

Facing challenges and identifying relevant research and development areas to enhance kiwifruit production in Nepal

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Abstract. Due to the favorable agro-climatic conditions of Nepal's mid-hills and increasing market demand, kiwifruit has emerged as a high-value horticultural crop in recent decades. Since its introduction in the late 1980s, area coverage and productivity have grown gradually. However, several production and postharvest challenges continue to limit its commercial potential. This study identifies key research and development (R&D) priorities to promote the sustainable growth of kiwifruit in Nepal. Major constraints include limited varietal adaptability, poor orchard practices such as canopy and crop load management, inadequate pollination and soil fertility management, lack of integrated pest and disease control, and inefficient weed control. Additional issues include weak postharvest infrastructure, low climate resilience, insufficient mechanization, and high labor dependency. Market development and value chain integration also remain underdeveloped. To address these challenges, the study highlights critical R&D interventions, including varietal improvement, pollinator management, nutrient optimization, pest and disease management, and climate-smart practices. Emphasis is also placed on postharvest handling, labor-efficient technologies, and building robust market linkages through cooperative models. Strategic investment in localized research, farmer capacity-building, and enabling policies is recommended to shift the kiwifruit industry from a subsistence model to a competitive, high-value, and export-oriented enterprise. These findings aim to guide researchers, policymakers, and producers in shaping a resilient and profitable kiwifruit sector that contributes to rural livelihoods, national fruit sufficiency, and export diversification.

Keywords: *Agro climate, postharvest management, constraints, market enhancement, and value chain.*

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1. Introduction

In the recent few decades, Kiwifruit (*Actinidia deliciosa*) has emerged as a promising high-value horticultural crop in Nepal due to its exceptional nutritional profile and medicinal benefits, increasing consumer demand, and suitability to the country's diverse agro-climatic conditions (Rai, 2025; Shrestha & Ghimire, 2019; Paudyal & Sapkota, 2019). Over the last decade, kiwi cultivation has expanded rapidly, particularly in mid-hill regions such as Dolakha, Ramechhap, Kavre, Ilam, Dhankuta, and Bhojpur, where the altitudes and climatic conditions are favorable for its growth (Rai & Rai, 2024a, 2024b; Koirala et al., 2022). Despite this encouraging growth trend, the kiwi industry in Nepal remains at an early developmental stage. It faces several production, postharvest, and market-related challenges that hinder its full potential for commercialization and establishment of an export-oriented production system (MoALD, 2021).

In this context, identifying and prioritizing relevant research and development (R&D) areas is critical to achieving accelerated and sustainable growth of kiwi production in Nepal. The R&D interventions are necessary to address bottlenecks across the entire kiwi value chain, from nursery management and varietal selection to postharvest handling and market expansion inside the country (FAO, 2018; Acharya & Dhakal, 2020). From a production level perspective, Nepalese kiwi farming often suffers from several issues, including poor quality plant material, inadequate and improper orchard management practices, a lack of proper training systems for the vines, and low productivity per vine (Paudyal & Sapkota, 2019; Koirala et al., 2022).

Besides, issues related to insect, pest, and disease management, soil fertility, and integrated nutrient management, as well as pollination, further exacerbate yield instability and fruit quality-related problems. In many regions, growers lack access to improved cultivars adapted to local conditions and resilient to biotic and abiotic stresses, thereby limiting both yield potential and fruit quality (Shrestha & Ghimire, 2019). Recently due to the outmigration from rural areas to urban areas, as well outmigration of populations towards foreign countries, there is an emerging trend of plant protection measures regarding the protection of crop plants from primates (Rai & Rai, 2024c).

In addition, postharvest management of any fruits in Nepal remains underdeveloped. Farmers often encounter significant postharvest losses due to improper harvesting techniques, lack of grading and sorting infrastructure, inadequate cold storage facilities, and limited knowledge on extending shelf life (Rakesh et al., 2021). These constraints reduce marketable surplus, compromise fruit quality, and result in poor price realization in both domestic and potential export markets (HODEC Nepal, 2017; FAO, 2018). Furthermore, value chain development, including the establishment of efficient collection centers, cold chains, and market linkages, is essential for increasing profitability and encouraging further investment in kiwi farming (Bajracharya & Sapkota, 2020). Market-oriented research on consumer preferences, quality standards, and potential for processing into value-added products (such as kiwi wine, jams, and dried kiwi slices) remains unexplored. However, it offers promising opportunities for income diversification (Rakesh et al., 2021).

Therefore, a strategic focus on key R&D areas such as varietal improvement and adaptability studies, appropriate and efficient propagation techniques, advanced orchard and canopy management, integrated pest, disease, and nutrient management, mechanization for labor efficiency, postharvest technology, and market development is crucial (Costa & Testolin, 1991; Acharya & Dhakal, 2020; Rai & Rai, 2024a, 2024b). Strengthening these areas through targeted research, extension, and policy support will play a vital role in overcoming current constraints and achieving accelerated growth of kiwi production in Nepal (Rai, 2025; Nepal et al., 2025). After systematically identifying and addressing these R&D priorities, Nepal can transform its kiwi sector from small-scale, subsistence-level production into a competitive, high-value commercial enterprise, contributing to rural livelihoods, national fruit self-sufficiency, and potential export earnings in the future (Paudyal & Sapkota, 2019; Koirala et al., 2022).

2. Variety improvement and development

The variety improvement is a cornerstone of any sustainable horticultural crop development program. In Nepal, kiwifruit cultivation is still relatively new and relies heavily on a few introduced cultivars such as 'Abbott', 'Allison', 'Bruno', 'Hayward', and Monty (Green fleshed), Golden kiwi, and red kiwi. These varieties, although popular, are not fully adapted to all Nepalese agro-climatic conditions and often face challenges related to low yield, poor fruit quality, and vulnerability to diseases and climatic stresses. Proper performance evaluation of these varieties along with improving and developing varieties that are well-suited to Nepal's diverse topography and climatic conditions is essential for enhancing productivity, fruit quality, and farmer profitability.

2.1. Current status of varieties and limitations

Till now, Nepal has mainly cultivated a few imported kiwifruit varieties, particularly 'Hayward' (a green-fleshed variety of *A. deliciosa*) and some yellow-fleshed cultivars like 'Hort16A'. These varieties have been introduced from New Zealand, Italy, and China through private nurseries and development projects (Poudel et al., 2019). However, these imported varieties may not be optimally suited to all Nepalese microclimates, leading to challenges such as inconsistent yield, susceptibility to diseases, and variable fruit quality. Some limitations are listed below:

Limited genetic diversity: Most orchards are established using a narrow genetic base, primarily depending on a few imported varieties. This limits adaptability and increases vulnerability to biotic and abiotic stresses.

Inconsistent fruit quality and yield: Existing cultivars often show variability in fruit size, shape, and internal quality due to poor adaptation and lack of proper canopy management.

Disease and pest susceptibility: Current varieties lack resistance to emerging pests and diseases observed in different growing regions.

Market constraints: The lack of varieties with diverse harvest windows limits market availability and price stability.

2.2. Need for variety improvement

Several challenges highlight the urgent need for local variety improvement in Nepal as listed below:

Low chilling and frost tolerance: Many imported cultivars are sensitive to late frosts and chilling injury, which are common in Nepalese hills (Shrestha & Ghimire, 2020).

Disease resistance: There is increasing concern over bacterial canker (*Pseudomonas syringae* pv. *actinidiae*), which affects yield and vine health (Kim et al., 2016).

Adaptation to diverse elevations: Nepal's diverse altitudes (800–2,500 m) require varieties suited to both low and high chilling requirements.

Quality improvement: Local breeding programs can focus on enhancing sweetness, storage life, and nutritional quality.

2.3. Approaches and strategies for variety improvement

Introduction and evaluation of exotic germplasm: One of the first steps involves introducing promising cultivars from kiwifruit-producing countries and evaluating their performance under Nepalese conditions. Several advanced selections from China and New Zealand have traits like better storage quality and disease resistance (Huang et al., 2021). It would be better to conduct multi-location trials to evaluate adaptability, yield potential, fruit quality, and resistance to local stresses in the different agro climatic conditions across the mid hills of Nepal from east to west.

Hybridization and breeding: Hybridization programs aim to combine desirable traits such as disease resistance, better fruit quality, and climatic adaptability. Crosses between *A. deliciosa* and *A. chinensis* have been successfully used in other countries to produce yellow- and red-fleshed varieties (Testolin & Ferguson, 2009a). In collaboration with Nepalese research institutions like NARC (Nepal Agricultural Research Council) MBUST could initiate controlled pollination and selection programs.

Selection of local adapted clones: Some farmers have observed spontaneous variation or chance seedlings in their orchards. Identifying and selecting such locally adapted clones with superior performance can be an effective, low-cost approach for Nepal (Subedi et al., 2020). Multiplication of selected lines through vegetative propagation and evaluate under different conditions.

Interspecific and Intraspecific Hybridization: (a) Use breeding programs involving crosses between different *Actinidia* species (e.g., *A. chinensis*, *A. arguta*, *A. deliciosa*) to combine desired traits. (b) Develop hybrids with improved traits such as higher vitamin C content, improved shelf life, and attractive flesh colors (e.g., yellow or red).

Biotechnological Interventions: Modern biotechnological tools, including marker-assisted selection and tissue culture propagation, can accelerate breeding programs. These techniques help in early detection of desirable traits and ensure the mass multiplication of elite planting materials (Ferguson & Huang, 2007).

Rootstock Improvement: (a) Explore and develop rootstocks with improved resistance to soil-borne diseases and abiotic stresses (drought, frost). (b) Study compatibility and influence of different rootstocks on scion performance.

2.4. Objectives of variety improvement

(a) Develop high-yielding, stable, and uniform varieties suited to different agro-ecological zones in Nepal. (b) Enhance fruit quality traits such as size, shape, taste, nutritional value, and shelf life. (c) Improve resistance to major diseases (e.g., bacterial canker) and pests. (d) Introduce early-, mid-, and late-maturing varieties to extend the harvesting season and supply.

2.5. Traits of interest for future varieties

High yield potential: Consistent and heavy bearing vines.

Superior fruit quality: Larger fruits with uniform size and shape, high soluble solids (sugar content), balanced acidity, and rich aroma.

Longer shelf life: To withstand postharvest handling and transport.

Disease and pest resistance: Especially resistance to bacterial canker and crown gall.

Adaptability: Ability to perform well under varying climatic and soil conditions found in Nepal.

Staggered maturity: Varieties with different harvesting times to ensure market continuity.

2.6. Challenges in variety development in Nepal

Limited infrastructure: Lack of advanced breeding facilities and nurseries.

Inadequate research manpower and expertise: Need for skilled plant breeders and molecular biologists.

Long breeding cycles: Kiwi breeding is time-consuming, as plants take several years to reach reproductive maturity.

Limited funding and policy support: R&D in horticultural crops often receives less priority.

2.7. Research and development areas

(a) Development of high-yielding, climate-resilient, and disease-resistant kiwi varieties suited for Nepalese conditions. (b) Breeding for early- and late-maturing varieties to extend harvest season and market supply. (c) Evaluation of new germplasm and interspecific hybrids for quality improvement.

3. Canopy management and crop load regulation

The canopy management and crop load regulation are crucial horticultural practices that directly affect fruit quality, yield consistency, and overall orchard health. Vine pruning and thinning of flowers/fruits directly influence fruit size, quality, and uniformity. In Nepal, improper pruning practices often lead to poor fruit quality and inconsistent yields. In this context canopy management and crop load regulation practices are crucial for achieving high-quality kiwifruit in Nepal (Baral et al., 2021; Costa, 1990a).

3.1. Importance of canopy management

The canopy management refers to the systematic training and pruning of vines to create an optimal framework for light interception, airflow, and fruit exposure. In kiwifruit, a well-managed canopy ensures better photosynthetic efficiency, reduces disease incidence, and enhances fruit coloration and size uniformity (Testolin & Ferguson, 2009b).

Nepalese kiwifruit growers primarily use the pergola and T-bar training systems to support vines. Pergola systems are preferred in higher rainfall areas as they promote better air circulation, reducing the risk of fungal diseases like Botrytis and Pseudomonas syringae pv. actinidiae (Psa) (Baral et al., 2021).

Pruning, an essential aspect of canopy management, helps maintain a balance between vegetative growth and reproductive output. Winter pruning (dormant pruning) is carried out to remove excess canes and stimulate fruitful bud development, while summer pruning controls excessive vegetative growth and improves fruit exposure to sunlight (Costa, 1990b).

3.2. Common problems in Nepal

(a) Dense, overcrowded canopies with excessive vegetative growth. (b) Poor light penetration leading to small, low-quality fruits. (c) High humidity and poor air movement favor disease development (e.g., bacterial canker).

3.3. Canopy management techniques

Training systems: Proper training shapes the vine structure during the early years. Common systems include: (a) T-bar (Pergola or overhead trellis): Widely used, allows good light interception and supports heavy crop loads. (b) Single or double leader systems: Encourage upright growth and facilitate pruning and harvesting.

Pruning: Pruning is an annual practice essential for controlling vine vigor and balancing vegetative and reproductive growth. There are two main types: (a) winter pruning (dormant pruning): Removes unproductive wood, shapes the vine, and regulates bud load. (b) Summer pruning (green pruning): Controls excessive vegetative growth, improves light penetration, and directs nutrients to developing fruits.

Objectives of pruning: (a) Maintain optimal bud load for quality fruit production. (b) Regulate vine size and prevent canopy overcrowding. (c) Renew fruiting wood to maintain consistent yields.

Shoot thinning and positioning: (a) Remove weak or excessive shoots during early growth stages. (b) Position shoots to avoid shading and improve airflow.

3.4. Crop load regulation

Crop load regulation refers to adjusting the number of fruits per vine to optimize fruit size and quality. Excessive crop load can lead to smaller, less flavorful fruits, delayed maturity, and reduced storage life (Antognozzi et al., 1997). In Nepal, natural fruit set in kiwifruit is generally high, especially in cultivars like 'Hayward'. Without thinning, vines may carry excessive fruit loads,

compromising marketable quality. To address this, manual thinning of flowers or young fruits is practiced to maintain an optimal number of fruits per cane or per square meter of canopy area (Baral et al., 2021). Research suggests maintaining approximately 25–30 fruits per square meter of canopy as an ideal crop load for 'Hayward' to achieve desirable fruit size and quality (Testolin, 2009).

3.5. Methods of crop load regulation

Flower thinning: (a) Remove excess flower buds during the early flowering stage. (b) Reduces fruit set, allowing the remaining fruits to grow larger and with better quality.

Fruit thinning: (a) Conducted shortly after fruit set (when fruits are pea-sized). (b) Weak, misshapen, or overcrowded fruits are removed. (c) Ensures optimal spacing of fruits on the vine.

Consequences of improper crop load: (a) Overloaded vines produce small, poor-quality fruits with low market value. (b) Reduced vine vigor and higher susceptibility to diseases. (c) Irregular bearing or biennial bearing cycles.

Synergistic effect on fruit quality: Proper canopy management combined with regulated crop load has a synergistic impact on fruit quality attributes such as soluble solids content (SSC), dry matter accumulation, skin color, and firmness. Adequate light distribution within the canopy enhances photosynthate allocation to developing fruits, resulting in improved sweetness and storability (Greer et al., 2003). Moreover, good canopy architecture reduces shading, thus minimizing fungal disease incidence and allowing better spray penetration during plant protection operations (Ferguson, 1999).

3.6. Research gaps in Nepal

Despite the importance, systematic studies on canopy and crop load management in Nepal are limited. Key gaps include: (a) Lack of region-specific pruning and thinning guidelines considering local climates and cultivars. (b) Inadequate knowledge on optimum bud and fruit load per vine for different varieties. (c) Limited farmer training on practical techniques for shoot management and load regulation.

3.7. Recommendations for Nepalese orchards

Develop localized guidelines: (a) Conduct multi-location trials to determine best pruning times and intensities for different elevations and varieties. (b) Establish ideal male-to-female vine ratios and canopy shapes for improved pollination and fruit set.

Farmer capacity building: (a) Organize regular training and demonstration programs focusing on pruning, shoot management, and fruit thinning. (b) Develop illustrated manuals and video guides in local languages.

Integrated approach: (a) Combine canopy and crop load management with nutrition and irrigation management for maximum benefits. (b) Promote integrated disease management practices to support healthy canopies.

Introduce mechanization tools: Design and introduce simple tools (e.g., pruning shears, ladders, lightweight trellis management equipment) suitable for hill terrains to improve labor efficiency.

3.8. Research and development areas

(a) Optimization of pruning systems and techniques tailored to Nepalese farming practices. (b) Study on flower and fruit thinning to achieve desirable fruit size and uniformity. (c) Training modules for farmers on canopy management for improved light interception and air circulation.

4. Pollination biology and pollinator management

4.1. Pollination biology of kiwifruit

Kiwifruit (*Actinidia deliciosa*) is a dioecious vine, meaning male and female flowers are borne on separate plants. Therefore, successful fruit set requires effective cross-pollination between male and female flowers. The female flowers are morphologically perfect but functionally female, while male flowers provide pollen but do not develop fruit (Testolin & Ferguson, 2009c). The female flowers have numerous stigmas arranged in a radial pattern, which require abundant viable pollen to achieve full seed set and optimal fruit development. Poor pollination leads to misshapen fruits, reduced size, and lower market value (Goodwin, 1980). In natural conditions, wind is insufficient for pollen transfer in kiwifruit; thus, insect pollinators, especially honey bees (*Apis mellifera*), play a crucial role in transferring pollen grains from male to female flowers (McBrydie et al., 2016).

4.2. Pollination requirements and challenges in Nepal

In Nepal, the adoption of kiwifruit cultivation has been expanding, especially in mid-hill regions (1,200–2,400 m) due to favorable agro-climatic conditions (Neupane & Paudel, 2021). However, pollination remains a significant challenge for many farmers. The spatial arrangement of male and female vines, insufficient bee populations, and erratic weather during flowering periods often cause suboptimal fruit set. Proper vine layout (usually a male to female ratio of 1:6 to 1:8) is crucial for adequate pollination (Testolin & Ferguson, 2009c). Farmers in Nepal sometimes lack awareness regarding optimal planting designs and bee management, leading to pollination failures and economic loss.

4.3. Role of managed pollinator in Nepal

Current situation: (a) Limited awareness among farmers about the importance of managed pollinators. (b) Low densities of natural pollinators in many orchards due to pesticide use and habitat loss. (c) Poor male-to-female vine ratios, often resulting in insufficient pollen availability.

4.4. Strategies for effective pollinator management

To ensure effective pollination the following strategies are recommended for Nepalese Kiwifruit growers.

Optimal male-to-female vine ratio and arrangement: Planting male vines evenly within female blocks to reduce pollen transfer distances. (a) Recommended ratio: Generally, one male vine for every 6–8 female vines (approx. 10–15% male plants) is optimal. (b) Planting male vines evenly throughout the orchard ensures uniform pollen distribution.

Introduction and management of bee colonies: Deploying honeybee colonies at appropriate densities and ensuring hives are introduced when at least 10% of the female flowers have opened (Howpage et al., 2001).

Honey bees (*Apis mellifera*): (a) Widely used due to availability and ease of management. (b) Approximately 8–10 strong bee colonies per hectare are recommended during flowering.

Bumble bees (*Bombus* spp.): (a) Effective under cool or cloudy conditions, as they can forage at lower temperatures than honey bees. (b) Not yet widely used in Nepal but have high potential, especially in high-hill areas.

Orchard management for bee activity: (a) Avoid pesticide spraying during flowering. (b) Plant flowering hedgerows or maintain natural flora around orchards to support bee populations. (c) Provide water sources and safe nesting sites.

Artificial pollination: Hand or mechanical pollen application can be used in critical situations but is labor-intensive and costly (Testolin & Ferguson, 2009d). (a) Hand pollination or mechanical pollen spraying can supplement natural pollination, especially in years with poor bee activity. (b) Requires collection and preservation of viable pollen from male vines.

Synchronization of flowering: (a) Select male varieties that bloom in synchrony with female varieties to ensure pollen availability. (b) Pruning or girdling techniques can sometimes be used to adjust flowering times.

Protection of pollinators: Avoiding pesticide sprays during flowering or using bee-friendly chemicals at dusk when bees are not active.

Habitat management: Providing flowering plants around orchards to support wild and managed pollinator populations year-round (Bhusal & Chapagain, 2020).

4.5. Challenges in pollinator management in Nepal

Low awareness and training: Many farmers do not know the significance of bees and other pollinators or how to manage them effectively.

Pesticide misuse: Indiscriminate use of broad-spectrum insecticides during critical periods harms pollinator populations.

Limited access to managed bee colonies: In many hilly and remote areas, there is poor availability of beekeeping services and colonies.

Weak extension services: Lack of practical field demonstrations and technical support.

4.6. Research and development needs

(a) Study on native pollinator species and their effectiveness in kiwi orchards. (b) Research on optimal colony strength and placement strategies for different agro-ecological zones. (c) Development of low-cost artificial pollination techniques suitable for smallholder farmers. (d) Studies on the impact of climate conditions on flowering synchrony and pollinator behavior.

4.7. Research and development areas

(a) Study on effective ratios of male to female plants in orchards. (b) Evaluation of different pollinator species and introduction of managed pollinators (e.g., honey bees, bumble bees). (c) Research on artificial pollination techniques to improve fruit set.

5. Soil and nutrient management

Kiwi vines have specific soil fertility and water requirements, which are often overlooked in Nepalese orchards. Soil and nutrient management are crucial for sustainable kiwifruit cultivation, as they directly influence vine health, yield potential, fruit quality, and orchard longevity. Kiwifruit is a deep-rooted, perennial climber with high nutrient and water demands, especially during flowering and fruit development stages.

In Nepal, kiwi is mainly grown in mid- and high-hill regions, where soils are often shallow, acidic, and low in organic matter. Inadequate knowledge of site-specific soil fertility and improper nutrient practices have resulted in stunted growth, poor fruit size, and lower yields. Effective soil and nutrient management can help Nepalese kiwi growers achieve higher productivity and improve fruit quality sustainably.

5.1. Soil requirements for kiwifruit

Ideal soil conditions: (a) Texture: Deep, well-drained sandy loam to loamy soils. (b) Depth: Minimum 1–1.5 m deep to support extensive root systems. (c) Drainage: Excellent drainage to prevent water logging, which can cause root rot. (d) pH range: Slightly acidic to neutral (5.5–6.5 is ideal). (e) Organic matter: High organic matter content enhances nutrient and water retention.

Soils with good moisture-holding capacity and aeration are preferred to support vigorous vine growth and root development. In Nepal, many mid-hill regions have acidic soils; hence, liming is often recommended to correct pH and improve nutrient availability.

Soil preparation and amendments: Before planting, thorough soil preparation is essential. This includes deep plowing and incorporation of organic manures such as well-decomposed farmyard manure (FYM) at a rate of 20–30 kg per plant to enhance soil fertility and microbial activity (Paudel et al., 2019). Green manuring and incorporation of compost also help in improving soil structure and nutrient content.

Soil amendments: (a) Lime application: Correct soil acidity based on soil test results; typically 2–4 tons/ha lime applied several months before planting. (b) Organic matter incorporation: Apply 20–30 tons/ha of well-decomposed farmyard manure (FYM) or compost to improve soil structure and fertility. (c) Green manuring: Planting leguminous cover crops to enhance nitrogen content and soil health.

5.2. Nutrient requirements and fertilizer management

Kiwifruit vines have high nutrient demands, particularly for nitrogen (N), phosphorus (P), and potassium (K). Balanced nutrition is crucial because excessive nitrogen can lead to excessive vegetative growth at the expense of fruiting, while deficiencies of phosphorus and potassium can negatively affect fruit quality and vine health.

General fertilizer recommendations (per mature vine per year) in Nepal are as follows: (a) Nitrogen (N): 500–600 grams. (b) Phosphorus (P_2O_5): 250–300 grams. (c) Potassium (K_2O): 600–800 grams (Subedi et al., 2020).

These fertilizers are usually applied in split doses: one-third before bud break (early spring), one-third during flowering, and the remaining during fruit development. Micronutrients such as boron (B), zinc (Zn), and magnesium (Mg) are also important for kiwifruit, as their deficiencies can cause poor fruit set, distorted fruits, and leaf chlorosis. Foliar sprays of boron (0.2%) and zinc sulfate (0.5%) are commonly recommended.

5.3. Organic nutrient management

In Nepal, organic farming practices are gaining popularity to cater to niche markets and reduce dependency on chemical fertilizers. Use of FYM, compost, vermicompost, bio-fertilizers (e.g., Azotobacter, phosphate solubilizing bacteria), and incorporation of cover crops help in maintaining soil fertility sustainably. Organic amendments improve soil organic carbon levels, enhance microbial diversity, and support long-term productivity (Liu et al., 2021).

5.4. Soil erosion and moisture conservation

Terracing, mulching, and cover cropping are important practices in Nepal's hilly terrain to minimize soil erosion and maintain soil moisture. Mulching with straw or plastic sheets helps reduce water loss, suppress weeds, and improve soil temperature, supporting root growth and nutrient uptake.

5.5. Soil and leaf nutrient analysis

Regular soil testing (every 2–3 years) and leaf nutrient analysis (during mid-summer) are recommended to monitor nutrient status and adjust fertilizer programs accordingly. This diagnostic approach helps prevent nutrient imbalances and ensures optimal vine health and fruit quality (MoALD, 2020).

5.6. Challenges and future needs

Despite the importance of proper soil and nutrient management, many Nepalese kiwifruit growers lack access to soil testing facilities and appropriate technical guidance. Over-reliance on chemical fertilizers without proper balance can lead to soil degradation and reduced vine performance in the long term. There is a need for capacity building among farmers on integrated nutrient management, improved extension services, and wider availability of soil health cards.

Current challenges in Nepal: (a) Limited access to soil testing facilities and advisory services. (b) Poor awareness among farmers about balanced nutrition and correct application methods. (c) Over-reliance on nitrogen fertilizers, often ignoring micronutrients. (d) Soil degradation from continuous erosion and inadequate soil conservation practices.

5.7. Research and development areas

(a) Soil fertility mapping and nutrient requirement studies for different agro-ecological zones. (b) Development of balanced fertilization schedules and organic amendments for kiwi. (c) Research on soil microbiome and its role in vine health and productivity.

6. Pest and disease management

As Kiwifruit (*Actinidia deliciosa*) cultivation in Nepal is gaining popularity, particularly in mid-hill regions with suitable climatic conditions. However, increasing production has also led to the emergence of various pests and diseases, which pose serious threats to yield and fruit quality. Integrated pest and disease management (IPDM) approaches are crucial for ensuring sustainable kiwifruit production in Nepal.

6.1. Major pests of kiwifruit in Nepal

Leaf rollers (*Ctenopseustis* spp., *Planotortrix* spp.): (a) Damage: Larvae feed on leaves, flowers, and developing fruits, causing defoliation and fruit scarring. (b) Impact: Reduced photosynthesis, poor fruit quality, and increased susceptibility to secondary infections.

Fruit flies (*Bactrocera* spp.): (a) Damage: Ovipositor punctures on developing fruits, leading to rotting and premature fruit drop. (b) Impact: Direct yield losses and reduced marketability.

Scale insects (e.g., San Jose scale): (a) Damage: Suck sap from twigs, leaves, and fruits, leading to weakening of vines and poor fruit development. (b) Impact: Reduced plant vigor and yield.

Aphids: (a) Damage: Feed on tender shoots and leaves, causing curling and stunted growth. Also act as vectors for viral diseases. (b) Impact: Weaken vines and affect new shoot development.

Mites: (a) Damage: Feed on undersides of leaves, causing stippling, bronzing, and leaf drop. (b) Impact: Lower photosynthetic efficiency and reduced vine vigor.

6.2. Major diseases in kiwifruit in Nepal

Bacterial canker (*Pseudomonas syringae* pv. *actinidiae*, PSA): (a) Symptoms: Cankers on trunks and canes, wilting of shoots, leaf spots, and exudation of red or white bacterial ooze. (b) Impact: Severe vine dieback and potential orchard-wide losses.

Crown and root rot (*Phytophthora* spp.): (a) Symptoms: Root decay, poor vine growth, leaf yellowing, wilting, and sudden vine collapse. (b) Impact: Death of vines and loss of orchard investment.

Botrytis fruit rot (*Botrytis cinerea*): (a) Symptoms: Grey mold on fruit surfaces during wet and humid conditions. (b) Impact: Fruit rotting pre- and post-harvest, reducing marketable yield.

Armillaria root rot (*Armillaria mellea*): (a) Symptoms: Decay of roots, white fungal mycelium under bark, and gradual vine decline. (b) Impact: Slow but progressive vine death.

Sclerotinia rot: (a) **Symptoms**: Soft, watery rot on fruits and vines with cottony white fungal growth. (b) **Impact**: Rapid fruit and vine deterioration in humid conditions.

6.3. Factors contributing to pest and disease problems in Nepal

(a) Dense canopies and poor pruning practices that reduce air circulation and light penetration. (b) Excessive nitrogen fertilization, leading to lush, susceptible growth. (c) Inadequate drainage, promoting root diseases. (d) Lack of awareness and limited access to integrated pest and disease management (IPDM) knowledge and tools.

6.4. Integrated pest and disease management (IPDM) strategies

Cultural practices: (a) Use disease-free and certified planting material. (b) Maintain proper vine spacing and open canopies to improve airflow and reduce humidity. (c) Implement proper pruning to remove infected or dead wood. (d) Manage orchard hygiene by removing fallen leaves, pruned debris, and mummified fruits.

Monitoring and early detection: (a) Regular scouting for early signs of pests and diseases. (b) Use of pheromone traps and yellow sticky traps for monitoring insect populations.

Biological control: (a) Promote natural predators such as ladybird beetles (against aphids) and predatory mites. (b) Encourage beneficial organisms by reducing broad-spectrum pesticide use.

Mechanical and physical methods: (a) Manual removal and destruction of infested plant parts. (b) Installation of sticky barriers or bands to prevent crawling pests.

Chemical control (judicious and targeted): (a) Use of recommended fungicides (e.g., copper-based compounds for bacterial canker, systemic fungicides for root rots) as per disease calendar. (b) Insecticides targeted to specific pest infestations, applied during susceptible stages only. (c) Avoid spraying during flowering to protect pollinators.

Resistant rootstocks and varieties: (a) Promote research and use of disease-tolerant rootstocks to reduce susceptibility to root and crown rots. (b) Encourage future breeding for canker resistance.

Sanitation and soil health: (a) Improve drainage and avoid water stagnation to reduce root diseases. (b) Regularly apply organic amendments and bio-control agents (e.g., *Trichoderma spp.*) to suppress soil pathogens.

6.5. Challenges and future directions in Nepal

Limited research data: There is a scarcity of region-specific data on pest and disease prevalence, thresholds, and management strategies in Nepal.

Capacity building: Farmers need training on identification, monitoring, and safe pesticide use.

Need for bio-based solutions: Promotion of organic and environmentally friendly practices is necessary, particularly in hill areas where ecological balance is important.

6.6. Research and development areas

(a) Surveillance and identification of prevalent and emerging pests/diseases. (b) Development of integrated pest management (IPM) modules, including biological and cultural controls.

7. Postharvest handling and shelf life extension of kiwifruit

Postharvest handling and shelf life extension are critical components of kiwifruit production that determine market value, consumer satisfaction, and profitability. In Nepal, while kiwifruit production is increasing rapidly, significant losses occur due to poor postharvest practices, leading to reduced fruit quality, shortened shelf life, and limited market reach. Addressing these challenges through improved postharvest handling, storage, and value chain development is essential for supporting Nepal's growing kiwi industry. Improving postharvest handling and extending shelf life are critical to maintain fruit quality, reduce losses, and improve market returns for farmers in Nepal (Paudyal & Baral, 2019).

7.1. Postharvest physiology of kiwifruit

Kiwifruit is a climacteric fruit, meaning it continues to ripen after harvest due to an increase in ethylene production and respiration rate (Antunes & Sfakiotakis, 2002). It is typically harvested at physiological maturity when the soluble solids content (SSC) reaches about 6.5–7.0%, but it is not yet ready to eat (Gerasopoulos & Kanellis, 1996). Postharvest ripening is completed during storage or after ethylene treatment.

7.2. Harvesting practices

Proper harvesting practices are essential for minimizing mechanical injuries and ensuring better postharvest performance. In Nepal, kiwifruit is often hand-picked using clippers to avoid bruising and tearing of the skin (Paudyal & Baral, 2019). Harvesting should be done during the cool parts of the day to reduce field heat and metabolic activity.

7.3. Handling and packaging

7.3.1. Harvest maturity and timing

Importance of correct harvest maturity: (a) Kiwifruit should be harvested at physiological maturity to develop optimal eating quality during ripening. (b) Harvesting too early results in poor flavor development and low consumer acceptance. (c) Late harvesting may lead to over-softening, increased bruising, and reduced shelf life.

Indicators of maturity: (a) **Soluble solids content (SSC):** Minimum 6.5%–7% Brix at harvest (may vary by variety and market preference). (b) **Firmness:** Should remain above 8 kgf (kilogram-force) at harvest to ensure safe handling. (c) **Seed color:** Dark brown or black seeds indicate physiological maturity.

7.3.2. Postharvest handling steps

Careful harvesting: (a) Hand-pick fruits carefully to avoid cuts, abrasions, and mechanical injuries. (b) Avoid harvesting during wet conditions to reduce disease risk.

Pre-cooling: (a) Immediate removal of field heat after harvest is critical to slow metabolic processes and reduce water loss. (b) Hydro-cooling or forced-air cooling methods can be used, although such facilities are limited in Nepal.

Sorting and grading: (a) Remove damaged, diseased, or undersized fruits. (b) Grade fruits based on size, shape, color uniformity, and absence of blemishes to meet market standards.

Cleaning and drying: (a) Light cleaning to remove field debris and dust. (b) Allow fruits to dry completely before packaging to prevent microbial growth.

Packaging: (a) Use well-ventilated, strong cartons or plastic crates lined with cushioning material (e.g., soft paper or foam netting). (b) Avoid over packing to reduce compression damage.

7.3.3. Storage conditions

Cold storage: (a) Temperature: 0°C to 1°C. (b) Relative humidity: 90%–95%. (c) Under these conditions, kiwifruit can be stored for 3–6 months with minimal quality loss.

Controlled atmosphere (CA) storage: (a) Use of reduced oxygen (2%–5%) and increased CO₂ (5%–10%) levels to slow down respiration and delay ripening. (b) Extends storage life up to 6 months while maintaining firmness and flavor.

Cold storage is the most effective method for extending kiwifruit shelf life. Optimal storage conditions are 0 to –1°C with 90–95% relative humidity, under which fruit can be stored for up to 6 months without significant quality deterioration (Gerasopoulos & Kanellis, 1996). However, in Nepal, the availability of cold storage facilities is limited, and farmers often rely on ambient storage, leading to faster ripening and decay (Paudyal & Baral, 2019). Improving access to cold storage infrastructure is essential to reduce postharvest losses.

7.3.4. Treatments to extend shelf life

Controlled atmosphere storage (CA): CA involves adjusting oxygen and carbon dioxide levels to slow respiration and ethylene production. For kiwifruit, CA storage with 1–2% O₂ and 3–5% CO₂ can extend storage life beyond 6 months while maintaining firmness and flavor (Kader, 2002).

Ethylene management: Kiwifruit is highly sensitive to ethylene. The use of ethylene scrubbers or absorbers (e.g., potassium permanganate sachets) can delay ripening and softening ([Antunes & Sfakiotakis, 2002](#)).

1-Methylcyclopropene (1-MCP) treatment: 1-MCP is an ethylene action inhibitor that binds to ethylene receptors and delays ripening. Treatment with 1-MCP has been shown to maintain firmness, reduce decay incidence, and extend shelf life significantly ([McDonald & Harman, 2011](#)). Adoption of this technology in Nepal is still at an early stage.

Edible coatings: Natural edible coatings (e.g., chitosan, aloe vera gel) can create semi-permeable barriers that reduce moisture loss and delay ripening ([Ali et al., 2011](#)). This eco-friendly technology can be a cost-effective alternative for smallholder farmers.

Temperature management: Maintain cold chain from orchard to consumer to reduce physiological and pathological deterioration.

Modified atmosphere packaging (MAP): (a) Packaging fruits in plastic films with selective gas permeability to modify the internal atmosphere naturally. (b) Reduces respiration and moisture loss, prolonging shelf life during marketing.

Use of anti-ethylene treatments: (a) 1-Methylcyclopropene (1-MCP) can be used to inhibit ethylene action and delay ripening.

Postharvest fungicide or biological treatments: (a) Treatment with approved fungicides or bio-fungicides to reduce Botrytis and other storage rots. (b) Use of safe, consumer-acceptable coatings (e.g., chitosan) to reduce microbial decay and moisture loss.

7.3.5. Postharvest challenges in Nepal

Limited cold chain infrastructure: There are few cold storage units in major kiwifruit-producing areas such as Dolakha, Ramechhap, and Okhaldhunga.

Lack of training: Many farmers lack knowledge of best practices in handling, packaging, and postharvest treatments.

Transportation constraints: Poor road connectivity and inadequate transport facilities exacerbate losses.

Market price fluctuations: Due to poor shelf life, farmers are often forced to sell immediately after harvest at lower prices.

7.3.6. Research and development areas

(a) Development of postharvest handling protocols to minimize mechanical and physiological losses. (b) Research on storage technologies, including controlled atmosphere and cold chain development. (c) Studies on packaging materials and treatments to prolong shelf life and maintain quality.

8. Climate change adaptation

Climate change has emerged as a major threat to agricultural systems globally, and Nepal is no exception. Kiwifruit (*Actinidia deliciosa*), a relatively new and emerging high-value fruit crop in Nepal, is especially sensitive to climatic variations. Rising temperatures, erratic rainfall patterns, increased frequency of extreme weather events, and shifts in pest and disease dynamics are creating challenges for sustainable kiwifruit production in the country ([MoALD, 2022](#)).

8.1. Vulnerability of kiwifruit to climate change

Kiwifruit cultivation requires specific climatic conditions, such as adequate winter chilling hours (600–800 hours below 7°C) for proper bud break and flowering, moderate summer temperatures (16–25°C), and well-distributed rainfall (1500–2000 mm annually) ([Huang et al., 2019](#)). In Nepal, rising winter temperatures threaten to reduce chilling hour accumulation, leading to irregular bud break and flowering, ultimately affecting fruit yield and quality ([Paudyal & Baral, 2020](#)).

Additionally, the increasing unpredictability of monsoon rainfall has led to water stress, soil erosion, and increased susceptibility to diseases like bacterial canker and root rot. Extreme weather events, such as hailstorms and unseasonal frosts, further threaten kiwifruit orchards, especially in high-altitude areas.

8.2. Adaptation strategies for kiwifruit farming

Site selection and microclimate management: Careful selection of orchard sites based on altitude and microclimatic conditions is crucial. Establishing orchards at elevations where winter chilling requirements can still be met is recommended. Creating windbreaks, planting shelterbelts, and adopting terracing can help mitigate the effects of strong winds and soil erosion ([Paudyal & Baral, 2020](#)).

Water management and irrigation: With increasingly erratic rainfall patterns, supplementary irrigation has become essential. Efficient water management practices such as drip irrigation, rainwater harvesting, and mulching help maintain soil moisture and reduce evapotranspiration losses (Rai et al., 2022). Adoption of water-conserving technologies is crucial to ensure consistent fruit development during dry spells.

Use of climate-resilient varieties: Breeding and introducing kiwifruit varieties with lower chilling requirements and greater tolerance to heat and drought stress represent a long-term adaptation strategy. Research institutions in Nepal can collaborate with international breeding programs to develop and test such varieties under local conditions (Gautam et al., 2021).

Improved canopy and crop load management: Adopting adaptive canopy management techniques, such as regulated pruning and thinning, helps optimize light interception and reduce heat stress on fruits. Crop load regulation ensures adequate resource allocation to each fruit, enhancing fruit quality even under stressful conditions (Costa, 1990c).

Soil and erosion management: (a) Construct terraces and contour planting to reduce soil erosion on slopes. (b) Use cover crops and green manures to improve soil structure, increase organic matter, and prevent erosion.

Frost protection measures: (a) Install wind machines or orchard fans to mix warm air and reduce frost formation on cold nights. (b) Use smoke, heaters, or sprinklers (overhead irrigation) to mitigate frost effects on sensitive growth stages. (c) Delay pruning to postpone bud break in areas prone to late frosts.

Shade and wind protection: (a) Erect shade nets to reduce fruit sunburn during intense summer heat and to mitigate hail damage. (b) Establish windbreaks (e.g., bamboo or local tree species) to protect vines from strong winds.

Integrated pest and disease management (IPDM): (a) Regular monitoring to detect new or emerging pests at early stages. (b) Promote natural enemies and adopt biological controls to reduce chemical dependency. (c) Select resistant or tolerant rootstocks where possible.

Infrastructure and technology improvements: (a) Invest in protected cultivation techniques (e.g., plastic tunnels, partial shelters) in vulnerable areas. (b) Develop and promote weather advisory services for real-time alerts to guide irrigation, frost protection, and spraying schedules.

Capacity building and farmer awareness: Building the capacity of farmers to understand climate risks and implement adaptive measures is essential. Training programs on climate-smart agricultural practices, pest monitoring, and water management should be prioritized by government and non-governmental organizations (MoALD, 2022).

8.3. Policy support and research needs

To promote climate change adaptation in kiwifruit farming, supportive policies are necessary. This includes subsidies for irrigation infrastructure, incentives for adopting climate-resilient technologies, and investment in research focused on breeding, pest dynamics, and microclimate modification (MoALD, 2022). Collaborative efforts between researchers, extension workers, and farmers will be vital to developing practical and locally relevant solutions.

8.4. Research and development areas

(a) Climate risk assessment and development of adaptation strategies (e.g., protective structures, mulching). (b) Evaluation of heat- and frost-tolerant cultivars. (c) Crop modeling to forecast production and plan mitigation measures.

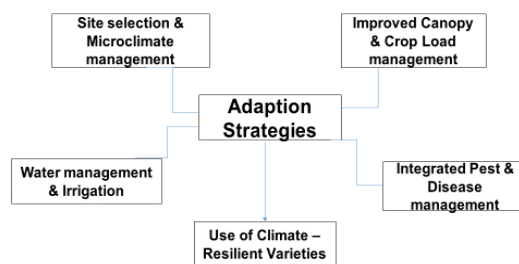


Figure 1. Climate change adaptation for kiwifruit farming in Nepal.

9. Mechanization and labor efficiency

Kiwifruit cultivation is labor-intensive, involving numerous operations such as pruning, training, canopy management, pollination support, thinning, harvesting, and postharvest handling. In Nepal, these activities are mostly done manually due to small farm sizes, hilly terrain, and limited access to machinery. With the growing scale of kiwi orchards and increasing labor shortages (especially due to youth migration and aging farming population), improving labor efficiency and introducing mechanization (even partially) have become crucial for sustainable and profitable kiwi production.

9.1. Current status of labor and mechanization

Kiwifruit cultivation in Nepal is predominantly labor-intensive. Most cultural practices— including land preparation, vine training, pruning, canopy management, fruit thinning, harvesting, and postharvest handling— are performed manually (Bhattarai et al., 2020). Labor costs contribute significantly to overall production expenses, often accounting for more than 50% of total costs in fruit farming (Dhakal & Paudyal, 2020). The increasing rural-to-urban migration has further exacerbated labor scarcity, affecting timely farm operations and reducing overall efficiency.

Mechanization levels in horticulture, and specifically in kiwifruit production, remain relatively low in Nepal compared to major producing countries like New Zealand, Italy, and China, where advanced machinery such as mechanical pruners, automated sprayers, harvest aids, and sorting and grading equipment are widely used (Montero et al., 2019).

9.2. Scope for mechanization in kiwifruit orchards

Land preparation and planting: (a) Use of small-scale power tillers or mini-tractors for initial land preparation, especially on terraced or moderately sloped land. (b) Auger-type planting hole diggers reduce time and labor compared to manual digging.

Pruning and canopy management: (a) Adoption of lightweight, battery-operated electric or pneumatic pruning shears improves speed and reduces worker fatigue. (b) Telescopic pruning tools and ladder platforms make canopy access safer and more efficient.

Weed and soil management: (a) Use of mini rotary weeder or brush cutters to control weeds between vine rows. (b) Mulch-laying machines (if terrain allows) for applying organic or plastic mulches quickly.

Fertilizer and pesticide application: (a) Portable or knapsack motorized sprayers for uniform and faster pesticide and foliar nutrient application. (b) Drip fertigation systems to deliver water and nutrients simultaneously, reducing manual fertilizer application labor.

Pollination support: (a) Mechanized pollen blowers or sprayers (where artificial pollination is practiced) reduce reliance on manual brush pollination. (b) Support for managed bee colonies (beekeeping boxes and related equipment) to improve natural pollination without extensive labor.

Harvesting and fruit handling: (a) Use of ergonomic fruit-picking bags or harnesses to reduce physical strain and prevent fruit bruising. (b) Lightweight hand-held picking aids or pole harvesters for higher canopies. (c) Mobile field sorting and grading tables to reduce postharvest labor in collection centers.

Transport within the orchard: (a) Small orchard transporters (mini tractors, electric carts) to move harvested fruits and materials between rows and packing sheds, especially important in sloped orchards.

9.3. Constraints to mechanization in Nepal

Small, fragmented orchard holdings: Limits the use of large or even medium-sized machinery.

Hilly and uneven terrain: Makes it difficult to use standard mechanization equipment.

Limited access to affordable and suitable orchard machinery: Most tools are imported and expensive.

Low capital investment capacity: Small and marginal farmers may lack financial resources to invest in new tools.

Lack of technical skills and maintenance services: Farmers often lack training to operate and maintain mechanized tools.

9.4. Research and development areas

(a) Research on small-scale mechanization tools for pruning, spraying, and harvesting.

(b) Design and testing of low-cost harvesting aids suited to hilly terrains.

(c) Development of labor-efficient orchard designs.

(d) Develop and adapt small-scale, lightweight, terrain-friendly machines tailored to Nepal's hilly kiwi orchards.

- (e) Design ergonomic tools that can be easily used by women and elderly workers, as they make up a significant portion of the rural workforce.
- (f) Innovate low-cost mechanization solutions (e.g., manual-drawn carts, hand-held mechanized sprayers) suitable for small-scale farmers.

10. Market and value chain development

The market and value chain development of kiwifruit in Nepal is gaining increasing attention as kiwifruit emerges as a promising high-value crop in hilly and mid-hill regions. The fruit's nutritional benefits and growing domestic and international demand have opened avenues for commercialization, but several challenges need to be addressed to fully realize its economic potential.

10.1. Current market status

Kiwifruit cultivation in Nepal started gaining traction in the early 2000s, with a focus on substituting imports and generating higher income for smallholder farmers. Currently, kiwifruit is cultivated in more than 50 districts, with major production hubs in eastern and central Nepal such as Ilam, Ramechhap, Dolakha, and Kavrepalanchok ([Subedi et al., 2021](#)). Despite increasing production, domestic supply often falls short during peak demand, leading to imports mainly from China and New Zealand ([Pandey et al., 2023](#)).

10.2. Market opportunities

The domestic market for kiwifruit is expanding due to changing consumer preferences, rising health consciousness, and urbanization. In addition, there is potential for exporting kiwifruit to neighboring countries like India and Bangladesh, where demand for exotic fruits is rising ([Paudyal & Baral, 2022](#)). However, export-oriented production requires meeting stringent quality standards and developing efficient postharvest handling systems.

10.3. Value chain structure

The kiwifruit value chain in Nepal generally involves input suppliers, producers, local collectors, wholesalers, retailers, and consumers. In some cases, cooperatives and farmer groups play a critical role in aggregation and collective marketing. Despite this structure, the value chain remains fragmented and dominated by middlemen, leading to limited bargaining power for farmers and reduced profit margins ([Paudel et al., 2020](#)).

A significant portion of kiwifruit is sold in local and regional markets without proper grading, packaging, or branding. Consequently, farmers often receive low farm-gate prices, while end consumers pay high retail prices ([Shrestha et al., 2018](#)). Strengthening farmer cooperatives and promoting direct marketing channels, such as farmers' markets and contract farming, can help improve producer incomes and market efficiency.

10.4. Constraints in market and value chain development

Several constraints hinder the development of a robust kiwifruit market and value chain in Nepal:

Limited postharvest infrastructure: Lack of cold storage, sorting, grading, and packaging facilities leads to high postharvest losses (up to 25–30%) and poor fruit quality at market entry ([Gautam et al., 2022](#)).

Weak market linkages: Inadequate coordination among value chain actors prevents effective market planning and integration ([Dhakal et al., 2020](#)).

Price fluctuations: Seasonal gluts and lack of price information systems contribute to unstable farm-gate prices, discouraging farmers from expanding cultivation.

Low value addition: Absence of kiwifruit-based processed products (e.g., juices, jams, dried slices) limits opportunities for diversification and income enhancement.

10.5. Policy support

The Government of Nepal has included kiwifruit as a high-value crop under its Agriculture Development Strategy (ADS) 2015–2035, which emphasizes commercialization and value chain development ([MoALD, 2015](#)). However, practical

implementation of supportive policies, including subsidies for infrastructure and incentives for export, needs further strengthening.

10.6. Strategies for strengthening market and value chain

Establish producer cooperatives and marketing groups: (a) Facilitate collective bargaining, bulk sales, and reduced transaction costs. (b) Enable joint investment in postharvest infrastructure (cold storage, grading units).

Develop collection and aggregation centers: (a) Establish strategically located collection points equipped with sorting, grading, and pre-cooling facilities. (b) Link centers with major urban wholesale and retail markets.

Improve postharvest handling: (a) Train farmers on standardized harvesting, sorting, grading, and safe packaging. (b) Promote use of protective packaging materials (foam nets, cushioned crates).

Expand cold chain and storage facilities: (a) Develop region-specific cold storage units and controlled atmosphere (CA) storage. (b) Promote mobile or shared cold storage systems to serve smallholder clusters.

Strengthen market linkages: (a) Connect producer groups directly with institutional buyers, retailers, hotels, and supermarkets. (b) Explore contractual marketing agreements to ensure price stability and regular supply.

Promote value addition and product diversification: (a) Train farmer groups and rural entrepreneurs on kiwi processing (juice, jam, wine, dried products). (b) Support small-scale processing units with equipment and technical guidance. (c) Develop branding strategies for Nepalese kiwi (e.g., "Himalayan Kiwi" brand) to enhance identity and premium market positioning.

Enhance market information systems: (a) Establish digital platforms and mobile applications to disseminate real-time price, demand, and supply data to farmers. (b) Provide market intelligence services through agricultural extension or cooperatives.

10.7. Research and development areas

(a) Study on domestic and export market demand trends. (b) Development of value-added products (e.g., kiwi juice, jam, dried slices). (c) Research on branding, certification (Organic, Good Agricultural Practices), and marketing strategies

11. Conclusions

Kiwifruit introduction and cultivation in Nepal dates back around four decades, since the introduction of kiwifruit in the mid-1980s in Jiri, Dolakha. During this period, the expansion of cultivated land and production and productivity has been significantly increased. The production of low-quality kiwifruit due to improper orchard management, as well as input constraints coupled with smaller size, low weight, and not good in appearance, are the main constraints facing the kiwifruit grower of Nepal. Due to all these reasons, consumers are facing the low market price of their kiwifruit. In some parts of the country, transportation is facing major problems as infrastructure development is not sufficient. For the improvements of the above mentioned quality constraints some interventions for the promotion of kiwifruit market price are noted viz. variety improvement and development, canopy management and crop load regulation, pollination biology and pollinator management, soil and nutrient management, pest and disease management, postharvest handling and shelf life extension, climate change adaptation, mechanization and labor efficiency, and market and value chain development are the key factors to be addressed.

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