ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 14, Issue 2, pp: (298-306), Month: April - June 2026, Available at: www.researchpublish.com

Problems of Horticulture Development in East Siang District of Arunachal Pradesh

MONSHI TAYENG

Controller of Examinations

Arunachal Pradesh University

Hill Top, Pasighat – 791103

East Siang District, Arunachal Pradesh, India

DOI: https://doi.org/10.5281/zenodo.20444197

Published Date: 29-May-2026

Abstract: **Horticulture has emerged as one of the most dynamic sectors of agricultural development in India, particularly in the northeastern region, where ecological diversity and varied climatic conditions favour the cultivation of a wide range of fruits, vegetables, spices, and plantation crops. Arunachal Pradesh possesses immense potential for horticultural expansion owing to its fertile soils, abundant rainfall, and varied altitudinal zones. Among its districts, East Siang District is particularly suitable for horticultural development due to its agro-climatic advantages and agrarian tribal economy. Despite these favourable conditions, the district continues to face several structural, technological, institutional, and infrastructural challenges that limit commercial horticultural growth. The present study analyses the major problems and prospects associated with horticultural development in East Siang District. Based on secondary data, field observations, and a critical review of existing literature, the findings reveal that horticultural growth in the district is constrained by poor cultivation practices, limited scientific knowledge, absence of quality planting materials, inadequate irrigation, pest infestations, transportation bottlenecks, weak marketing networks, labour scarcity, limited banking access, and a complete absence of cold storage infrastructure. At the same time, the district demonstrates significant potential owing to favourable agro-climatic conditions, growing farmer awareness, improving market connectivity, and governmental initiatives promoting horticulture in northeastern India. The paper recommends integrated policy interventions covering extension services, cold storage infrastructure, institutional credit, market reforms, and transportation development as prerequisites for sustainable horticultural growth in the region.**

Keywords: **horticulture, East Siang District, Arunachal Pradesh, tribal economy, agricultural development, agro-climatic conditions, rural livelihood, post-harvest management, market infrastructure.**

1. INTRODUCTION

Agriculture has historically formed the backbone of the economy and social organization of tribal communities in northeastern India. In the hill regions of Arunachal Pradesh, traditional agricultural systems — including shifting cultivation (jhum), hunting, gathering, and forest-based subsistence economies — have long shaped the livelihood patterns of indigenous communities (Roy, 2004). However, demographic growth, environmental degradation, declining productivity of shifting cultivation, and increasing integration with market economies have necessitated a gradual transition toward more sustainable and commercially viable agricultural practices (Borthakur, 1992).

In this context, horticulture has emerged as one of the most promising alternatives. Horticulture refers to the scientific cultivation of fruits, vegetables, flowers, spices, medicinal plants, and plantation crops and is recognized as a high-value agricultural activity capable of generating employment, improving nutritional security, increasing household income, and promoting ecological sustainability (Chadha, 2001; Singh et al., 2008). Unlike shifting cultivation, horticulture supports permanent cultivation systems and reduces pressure on forests and fragile hill ecosystems.

The northeastern region of India possesses remarkable potential for horticultural development due to its rich biodiversity, fertile soils, heavy rainfall, and diverse climatic zones (Pattanayak et al., 2014). Policy support has grown progressively: the Ninth Five-Year Plan (1997–2002) gave priority attention to horticulture (Government of India, Planning Commission, 1997), followed by the launch of the Technology Mission for Integrated Development of Horticulture in the North Eastern and Himalayan States in 2001–02 (Government of India, Ministry of Agriculture, 2001). The subsequent National Horticulture Mission (NHM), launched during 2005–06, marked a landmark institutional commitment to promoting horticulture as an engine of rural economic development (Government of India, Ministry of Agriculture, 2005).

Within Arunachal Pradesh, East Siang District occupies a strategic position in terms of agricultural and horticultural development. The district is characterized by rolling slopes, fertile valleys, subtropical climatic conditions, abundant rainfall, and adequate sunshine, all of which favour the cultivation of diverse horticultural crops such as orange, pineapple, banana, ginger, cardamom, lemon, papaya, sugarcane, pear, plum, and green vegetables (Arunachal Pradesh Horticulture Policy, 2025). Villages located near roads and urban centres have shown particularly strong interest in plantation crops such as cardamom and citrus.

Despite possessing enormous potential, horticulture in East Siang District remains underdeveloped. Farmers continue to face numerous obstacles related to infrastructure, marketing, finance, irrigation, scientific knowledge, and transportation. In many cases, horticultural production remains subsistence-oriented rather than market-driven, and perishable commodities suffer extensive post-harvest losses due to the absence of cold storage and processing facilities (Deka & Shadeque, 2009). Weak market systems render farmers vulnerable to exploitation by middlemen, further depressing farm incomes.

The present paper seeks to critically examine the major problems hindering horticultural development in East Siang District and to analyse the future prospects of the sector. The study is significant because horticulture has the potential to transform the rural economy of the district by generating employment, reducing poverty, promoting sustainable land use, and improving the socio-economic conditions of tribal communities.

2. OBJECTIVES OF THE STUDY

The present study has been undertaken with the following objectives:

i. To examine the present status of horticultural development in the East Siang District of Arunachal Pradesh.

ii. To analyse the major socio-economic, technological, and infrastructural constraints affecting horticulture in the district.

iii. To identify the prospects and opportunities for commercial horticultural development.

iv. To suggest policy measures and developmental strategies for sustainable horticultural growth.

3. METHODOLOGY

The study is primarily descriptive and analytical in nature. It relies on a systematic review of secondary sources, including field survey reports, government publications, peer-reviewed research articles, agricultural records, and unpublished monographs relating to horticulture in East Siang District. Qualitative analysis has been employed to understand the major challenges and prospects associated with horticultural development in the district.

Data concerning transportation infrastructure, banking facilities, irrigation systems, marketing structures, pest incidence, cultivation practices, and post-harvest conditions have been systematically gathered and analysed to identify the structural limitations of horticultural development. The analysis follows a problem-identification framework organized around production, institutional, infrastructural, and market-related constraints, consistent with the methodological approach used in comparable regional studies (Imchen, 2014; Sangma & Bhatt, 2008).

4. AGRO-CLIMATIC CONDITIONS AND HORTICULTURAL POTENTIAL

East Siang District possesses highly favourable agro-climatic conditions for horticultural development. The district experiences heavy monsoonal rainfall exceeding 200 cm annually (Arunachal Pradesh Horticulture Department, 2018) and features varied topographical terrain ranging from alluvial plains to rolling hills and elevated slopes. These geographical and climatic characteristics create suitable ecological niches for a wide variety of horticultural crops.

The southward-facing rolling slopes of the district are particularly ideal for plantation and fruit crops, providing adequate drainage, abundant sunshine, and reduced waterlogging. The climatic regime supports the cultivation of both tropical and subtropical crops, including citrus fruits (orange and lemon), pineapple, banana, ginger, sugarcane, pear, plum, cardamom, and multiple green vegetables (Krishnamurthy et al., 2010; Arunachal Pradesh Horticulture Policy, 2025).

Agriculture remains the principal occupation of the majority of the tribal population in the district. Traditional farming practices are deeply embedded in social customs, rituals, and cultural life. Historically, the people practised shifting cultivation primarily for subsistence needs. However, population growth, depletion of forest resources, and increasing exposure to market systems have gradually encouraged farmers to adopt settled horticultural cultivation, recognizing its superior economic returns and lower ecological cost (Roy, 2004; Borthakur, 1992).

Horticulture offers multiple economic advantages over shifting cultivation. Once established, orchards and plantation crops continue to yield produce for many years without requiring annual land clearing. Permanent cultivation also supports soil conservation and reduces forest degradation (Singh et al., 2008). Improving connectivity with markets in Assam — enabled by the construction of major infrastructure projects such as the Bogibeel Bridge and the Dhola-Sadiya Bridge across the Brahmaputra — has further enhanced prospects for the commercialization of horticultural products from the district (Arunachal Pradesh Horticulture Policy, 2025).

5. MAJOR PROBLEMS OF HORTICULTURE DEVELOPMENT

While East Siang District possesses considerable agro-climatic potential, a range of production, institutional, infrastructure, and market constraints have prevented the sector from achieving commercial viability. The following subsections analyse each constraint systematically.

5.1 Poor Cultivation Practices and Low Productivity

One of the most fundamental constraints is the widespread non-adoption of scientific cultivation practices. Despite favourable environmental conditions, the productivity of all major horticultural crops in the district remains below the national average (National Horticulture Board, 2021). Farmers continue to rely on traditional techniques that are low-input, low-yield, and poorly adapted to commercial-scale production (Pattanayak et al., 2014). No systematic agronomic practices, such as proper spacing, pruning, fertilization, or integrated nutrient management, are consistently applied. Technical intervention through extension services is urgently needed to bridge this productivity gap.

5.2 Absence of Quality Planting Materials

The unavailability of disease-free, genetically verified planting material poses a serious constraint to productivity enhancement. Farmers typically rely on locally sourced, unverified saplings and seeds, which frequently carry latent pathogens and exhibit poor performance (Chadha, 2001). Systematic screening, multiplication, and distribution of certified planting materials through government nurseries and accredited private sources are virtually absent in the district. The development of regional nursery infrastructure is considered essential for ensuring a reliable supply of quality germplasm (Pattanayak et al., 2014).

5.3 Inadequate Marketing Facilities

The absence of an organized marketing structure is among the most economically damaging constraints facing horticultural farmers. Due to weak market linkages, producers receive significantly lower prices compared to farmers in states with better-developed horticultural marketing systems (Sangma & Bhatt, 2008). Intermediaries and commission agents capture a disproportionately large share of the value chain, leaving primary producers with minimal margins. For high-value commodities such as orange, cardamom, ginger, and litchi, post-harvest losses are amplified by the perishable nature of the produce and the absence of market infrastructure. The Arunachal Pradesh Marketing Corporation (APMC), established by the state government to monitor market prices, has been unable to effectively regulate the market or protect producer interests. The absence of a formal produce market (sabzi mandi) within the district further constrains farmer access to transparent pricing.

5.4 Scarcity of Trained Manpower and Extension Services

The dearth of trained horticultural extension personnel represents a critical institutional gap. In states such as Himachal Pradesh, Punjab, and Sikkim, where extension services are comparatively efficient, horticultural development has advanced

at a faster pace (Nath & Gaddagimath, 2011). In East Siang District, most farmers are either illiterate or educated only to the primary level, limiting their capacity to access published technical information independently. Regular field demonstrations, farmer training programmes, and exposure visits to progressive horticultural zones are required to upgrade farmer competencies (Imchen, 2014).

5.5 Long Gestation Period and Financial Constraints

Plantation crops such as cardamom, orange, and pear carry long gestation periods, with a gap of several years between planting and the first marketable harvest. This biological reality makes it virtually impossible for marginal and small-scale farmers to finance establishment costs without access to long-term institutional credit (Sharma et al., 2002). However, nationalized banks are reluctant to lend against horticultural ventures due to uncertainties regarding crop recovery and the prevailing land tenure system in the tribal belts of Arunachal Pradesh, which prohibits the mortgage of land in favour of lending institutions. Farmers are also generally unfamiliar with banking procedures and the concept of agricultural credit. Until institutional credit mechanisms are reformed to accommodate the specific characteristics of tribal land tenure systems, adequate financial support will remain inaccessible to most growers.

5.6 Absence of Processing and Cold Storage Infrastructure

The success of commercial fruit and vegetable cultivation is intimately linked to the availability of post-harvest processing and storage infrastructure (Singh et al., 2008). Currently, East Siang District has no cold storage facility, and fruit processing units are absent. This infrastructure deficit forces farmers to sell surplus perishable produce at distressed prices, particularly during peak harvest seasons when supply exceeds immediate market absorption (Deka & Shadeque, 2009). The absence of pre-harvest and post-harvest management practices — including grading, packaging, and cold chain logistics — further depresses farmgate prices and discourages investment in commercial horticulture. Establishment of cold storage facilities and primary processing units at strategic nodal points would substantially reduce post-harvest losses and improve market returns.

5.7 Inadequate Investment in Research

Investment in applied horticultural research in Arunachal Pradesh has historically been inadequate relative to the number of crops and the complexity of agro-ecological conditions in the state (Pattanayak et al., 2014). Many technical problems affecting productivity — including site-specific soil constraints, varietal performance under local conditions, and optimum management practices — remain unresolved due to this research deficit. Research institutions need to strengthen their field presence, conduct participatory trials in farmers' plots, and translate research findings into actionable recommendations. The Central Agricultural University (CAU), Pasighat, has a significant role to play in this regard, given its geographical proximity and institutional mandate in the region (Central Agricultural University, Pasighat, 2016).

5.8 Unavailability of High-Yielding Varieties

Most farmers continue to cultivate traditional, low-yielding varieties that offer cultural familiarity but limited commercial value. While these varieties provide a degree of resilience and food security, their productivity is inadequate for commercial operation. Introducing high-yielding, disease-resistant varieties adapted to local agro-climatic conditions is a critical intervention required to enhance production (Nath & Gaddagimath, 2011). This requires coordinated action between research institutions, the State Department of Horticulture, and the National Horticulture Mission.

5.9 Pest and Disease Management

Pest attacks represent a significant source of crop loss for horticultural farmers in the district. Citrus crops, in particular, suffer from severe damage caused by citrus trunk borers (*Lamiidae: Coleoptera*), citrus butterfly, citrus borer, fruit sucking moth, fruit fly, capsule borers (*Conogethes punctiferalis*), thrips, shoot fly, and aphids (Panda, 1997). Farmers typically apply traditional remedies such as lime paint and wood ash application, which are ineffective against borers that have already penetrated the stem tissue. Pesticide misuse has also been documented, including inappropriate application of agricultural chemicals for non-target purposes such as fish poisoning. Systematic Integrated Pest Management (IPM) training, regular field surveillance by extension officers, and the timely supply of appropriate phytosanitary inputs are required to mitigate pest-related losses (Panda, 1997).

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 14, Issue 2, pp: (298-306), Month: April - June 2026, Available at: www.researchpublish.com

Table 1: Major Natural Enemies of Horticultural Pests in East Siang District

Scientific Name	Common Name	Type	Pest(s) Targeted
Bombyliidae	Bee fly	Parasitoid	Butterfly/moth larvae, bee/wasp larvae, beetles
Braconidae	Braconid wasp	Parasitoid	Beetle larvae, caterpillars, flies, sawflies
Cantharidae	Soldier beetle	Predator	Aphids, insect eggs, beetle/moth larvae
Carabidae	Predaceous ground beetle	Predator	Soil-dwelling larvae and eggs; weed seeds
Chalcidoidea	Chalcid wasp	Parasitoid	Insect eggs, aphids, beetles, flies, scales
Chrysopidae	Green lacewings	Predator	Aphids and other soft-bodied insects
Coccinellidae	Lady beetles	Predator	Aphids (primary pest control agent)
Ichneumonidae	Ichneumonid wasps	Parasitoid	Beetles, caterpillars, wasps
Syrphidae	Hover flies/Syrphid flies	Predator	Aphids and other soft-bodied insects
Tachinidae	Tachinid flies	Parasitoid	Beetles, butterflies, moths

Source: *Central Agricultural University, Pasighat (2016). Compiled by the author.*

5.10 Crop Damage by Domestic Animals

In the tribal economy of East Siang District, domesticated animals — including mithun (Bos frontalis), cattle, pigs, goats, and poultry — hold important social, ritual, and economic significance (Roy, 2004). They serve as instruments of bride price, ceremonial sacrifice, social exchange, and livelihood security. As a result, large numbers of animals are kept and allowed to roam freely, creating serious conflict with horticultural cultivation. Stray animals cause extensive physical damage to crops, including banana, pineapple, sugarcane, cardamom, and orange. Although temporary bamboo fencing is constructed around gardens, these barriers deteriorate rapidly in the humid climate and must be replaced frequently. The aspiration of most farmers is access to permanent metallic wire fencing, a modest but significant capital investment that could substantially reduce crop losses. While metal wire fencing has occasionally been supplied at subsidized rates through government schemes, both its quantity and quality have been insufficient.

5.11 Limited Training and Technology Transfer

Adequate training in scientific cultivation techniques is largely unavailable to farmers in the district. Where willingness to learn exists, the absence of local training centres and practical demonstration plots limits technology uptake. Short-duration exposure training programmes covering topics such as organic farming, vermicomposting, weed management, bio-composting, seed preservation, plant propagation, and pest management would significantly benefit farmers (Imchen, 2014). Training should also address practical aspects of accessing government schemes, applying for institutional credit, and managing farm finances.

5.12 Inadequate Irrigation Infrastructure

Crop desiccation during the dry season (October to February) is a significant constraint to year-round horticultural production. Most horticultural crops are cultivated on south-facing sunny slopes that drain rapidly and are prone to drought stress during this period. Temperate and subtropical crops such as orange, pear, and lemon undergo leaf shedding during dry months, suppressing flowering and fruiting. The absence of canal or lift irrigation systems means that farmers are entirely dependent on seasonal rivers and streams, rendering regular irrigation practically impossible during the dry period (Arunachal Pradesh Horticulture Department, 2018). Investment in small-scale irrigation infrastructure — including check dams, water harvesting structures, and drip irrigation systems — is essential for enhancing year-round productivity (Kumar & Dey, 2011).

5.13 Climatic Risks: Excessive Rainfall and Uneven Sunshine

While the district benefits from heavy monsoonal precipitation, excessive rainfall in certain years constitutes an agronomic hazard. Farmers reported that during 2012, unusually high rainfall led to widespread crop failure despite elevated market prices, resulting in significant income losses. Additionally, the unequal distribution of sunshine across the district's varied topography — particularly in high-altitude zones that receive limited direct sunlight — creates localized constraints for light-demanding horticultural crops. These climatic risks underscore the importance of robust crop insurance mechanisms that are currently virtually absent for most horticultural crops.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 14, Issue 2, pp: (298-306), Month: April - June 2026, Available at: www.researchpublish.com

5.14 Transportation and Connectivity Constraints

Poor road connectivity constitutes a major structural impediment to the commercialization of horticultural produce. Most circle headquarters in East Siang District are located 60–156 km from the district headquarters at Pasighat (Table 1). Many inter-circle roads are seasonal and unmetalled, becoming impassable during the monsoon season. The case of Sissen village — recognized nationally for its organic spice production yet lacking a motorable road, with residents carrying produce on their backs for 6 km to the nearest main road — illustrates starkly how infrastructural isolation negates productive potential. Without reliable all-weather road access, horticultural products cannot be transported to markets in a commercially viable timeframe, particularly for time-sensitive perishables.

Table 2: Distance of Circle Headquarters from District Headquarters

S.No.	Name of Circle	Altitude (Mtr.)	Distance from Dist. HQs. (km)	Mode of Communication	No. & Name of Bank
1.	Pasighat	155	0	APST/PVT	09
2.	Bilat	244	27	APST/PVT	Nil
3.	Sille-Oyan	140	24	APST/PVT	01 (APRB)
4.	Ruksin	139	35	APST/PVT	01 (APRB)
5.	Nari	133	75	APST/PVT	Nil
6.	Koyu	627	65	APST/PVT	Nil
7.	New-Seren	130	97	APST/PVT	Nil
8.	Mebo	346	18	APST/PVT	01 (APRB)
9.	Pangin	397	76	APST/PVT	01 (APRB)
10.	Boleng	180	98	APST/PVT	01 (APRB)
11.	Rebo-Perging	506	121	APST/PVT	Nil
12.	Riga	752	156	APST/PVT	Nil
Total					**14**

Source: *Compiled from field survey data.*

5.15 Labour Shortage

Commercial-scale horticulture is labour-intensive and demands adequate human capital across the growing cycle. However, labour availability in rural East Siang is constrained by the migration of youth to urban areas in pursuit of education and employment, reducing the agricultural workforce in villages. The Inner Line Permit (ILP) system, which restricts the entry of non-residents into Arunachal Pradesh, further limits the availability of migrant agricultural labour. The absence of modern amenities in rural areas also deters outside workers. Most farmers currently manage operations with family labour supplemented by reciprocal village labour arrangements, a system that is inadequate for large-scale commercial cultivation.

5.16 Absence of Crop Insurance

Risk management mechanisms for horticultural crops are almost absent in the district. While the National Agriculture Insurance Scheme covers potato and onion in parts of India, most horticultural crops cultivated in East Siang remain uninsured (Government of India, Ministry of Agriculture & Farmers Welfare, 2022). Farmers are generally unaware of available insurance products; awareness of even basic financial institutions, such as the Life Insurance Corporation (LIC), is limited. The government provides one-time relief for crop losses caused by major natural calamities (floods, landslides), but this is neither systematic nor adequate. A comprehensive crop insurance programme based on area-level yield indicators would encourage greater investment in horticulture by reducing downside financial risk.

5.17 Inadequate Banking Infrastructure

The uneven geographical distribution of banking services across the district severely restricts farmers' access to institutional credit and savings facilities. Out of 14 bank branches identified in the district (comprising State Bank of India and Arunachal Pradesh Rural Bank branches), nine are concentrated in Pasighat circle alone, while six of the twelve circles have no banking facility whatsoever (Table 1). Farmers in remote circles must travel distances exceeding 100 km to access the nearest bank branch, making routine financial transactions prohibitively costly in terms of time and transportation expenses. Expansion of banking infrastructure through satellite branches, banking correspondents, and mobile banking units is essential for enabling credit-led horticultural investment.

5.18 General Lack of Awareness and Orientation

A significant proportion of rural residents in the district have had limited exposure to alternative livelihood systems beyond traditional shifting cultivation. Awareness of the economic potential of commercial horticulture, available government schemes, technical inputs, and market opportunities is inadequate. Structured awareness campaigns, farmer-to-farmer learning programmes, and participatory demonstrations organized by the Department of Horticulture and allied agencies are needed to stimulate greater interest and adoption.

6. PROSPECTS OF HORTICULTURE DEVELOPMENT

Notwithstanding the constraints discussed above, several positive drivers position East Siang District for accelerated horticultural development over the medium to long term.

At the national level, horticulture has emerged as a high-growth sector: vegetables account for approximately 60% of total horticultural production by volume, followed by fruits (31%), plantation crops (7%), and spices (2%) (Nath & Gaddagimath, 2011). The sector's contribution to agricultural GDP has grown substantially over the past two decades (National Horticulture Board, 2021), reflecting rising domestic demand and export potential.

The Government of India's institutional framework for northeastern horticulture is increasingly supportive. The Technology Mission for Integrated Development of Horticulture in the North Eastern and Himalayan States (2001–02) channelled significant public investment into production, post-harvest management, marketing, and capacity building in the region (Government of India, Ministry of Agriculture, 2001). The NHM (2005–06) expanded this framework further (Government of India, Ministry of Agriculture, 2005), and subsequent policies, such as the Pradhan Mantri Krishi Sinchai Yojana, have addressed irrigation deficits. The Arunachal Pradesh State Horticulture Mission has developed an action plan for 2020–2025 that specifically addresses production enhancement, post-harvest infrastructure, and market linkage development (Arunachal Pradesh Horticulture Policy, 2025).

The agro-climatic conditions of East Siang District are a strong comparative advantage. The southward-facing rolling slopes, free from waterlogging, with abundant sunshine and varied elevational zones, are ideally suited to a diverse portfolio of horticultural crops. Such natural endowments are rare and, if properly leveraged, provide a durable basis for competitive horticultural production.

Market access has improved substantially following the completion of major bridge infrastructure over the Brahmaputra River, including the Dhola-Sadiya Bridge (2017) and the Bogibeel Bridge (2018). These projects have effectively opened the district to the large and dynamic markets of Assam and wider eastern India, transforming the commercial viability of horticultural exports from the district.

Farmers in the district are broadly willing to transition to horticulture, provided initial financial and technical support is available. The existing workforce, accustomed to agricultural labour and possessing traditional ecological knowledge, represents a valuable human capital base that can be effectively retrained and redirected toward scientific horticulture. The strong cultural attachment to land and farming also supports the case for agricultural transformation rather than rural-to-urban migration as the primary livelihood strategy.

The district's existing horticultural farmers — particularly those in roadside villages and peri-urban areas — have demonstrated that commercial cultivation of cardamom, orange, and other crops is viable, providing proof of concept for wider adoption. The advantages of horticulture over shifting cultivation, summarized below, make the case for transition compelling:

i. Greater profitability per unit of land compared to shifting cultivation;

ii. Perennial production from established orchards and plantations without annual land clearing;

iii. Significantly lower ecological impact on forest and biodiversity resources;

iv. Employment generation and support for rural non-farm income activities;

v. Enhanced household nutritional security through diversified food production; and

vi. Compatibility with the livelihood aspirations of older and less mobile rural residents who can maintain orchards with less physical effort than shifting cultivation.

7. POLICY RECOMMENDATIONS

Based on the foregoing analysis, the following policy recommendations are advanced for the sustainable development of horticulture in East Siang District:

i. The government should establish permanent horticultural extension centres at the circle level and recruit adequately trained extension officers. Regular farmer training programmes covering scientific cultivation, pest management, organic farming, vermicomposting, and post-harvest practices should be institutionalized. Farmer exposure visits to progressive horticultural zones in Himachal Pradesh, Sikkim, and Meghalaya should be organized to demonstrate best practices.

ii. Investment in small-scale irrigation systems — including water harvesting structures, check dams, and micro-irrigation (drip and sprinkler) systems — is essential for extending the productive horticultural season and mitigating drought stress during October–February.

iii. Establishment of community-level cold storage facilities and primary processing units at key market nodes would substantially reduce post-harvest losses, stabilize farmgate prices, and enable market access for perishable commodities beyond the local district market.

iv. A dedicated horticultural credit programme, with adapted collateral requirements that acknowledge the tribal land tenure system of Arunachal Pradesh, should be developed in consultation with regional rural banks and the State Government. Farmer producer organizations (FPOs) could serve as collective borrowers, reducing individual credit risk.

v. Government nurseries supplying certified, disease-free, and high-yielding planting material should be expanded and made accessible to farmers in all circles. Private nursery development should be encouraged through subsidized registration and quality certification systems.

vi. A network of regulated produce markets (mandis), direct farmer-to-consumer linkages, and electronic market platforms should be developed to reduce intermediary exploitation. The existing APMC framework should be strengthened and reformed to genuinely serve producer interests.

vii. A horticultural crop insurance scheme adapted to northeastern Indian conditions — possibly based on weather-index or area-yield index approaches — should be extended to cover all major horticultural crops in the district.

viii. Subsidized supply of durable galvanized wire mesh fencing, with adequate quantities to secure full garden perimeters, should be provided to all registered horticultural farmers to protect crops from stray domestic animals.

ix. All-weather road connectivity to circle headquarters and major producing villages — including Sissen village and similar isolated settlements — should be prioritized in state public works planning to enable effective market access for horticultural produce.

8. CONCLUSION

Horticulture holds transformative potential for the rural economy of East Siang District, Arunachal Pradesh. The district's favourable agro-climatic endowments — fertile soils, abundant rainfall, varied topography, and diverse crop suitability — constitute a strong natural foundation for horticultural expansion. However, realizing this potential requires sustained and coordinated public investment across multiple dimensions simultaneously: scientific training, extension outreach, cold storage and processing infrastructure, small-scale irrigation, institutional credit, crop insurance, market development, and all-weather road connectivity.

The structural constraints documented in this study are not isolated — they are mutually reinforcing. Poor connectivity limits market access; limited credit access prevents investment in irrigation and fencing; the absence of cold storage forces distress sales; and weak extension services prevent productivity improvement. This systemic interdependence means that piecemeal interventions are likely to have limited impact. An integrated horticultural development programme, co-designed with farmer communities and aligned with the State Horticulture Action Plan 2020–2025, is the appropriate policy response.

If adequately supported, horticulture can become a major source of livelihood security, employment generation, ecological conservation, and economic transformation among the tribal communities of East Siang District and Arunachal Pradesh as a whole. Reducing dependence on shifting cultivation through commercial horticulture is not only an economic imperative but also an ecological necessity in the face of growing pressure on the fragile hill ecosystems of the northeastern Himalayan region.

REFERENCES

[1] Arunachal Pradesh Horticulture Department. (2018). *Annual Report on Horticulture Development in Arunachal Pradesh*. Government of Arunachal Pradesh, Itanagar.

[2] Arunachal Pradesh Horticulture Policy (2025). *State Horticulture Action Plan 2025–2035*. Directorate of Horticulture, Government of Arunachal Pradesh.

[3] Borthakur, D. N. (1992). Agriculture and allied activities in north-east India: Problems and prospects. *Indian Journal of Agricultural Economics*, *47*(3), 365–374.

[4] Central Agricultural University, Pasighat. (2016). *Survey Report on Natural Enemies of Horticultural Pests in East Siang District*. CAU-Pasighat.

[5] Chadha, K. L. (Ed.). (2001). *Handbook of Horticulture*. Indian Council of Agricultural Research, New Delhi.

[6] Das, A., Ramkrushna, G. I., Patel, D. P., Munda, G. C., & Ghosh, P. K. (2011). Productivity improvement and soil health in ginger-based cropping systems in north-east India. *Journal of Sustainable Agriculture*, *35*(7), 763–785. https://doi.org/10.1080/10440046.2011.588726.

[7] Deka, B. C., & Shadeque, A. (2009). Horticultural development in the northeast: Constraints and prospects. In *Proceedings of the National Seminar on Horticulture for Rural Prosperity*, pp. 45–58. Indian Society of Horticultural Research, Bangalore.

[8] Government of India, Ministry of Agriculture. (2001). *Technology Mission for Integrated Development of Horticulture in the North Eastern and Himalayan States*. Ministry of Agriculture, New Delhi.

[9] Government of India, Ministry of Agriculture. (2005). *National Horticulture Mission: Scheme Guidelines*. National Horticulture Mission, New Delhi.

[10] Government of India, Planning Commission. (1997). N*inth Five Year Plan 1997–2002: Agriculture and Allied Sectors*. Planning Commission of India, New Delhi.

[11] Government of India, Ministry of Agriculture & Farmers Welfare. (2022). *Horticulture Statistics at a Glance 2021*. Department of Agriculture & Farmers Welfare, New Delhi.

[12] Imchen, T. (2014). Development of horticulture in northeast India: Issues and challenges. *Indian Journal of Hill Farming*, *27*(1), 32–40.

[13] Krishnamurthy, K. S., Parthasarathy, V. A., Srinivasan, V., & Thankamani, C. K. (2010). Cardamom cultivation: Problems and prospects in hill regions of India. *Journal of Spices and Aromatic Crops*, *19*(1–2), 37–52.

[14] Kumar, S., & Dey, P. (2011). Effects of different mulches and irrigation methods on root growth, nutrient uptake, water-use efficiency and yield of strawberry. *Scientia Horticulturae*, *127*(3), 318–324.

[15] Nath, P., & Gaddagimath, P. B. (2011). *Horticulture Development in India*. Agricultural Development Publications, New Delhi.

[16] National Horticulture Board. (2021). *Indian Horticulture Database 2020*. National Horticulture Board, Ministry of Agriculture & Farmers Welfare, Gurugram.

[17] Panda, N. (1997). Principles of integrated pest management. In *Pest Management in Horticulture* (pp. 104–128). Kalyani Publishers, New Delhi.

[18] Pattanayak, A., Mohapatra, S. D., & Shukla, A. K. (2014). *Constraints in production and productivity of horticulture crops in North-East India*. ICAR Research Complex for NEH Region, Umiam.

[19] Ramesh, P. (2000). Effects of vermicomposts and vermiculture on plant growth and soil nutrient status. *Indian Journal of Agronomy*, *45*(3), 572–576.

[20] Roy, B. (2004). Tribal economy and forest resource use in Arunachal Pradesh. *Man and Environment*, *29*(2), 81–92.

[21] Sangma, P. A., & Bhatt, M. D. (2008). Marketing of fruits and vegetables in Meghalaya: Problems and prospects. *Agricultural Marketing*, *51*(1), 30–36.

[22] Sharma, B. D., Pant, C. C., & Pandey, R. K. (2002). Horticultural development in mountain regions. *Journal of Mountain Science*, *9*(4), 217–230.

[23] Singh, H. P., Parthasarathy, V. A., & Nirmal Babu, K. (Eds.). (2008). *Horticulture for Sustainable Income and Environmental Protection (Vol. 1)*. Malhotra Publishing House, New Delhi.