejaangami@yahoo.com

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ABSTRACT

The Arunachal Himalayas, characterized by diverse agro-climatic zones, abundant rainfall, fertile soils, and rich biodiversity, provide immense opportunities for the cultivation of exotic fruit crops. The growing demand for high-value fruits, coupled with changing consumer preferences and the need for crop diversification, has created significant prospects for introducing suitable exotic species in the state. This article highlights the production potential, adaptability, and economic importance of major exotic fruit crops including dragon fruit (*Selenicereus* spp.), persimmon (*Diospyros kaki*), avocado (*Persea americana*), kiwifruit (*Actinidia deliciosa*), passion fruit (*Passiflora edulis*), blueberry (*Vaccinium* spp.), water apple (*Syzygium samarangense*), rambutan (*Nephelium lappaceum*) etc. The varied altitudinal range of Arunachal Pradesh allows the cultivation of tropical, sub-tropical and temperate exotic fruits, offering opportunities for year-round production and income generation. The expansion of exotic fruit cultivation can contribute to enhanced farm profitability, nutritional security, employment generation, value addition, agro-tourism, and export opportunities while reducing dependence on conventional horticultural crops. However, large-scale adoption remains constrained by limited availability of quality planting materials, inadequate scientific production technologies, insufficient post-harvest infrastructure, weak market linkages, and poor awareness among growers. Strengthening research on crop evaluation, varietal selection, climate resilience, pest and disease management, propagation techniques, and value chain development is essential for sustainable expansion. With appropriate policy support, infrastructure development, and farmer-oriented extension programmes, exotic fruit cultivation has the potential to emerge as a profitable and climate-resilient component of horticultural diversification in the Arunachal Himalayas.

INTRODUCTION

Arunachal Pradesh, often hailed as the "Land of the Dawn-Lit Mountains," stands as a unique ecological bridge between the tropical plains of the Brahmaputra Valley and the icy peaks of the Eastern Himalayas. As part of a global biodiversity hotspot, the state possesses an extraordinary range of agro-climatic zones - stretching from tropical and sub-tropical to temperate and sub-alpine - within a relatively compact geographical area (Mitra and Roy, 2014; Tok and Mandal, 2023). This diverse topography has traditionally supported a wide variety of indigenous fruits, such as the famous Arunachal orange and pineapple. However, in recent years, a significant horticultural shift has begun to take root. Farmers and policymakers are increasingly looking beyond traditional crops toward high-value "exotic" fruit species that can leverage the state's pristine environment and naturally fertile, organic-rich soils (Boi et al., 2024; Tok and Mandal, 2023).

The emergence of exotic fruit cultivation in the Arunachal Himalayas is not merely a trend but a strategic response to both economic opportunities and environmental shifts. As climate change alters traditional temperature regimes in the lower Himalayan belts, many conventional temperate crops, such as older apple varieties, are seeing reduced yields and quality (Irenaeus et al., 2023). In contrast, exotic species like Kiwifruit, Avocado, and Persimmon have demonstrated remarkable resilience and suitability for these changing micro-climates (Kochithara et al., 2025). For instance, the successful introduction of Kiwifruit in regions like the Ziro Valley has already positioned Arunachal Pradesh as the leading producer of the fruit in India, proving that these exotic "interlopers" can thrive and even outperform native commercial crops (Sanjay et al., 2025; Singh et al., 2019).

This transformation is fueled by a growing domestic demand for nutrient-dense, premium produce. Urban Indian markets are increasingly seeking "superfoods," and Arunachal's ability to produce these fruits organically gives it a distinct competitive edge (Nath et al., 2018; Sanjay et al., 2025). By transitioning from subsistence-based agriculture or traditional *Jhum* (shifting cultivation) toward settled, high-value exotic horticulture, the state is creating a pathway for sustainable livelihood improvement and rural prosperity (Tok and Mandal, 2023). This article explores the unique agro-climatic suitability of the Arunachal Himalayas, the species showing the most promise for the region, and the logistical and technical hurdles that must be overcome to fully unlock this "Himalayan Goldmine."

A Natural Greenhouse: The Agroclimatic Advantage

Arunachal's geography is its greatest asset. With altitudes ranging from near tropical to sub-alpine, the state offers diverse "micro-climates" that can support almost any fruit variety (Mitra and Roy, 2014).

- **Soil Fertility:** The soil in these Himalayan foothills is naturally rich in organic matter and typically acidic, providing a perfect bed for many exotic species that struggle in the plains (Mitra and Roy, 2014).
- **Climate Resilience:** As traditional temperate crops like apples and peaches face declining yields due to rising temperatures, exotic alternatives like kiwifruit and avocado are showing

remarkable adaptability to these evolving conditions (Irenaeus et al., 2023; Kochithara et al., 2025).

Star Performers among Exotic Fruit crops in the state

The success story of exotic fruits in Arunachal is led by the Kiwifruit. Introduced on a trial basis in Dirang around the year 2000, Arunachal Pradesh has now emerged as the leading producer of kiwi in India (Singh et al., 2019).

- **Kiwifruit:** Thriving at elevations between 3,000 to 5,500 feet, varieties like *Hayward*, *Allison*, and *Monty* are being grown organically (Sanjay et al., 2025; Singh et al., 2019). In areas like the Ziro Valley, a single acre organic orchard can produce 2-3 tonnes of fruit annually, providing a steady income of ₹2-3 lakh for local farmers (Sanjay et al., 2025).
- **Avocado:** Once a rare sight, avocado is now being integrated into household gardens and commercial trials. It is increasingly favored as a "low-chilling" alternative to traditional fruits, thriving even as winter frosts become less predictable (Irenaeus et al., 2023).
- **Rambutan:** The tropical "cousin" of the lychee and longan, rambutan (*Nephelium lappaceum*) is gaining a foothold in the low-lying, humid pockets of Arunachal (Awachare et al., 2022). In place like Namsai district in the foothills, the warm, moist climate provides the well-drained, humid conditions this fruit requires, unlike the state's higher altitudes. Its bright red, hairy exocarp and sweet, juicy white aril have already drawn interest from niche markets looking for tropical exotic alternatives to imported lychee.
- **Blueberry:** Often dubbed a "future super fruit" due to its exceptionally high antioxidant content, blueberry (*Vaccinium* spp.) thrives in acidic soils with cool winters-conditions almost identical to the mid and high altitude belts of the Arunachal Himalayas (Negi and Upadhyay, 2017, 2018, 2021). Cultivars like *Jewel*, *Misty*, and *Sharp blue* have shown encouraging growth in India's northern temperate zones where soil pH and chilling requirements mimic those found in places like the Shergaon area. Once established, blueberry bushes are remarkably low-maintenance compared to tree crops, making them an attractive option for smallholder farms in Arunachal's temperate highland villages.
- **Dragon Fruit:** Dragon fruit has significant potential as an emerging high-value fruit crop in Arunachal Pradesh, particularly in the mid-hill and foothill regions where the subtropical climate, well-distributed rainfall, and well-drained soils are favorable for its cultivation. The crop is well suited to the state's diversified farming systems due to its tolerance to intermittent drought, relatively low water requirement, early bearing habit, and high productivity compared to many traditional fruit crops. The increasing consumer demand for dragon fruit, driven by its attractive appearance, nutritional value, antioxidant-rich composition, and health-promoting properties, offers substantial market opportunities for growers. Furthermore, the crop can diversify existing orchards, improve farm income, and utilize marginal lands efficiently with proper support structures and scientific management. Preliminary observations indicate that several introduced cultivars adapt well under foothills conditions of the state, highlighting the need for systematic evaluation to identify high-yielding and quality genotypes suitable for different agro-climatic zones.

- **Persimmon:** Newer introductions like persimmon are gaining traction (Kochithara et al., 2025). These fruits cater to a growing health-conscious "metro" market in India, where demand for nutrient-dense, exotic produce is skyrocketing (Nath et al., 2018).
- **Passionfruit:** Passionfruit has been introduced and evaluated in several districts through the efforts of research institutions, Krishi Vigyan Kendras (KVKs) and the State Department of Horticulture. Demonstrations and farmer training programmes have shown that the crop adapts well to the state's climatic conditions, particularly in areas where traditional citrus orchards have declined due to diseases. Its early bearing habit, good economic returns, and compatibility with trellis-based cultivation make it an attractive option for crop diversification and income enhancement among farmers.
- **Water apple:** At present, water apple is not a commercially established fruit crop in Arunachal Pradesh. It is grown only on a limited scale in home gardens and as scattered trees in a few localities, with no organized orchards or systematic production statistics available. Water apple has received little research or extension attention in the state. However, increasing interest in exotic fruit cultivation, coupled with the favourable agro-climatic conditions of Arunachal Pradesh, indicates considerable potential for future evaluation, varietal selection, and commercial cultivation.



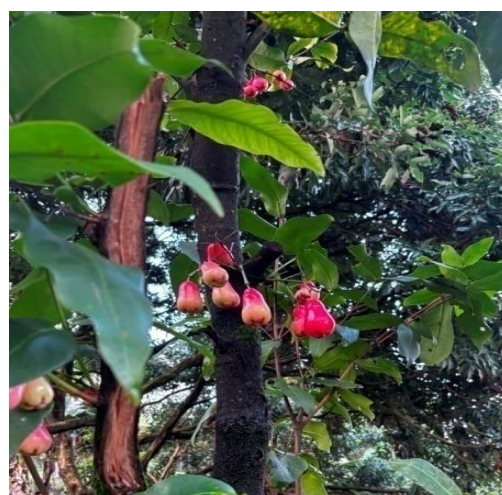
Kiwi fruit in Ziro



Avocado in Itanagar



Dragon Fruit in East Siang



Water apple in Itanagar



Non-Astringent type persimmon in Dirang



Astringent type persimmon in Geku



Blueberry in Shergaon



Rambutan in Namsai



Passionfruit at East Siang

Turning Potential into Profit

The economic "pull" of these fruits is significant. Because they are often marketed as "organic" and "Himalayan-grown," they command premium prices in major cities like Delhi, Mumbai, and Rajasthan (Sanjay et al., 2025). Beyond just fresh fruit sales, there is a burgeoning industry for value-added products. Lower-grade fruits that don't meet export size standards are being processed into kiwifruit wine and dried fruit snacks, ensuring that no part of the harvest goes to waste (Sanjay et al., 2025). The economic promise of exotic fruit cultivation in the Arunachal Himalayas is no longer theoretical. Across the state, pioneering farmers and progressive villages have already demonstrated how these "newcomer" crops can translate the region's natural advantages into real, measurable income. The following case studies illustrate how the potential is being converted into profit on the ground.

Perhaps the most documented real-world success story is the one-acre terraced organic kiwifruit orchard owned by Mr. Tage Obing in the Ziro Valley. Established in 2011, the orchard produces 2-3 tonnes of kiwifruit annually and grows four cultivars - *Hayward*, *Allison*, *Monty*, and *Bruno* entirely organically, without the use of any synthetic fertilizers or pesticides. Fruits are graded A through D based on size; the premium Grade A fruits are exported to high-value markets in Uttar Pradesh, Delhi, Maharashtra, and Rajasthan, while the smaller grades are processed locally into kiwifruit wine and dried fruit snacks. The orchard earns Mr. Obing approximately ₹2-3 lakh per year, supplemented by ₹3.8 lakh in financial support received under the *Atma Nirbhar Bagwani Yojana* (Sanjay et al., 2025). This single farm has become a blueprint for the wider Ziro Valley, proving that organic kiwi cultivation is not only technically feasible but commercially viable in the Apatani highland plateau.



Figure: Kiwifruit Orchard in Ziro, Arunachal Pradesh

The Kiwifruit Landscape of Arunachal Pradesh can be traced back to a single trial plot. In 2000, kiwifruit was first introduced on a trial basis in Dirang, where the climate and soil conditions were found suitable (Singh et al., 2019). Encouraged by the initial results, farmers in neighbouring Kalaktang, Tenzing Gaon, Rupa, Singchung and Nafra began adopting the crop, and from those early adopter villages, kiwi cultivation spread rapidly to other districts across the state. Today, Arunachal Pradesh is the leading producer of kiwifruit in India. This "ripple effect" demonstrates how a single,

well-targeted introduction - matched to the right agro-climatic niche can scale up into a state-wide industry through horizontal farmer-to-farmer diffusion.

Climate change is actively rewriting the orchard map of the Arunachal Himalayas. In the traditional apple-growing foothills of Bomdila and Dirang, the rising temperatures have made it increasingly difficult for apples to achieve the requisite quality (Irenaeus et al., 2023). In response, kiwifruit with more robust rootstocks capable of tolerating the warmer conditions is steadily replacing apple orchards in these areas. This case study is a striking example of how exotic species can serve not just as a luxury addition but as a strategic climate-adaptation pathway, allowing farmers to protect their livelihoods by switching to a more resilient crop while staying within a familiar altitudinal band.

In several villages of the Upper Siang district, a quiet horticultural transition has been underway. Traditionally reliant on local varieties of paddy and millets, farmers have gradually shifted toward wet-rice cultivation on terraces alongside high-value cash crops such as kiwifruit and large cardamom (Mylliemngap, 2021). While this transition has improved household incomes, it has also reduced the cultivation of indigenous paddy and millet landraces, creating a real concern about the erosion of local agrobiodiversity and the loss of important genetic resources. The Upper Siang experience therefore serves as both an encouraging economic case study and a cautionary reminder: market-driven diversification must be balanced with active conservation of traditional varieties.

The Krishi Vigyan Kendras of West Kameng and East Kameng have played a critical role in institutionalizing exotic fruit expansion. Recognizing that the lack of quality planting material, documented package of practices, modern technology, and trained manpower were the major constraints holding back productivity, the KVKs have drawn up dedicated roadmaps for precision farming, organic production, and improved economic estimates for kiwifruit (Singh et al., 2019). Their work demonstrates how public-sector extension can act as a multiplier on farmer-led innovation, accelerating the journey from "trial plot" to "commercial orchard" across multiple districts.

Overcoming the "Himalayan Hurdles"

While the biological potential of the Arunachal Himalayas is undeniable, the transition from successful trials to a global-scale exotic fruit industry faces several deep-rooted "Himalayan hurdles." Addressing these challenges is essential for ensuring that the region's natural advantages translate into long-term economic prosperity for its farmers.

1. The Logistical Bottleneck and Topography:

The state's greatest asset - its rugged, high-altitude terrain is also its most significant logistical barrier. The undulating topography makes the transport of delicate, perishable fruits like kiwifruit and avocado extremely difficult. Currently, winding mountain roads and long transit times lead to high transportation costs and physical damage to the produce before it even reaches the plains (Boi et al., 2024; Sanjay et al., 2025). Without dedicated "green corridors" or improved rural-to-urban connectivity, many farmers remain confined to local markets where they cannot command the premium prices these exotic fruits deserve (Sanjay et al., 2025).

2. Post-Harvest Infrastructure Deficits:

The lack of a robust "cold chain" is perhaps the most critical infrastructure gap. Exotic fruits require immediate cooling and specialized handling to maintain their nutrient profile and shelf life. However, there is a severe shortage of community cold storage facilities and modern packaging houses in the growing regions (Singh et al., 2019). In areas like the Ziro Valley, the absence of specialized grading facilities means that fruits of varying quality are often packed together, reducing their appeal for high-end export markets (Sanjay et al., 2025; Singh et al., 2019).

3. Technical Knowledge and Quality Planting Material:

Despite the enthusiasm for these new crops, many growers still face a "technical vacuum." There is a persistent need for:

- **Quality Germplasm:** Access to "true-to-type," high-quality planting materials from certified nurseries remains limited (Singh et al., 2019).
- **Precision Farming:** Farmers require modern training in canopy management, organic pest control, and efficient irrigation systems specifically adapted to Himalayan slopes (Boi et al., 2024; Singh et al., 2019).
- **Standardization:** Developing standardized organic protocols is necessary to ensure that "Himalayan-grown" becomes a globally recognized mark of quality (Sanjay et al., 2025).

4. Enhancing Market Linkages and Value Addition:

To reduce dependency on volatile fresh-fruit markets, there is a burgeoning need for local value-addition units. Currently, significant portions of the harvest can be lost if they do not meet strict cosmetic standards for fresh sale. Establishing small-scale processing units for products like kiwifruit wine, juices, and dried fruit snacks can ensure that even "B-grade" produce generates income, thereby minimizing waste and maximizing the economic return per acre (Sanjay et al., 2025).

By bridging these gaps through targeted policy support and private investment, Arunachal Pradesh can transform these hurdles into stepping stones toward becoming India's premier exotic fruit hub (Boi et al., 2024; Tok and Mandal, 2023).

CONCLUSION

The Arunachal Himalayas are on the cusp of a horticultural revolution, with exotic species like kiwifruit, avocado, and persimmon transforming the state into a premier organic hub for high-value produce. By leveraging its unique altitudinal micro-climates and naturally fertile soils, the region can offer sustainable, high-income alternatives to traditional farming, as evidenced by the economic success of organic kiwi cultivation in the Ziro Valley. However, realizing this full potential requires addressing critical "Himalayan hurdles" in logistics, cold-chain infrastructure, and technical training. With targeted policy support and investment in research and development, Arunachal Pradesh is well-positioned to not only secure the livelihoods of its rural communities but also to become a major contributor to India's burgeoning exotic fruit market. The future of the Arunachal Himalayas lies in its ability to blend traditional farming wisdom with these high-value exotic arrivals. By focusing on organic certification and building robust cold-chain infrastructure, Arunachal is well on its way to

becoming the premier hub for exotic fruits in South Asia. For the farmers of the "Land of the Dawn-Lit Mountains," the future isn't just green - it's colorful, exotic and highly profitable.

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