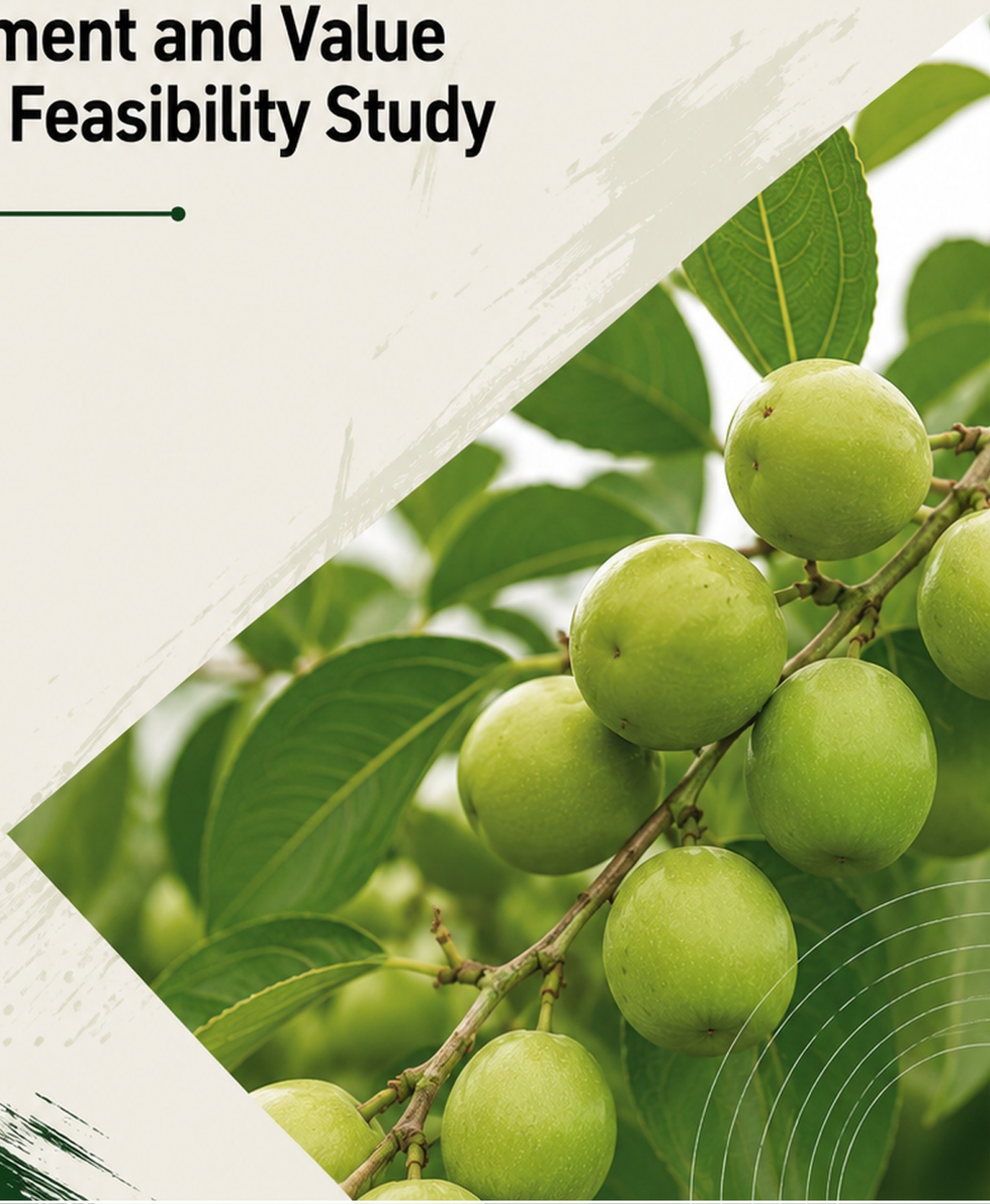
# Apple Ber

## Value Chain, Post-Harvest Management and Value Addition Feasibility Study



*Prepared By*
**Seven Sisters Development Assistance (SeSTA)**

*Supported By*
**Axis Bank Foundation**

SeSTA

# Apple Ber Value Chain, Post-Harvest Management and Value Addition Feasibility Study

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Seven Sisters Development Assistance

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## List of abbreviations

Bigha: Local unit of land measurement

FGD: Focus Group Discussion

FPO: Farmer Producer Organisation

GIS: Geographic Information System

HH: Household

KII: Key Informant Interview

KVK: Krishi Vigyan Kendra

SeSTA: Seven Sisters Development Assistance

SHG: Self Help Group

Std. Dev.: Standard Deviation

TSS: Total Soluble Solids

## Executive Summary

This study examines the apple ber (Thai apple ber, Ziziphus mauritiana) value chain in six villages of Debitola block, Dhubri district, Assam, where SeSTA has promoted the crop as a supplementary livelihood for smallholder women farmers. It follows the pathway from production to post-harvest management, market access, value addition and income enhancement, to identify where each link is weak and which interventions are realistic.

A mixed-method approach was used: a household survey of 67 apple ber growers, all women; focus group discussions with farmers and women's groups; key informant interviews with traders, Siliguri commission agents and KVK Gossaigaon; and visits to the Dhubri and Siliguri markets.

Production has grown. Average output rose from 36 kg per grower in 2023 to 100 kg in 2024 and 97 kg in 2025, although output varies widely and growers are evenly split between rising (31.3%), falling (32.8%) and stable (35.8%) production. At ₹35 per kg, average output yields a gross income of about ₹3,400 a season. Half of the growers cultivate apple ber on one bigha or less.

The main constraint lies after harvest. All growers harvest between December and February, 97% have no storage, the fruit holds for only a few days, only 4.5% sort and none grade. This synchronised harvest creates a seasonal glut: buyers are available, but prices fall at peak, and 38.1% of growers selling only to traders say the trader fixes the price. Regional markets offer limited relief, as Siliguri is already well supplied and Dhubri now produces enough for its own needs.

Farmers' interest in value addition is real but conditional: 92.5% want market linkage and 74.6% are motivated mainly by a better price than fresh fruit. However, KVK reported that earlier processing trials failed because the high moisture content of Thai apple ber caused fungal spoilage, so processing remains unproven locally.

The study concludes that the immediate opportunity lies in strengthening the fresh-fruit system through village collection points, sorting and grading, SHG-led collective selling and wider market outlets, with women and SHGs as central actors. Processing should follow only after technical validation. A three-phase roadmap sets out these steps, alongside the risks of dependence on project support and competition from rubber cultivation.



**Pic 1. Apple ber orchard in the study area**

# Chapter 1: Introduction

## 1.1 Background of Apple Ber Cultivation

Apple ber (*Ziziphus mauritiana*), also known as Indian jujube, is a drought-tolerant fruit crop well suited to the subtropical conditions of Northeast India, including the flood-prone plains of Dhubri district's Debitola block. Studies confirm that Thai apple ber varieties thrive in Assam, with yields of 50-100 kg per plant and high TSS (14.2° Brix). High-density planting and thornless varieties can boost yields by 25-50%, while the fruit's Vitamin C content (three times that of oranges) adds to its value as a supplementary livelihood crop for smallholders.



**Fig 1.1 Apple Ber Cultivation**



**Fig 1.2 Apple Ber plant**

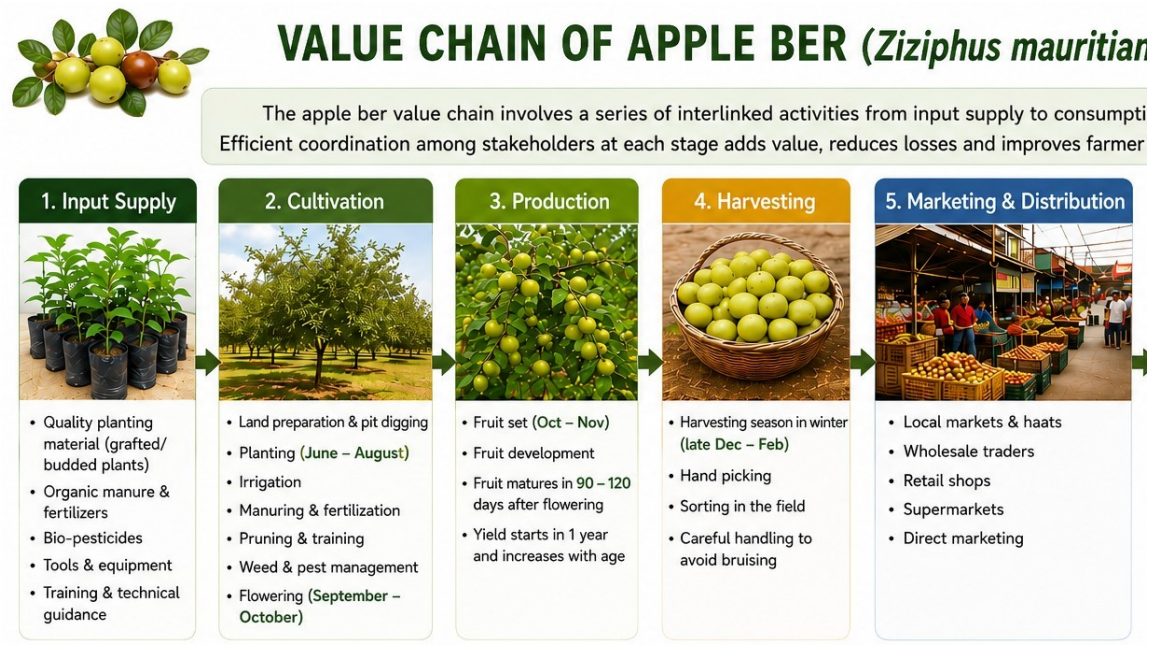



**Fig 1.3 Value chain representation of Apple Ber**

## 1.2 Rationale of the Study

Apple ber cultivation has expanded in the study villages with support from SeSTA, but higher production does not automatically become higher income. The fruit is highly perishable, almost no farmers have storage, the whole area harvests between December and February, and most produce is sold immediately to local traders or markets when prices are at their lowest. Processing has been proposed as a way to use surplus fruit, but its technical feasibility for Thai apple ber has not been established locally.

The study therefore follows the livelihood pathway from **production** to **post-harvest management**, **market access**, **value addition** and **income enhancement**, to identify where each link is weak, which interventions are realistic in the short term, and which require further testing before investment. This community-based study covers market linkages, buyer requirements and farmer skills in six villages of Debitola block.

## 1.3 Objectives of the Study

1. Map current post-harvest practices and quantify losses (e.g., spoilage rates) across villages to pinpoint value addition gaps like poor storage or unprocessed surpluses, and review production trends over the last few years.
2. Evaluate 5-7 farmer-led value addition options (solar drying, jam-making, pulp extraction, packaging) via matrix scoring for feasibility, profit potential and market fit.
3. Identify market linkages, buyer preferences, and barriers (e.g., equipment, skills) through FGDs to prioritise scalable innovations like cooperative branding.
4. Develop village-specific action plans with prototypes (e.g., low-cost dryers) validated by farmers, yielding GIS-visualised value chain maps for scaling.
5. Assess whether value addition is feasible or whether the fruit is best sold fresh.
6. Map farmers' acceptance and adaptation of the fruit and value-added products.

## 1.4 Scope of the Study

The study is geographically limited to six villages in Debitola block, Dhubri district, where apple ber cultivation is prominent, covering 67 farming households plus traders and stakeholders. It encompasses production practices, post-harvest losses, value addition feasibility, and market linkages, but excludes broader regional or national scaling. Emphasis is on community-based solutions tailored to local agro-climatic conditions and smallholder systems.

## 1.5 Methodology Overview

The study adopted a mixed-method approach combining quantitative and qualitative techniques. Quantitative data were collected through structured household surveys with apple ber cultivating farmers to understand production levels, cultivation practices, losses, incomes, and marketing patterns. Qualitative insights were generated through Focus Group Discussions (FGDs) with farmers and women's groups, along with Key Informant Interviews (KIIs) involving traders (Assam, Siliguri), shopkeepers, intermediaries, village leaders, and the Krishi Vigyan Kendra (KVK), Gossaigaon, to learn their perspective on value addition of apple ber. Purposive sampling was used to select apple ber producing villages and respondent households. A total of 67 farming households were covered, along with selected market actors. Data analysis included descriptive statistics, comparative analysis, value chain mapping, ranking of constraints, and feasibility assessment of value-added products. The markets of Dhubri, Assam and Siliguri, West Bengal were also visited to explore opportunities and gain insight into the scenario for selling apple ber.

The respondent groups, sample sizes and their use in the analysis are summarised in Table 1.1.

| Respondent type | Sample size | Purpose | Analytical use |
|---|---|---|---|
| Apple ber growers (household survey) | 67 households; all respondents women | Production, practices, storage, selling channels, price-setting, support needs | Descriptive statistics and cross-tabulations (Chapters 2 to 8, 10) |
| Farmers and women's groups (FGDs) | [Number of FGDs and participants] | Aspirations, distress sales, surplus use, interest in value addition | Qualitative evidence (Chapters 3, 5 to 7, 10) |
| Local traders, shopkeepers and intermediaries (KIIs) | [Number] | Price behaviour, buyer preferences, quality requirements | Market and value-chain analysis (Chapters 8 and 9) |
| Wholesalers and commission agents, Siliguri (KIIs) | [Number] | Regional supply, volumes and prices | Regional market assessment (Section 9.3) |
| KVK Gossaigaon scientist (KII) | 1 | Technical feasibility of processing | Value-addition feasibility (Chapter 7) |
| Market visits | Dhubri and Siliguri markets | Observation of market conditions | Chapter 9 |

**Table 1.1 Respondent categories, sample size and analytical use**

Because households were selected purposively from SeSTA-supported growers, the findings describe the programme's growers rather than all apple ber cultivation in the block. Production, prices and incomes are self-reported, and post-harvest losses were described by farmers rather than measured.

# Chapter 2: Socio-Economic Profile of Farmers and Farm Characteristics

## 2.1 Area Context: Soil, Geography and Agro-ecological Profile

The study area falls under the Lower Brahmaputra Valley agro-climatic zone, characterised by a humid subtropical climate and alluvial soils (Government of Assam, 2019; ICAR, n.d.). Annual rainfall is high, ranging from approximately 2,500 to 3,500 mm, concentrated during the monsoon months (June to September). Temperatures generally vary between 10-12°C in winter and 30-35°C in summer, creating favourable conditions for a range of horticultural crops, including apple ber.

## 2.2 Demographic Profile

A total of 67 apple ber cultivators were surveyed across selected villages of Debitola block. All respondents were female (100%). The average age of respondents was 39 years, with nearly half belonging to the 31-40 years category (49.3%), followed by 41-50 years (26.9%). Village-wise participation was highest from Debitola PT4 (29.9%), followed by Ramsarobar (25.4%) and Hatibandha (22.4%) after adjustment of unrecorded entries. The findings indicate that apple ber cultivation is largely sustained by economically active rural women across the surveyed villages.

| Indicator | Category | No. of HH |
|---|---|---|
| Gender | Female | 67 |
| Age Group | ≤30 years | 9 |
| | 31-40 years | 33 |
| | 41-50 years | 18 |
| | 51+ years | 7 |
| Village | Debitola PT4 | 20 |
| | Hatibandha | 15 |
| | Ramsarobar | 17 |
| | Puran Panbari | 9 |
| | Debitola PT 2 | 5 |
| | Kalbhandari | 1 |

**Table 2.1 Demographic details of the farmers**

## 2.3 Landholding and Area Under Apple Ber

The survey indicates that apple ber cultivation is primarily practised by small and medium growers, reflecting its suitability for household-level horticulture and diversified farming systems. A majority of respondents cultivated apple ber on relatively limited land parcels, suggesting that the crop is accessible even to farmers with modest land resources. Medium growers also formed a substantial share, while large-scale cultivation remained limited. This pattern highlights apple ber as a viable income-generating crop for smallholders, requiring comparatively manageable land investment while offering opportunities for market sale and future value addition.

| Category | Land Under Apple Ber | No. of HH | Percent (%) |
|---|---|---|---|
| Small Growers | Up to 1 bigha | 34 | 50.7 |
| Medium Growers | 1.01 - 3 bighas | 25 | 37.3 |
| Large Growers | Above 3 bighas | 8 | 11.9 |
| Total | | 67 | 100 |

**Table 2.2 Land holding and growers**

Based on the area under apple ber cultivation, farmers can be classified into three broad categories: small, medium, and large growers. The findings show that the sector is predominantly led by small growers, accounting for 34 farmers (50.7%), who cultivate apple ber on relatively limited land and often use it as a supplementary source of income. Medium growers comprise 25 farmers (37.3%), representing an important segment with comparatively larger market participation. Only 8 farmers (11.9%) fall under the large grower category, indicating that commercial-scale cultivation remains limited. Overall, the distribution highlights that apple ber cultivation is primarily a smallholder-based enterprise, with significant potential for inclusive livelihood growth and collective value addition initiatives.

### 2.4 Farming Experience

The findings suggest that apple ber cultivation has steadily emerged as an established livelihood activity among the surveyed farmers. Most respondents reported 3 to 5 years of cultivation experience, indicating that many households have moved beyond the trial stage and are continuing with growing confidence. A notable share of farmers also had longer experience, reflecting sustained trust in the crop over time. Farmers were primarily motivated by SeSTA to start cultivating apple ber due to its good market demand, comparatively attractive returns, suitability to local conditions, and recommendations from fellow farmers or local networks. For many households, apple ber was seen as a practical option to diversify income and make productive use of available land resources.

| Experience Category | Years of Cultivation | No. of Respondents | Percent (%) |
|---|---|---|---|
| New Growers | Up to 2 years | 12 | 17.9 |
| Emerging Growers | 3-5 years | 31 | 46.3 |
| Experienced Growers | 6-8 years | 16 | 23.9 |
| Long-term Growers | Above 8 years | 8 | 11.9 |
| Total | | 67 | 100 |

**Table 2.3 Farmers' experience level in growing apple ber**

## Chapter 3: Production Performance and Trends

### 3.1 Production Levels and Growth/Decline Trends (2023-2025)

The production trend over the last three years reflects a generally encouraging trajectory in apple ber cultivation among the surveyed farmers. Average production levels improved between 2023 and 2025, indicating that farmers are gaining confidence in managing the crop and expanding production over time. Improved orchard maintenance, growing experience, and stronger market interest may have contributed to this positive movement. However, production varied across households depending on land size, weather conditions, pest incidence, and management practices.

| Year | Mean Production (kg) | Std. Dev. | Minimum | Maximum | Observation |
|---|---|---|---|---|---|
| 2023 | 36.09 | 100.08 | 0 | 600 | Baseline year with low average production |
| 2024 | 99.79 | 139.97 | 0 | 600 | Sharp increase in average production |
| 2025 | 96.96 | 136.29 | 0 | 700 | Production remained high, with slight decline from 2024 |
| Overall Change (2023-2025) | | | | | Strong upward trend from baseline |

**Table 3.1 Production pattern from 2023-2025 with observation**

Apple ber production shows a clear rise after the baseline year. Mean production increased from 36.09 kg in 2023 to 99.79 kg in 2024, reflecting a substantial improvement in output. In 2025, the mean remained high at 96.96 kg, showing that the production gains were largely sustained, although with a slight decline from 2024. The high standard deviation across all years indicates wide variation among farmers, suggesting that production is uneven and influenced by differences in land area, crop maturity, management practices, and local conditions.

At the household level, however, production trends were evenly divided: 31.3% of growers (21) reported an increase, 32.8% (22) a decline and 35.8% (24) no change (Table 3.3). Average output rose and then stabilised, but individual orchards moved in different directions (see Section 3.4).

## 3.2 Drivers of Production Change

The changes in apple ber production over recent years were influenced by a combination of environmental and farm-level factors. Among the surveyed farmers, better management practices such as timely pruning, irrigation, and regular orchard care were the most commonly cited reasons for increased production. Expansion of cultivation area also contributed positively, as several farmers allocated more land to apple ber after observing encouraging returns. On the other hand, weather variability, including irregular rainfall and extreme conditions, remained a major challenge affecting yield stability. Pest incidence was another important factor reported by farmers, particularly where timely control measures were limited. These findings indicate that while improved management can significantly enhance output, climate and pest-related risks continue to influence production outcomes.

| Variable | Mean (kg) | Std. Dev. | Min | Max |
|---|---|---|---|---|
| production_2023 | 36.08955 | 100.0833 | 0 | 600 |
| production_2024 | 99.79104 | 139.9679 | 0 | 600 |
| production_2025 | 96.95522 | 136.2886 | 0 | 700 |

**Table 3.2 Mean and standard deviation of production over the years**

The comparison of mean production levels over the three-year period indicates a substantial rise in apple ber output after 2023. Average production increased sharply from 36.08 kg in 2023 to 99.79 kg in 2024, suggesting a strong expansion in production during this period. In 2025, mean production remained relatively stable at 96.96 kg, indicating that the gains achieved in the previous year were largely sustained. While the confidence intervals for 2024 and 2025 overlap, both years show markedly higher production levels than 2023. Overall, the results suggest that apple ber cultivation experienced significant growth after the baseline year, followed by a phase of consolidation and stable output.

The relationship between years of apple ber cultivation and production trend presents a mixed but informative pattern. Farmers with two years of cultivation experience showed the most favourable outcomes, with 52.9% reporting increased production, suggesting that orchards may begin yielding more consistently after the initial establishment phase. Among those with three years of experience, production trends were evenly distributed across increase, decrease, and stable output, indicating varying management and environmental conditions. In contrast, farmers with four years of cultivation reported a higher incidence of declining production (57.1%), which may reflect ageing orchards, management fatigue, or pest and soil-related challenges. Overall, the findings indicate that production gains are strongest during the early productive years, while sustained output over time may require improved orchard rejuvenation and technical support.

| Category | Sub-category | Decreased | Increased | Remained the Same | Total |
|---|---|---|---|---|---|
| Years Cultivated | 0 years | 4 (100.00%) | 0 (0.00%) | 0 (0.00%) | 4 |
| | 1 year | 0 (0.00%) | 0 (0.00%) | 4 (100.00%) | 4 |
| | 2 years | 3 (17.65%) | 9 (52.94%) | 5 (29.41%) | 17 |
| | 3 years | 11 (31.43%) | 12 (34.29%) | 12 (34.29%) | 35 |
| | 4 years | 4 (57.14%) | 0 (0.00%) | 3 (42.86%) | 7 |
| Land Cultivated | 0.5 bigha | 0 (0.00%) | 1 (100.00%) | 0 (0.00%) | 1 |
| | 1.0 bigha | 16 (30.19%) | 15 (28.30%) | 22 (41.51%) | 53 |
| | 1.5 bigha | 2 (22.22%) | 5 (55.56%) | 2 (22.22%) | 9 |
| Overall Total | | 22 (32.84%) | 21 (31.34%) | 24 (35.82%) | 67 |

**Table 3.3 Increase and decrease in production by years of cultivation and land used**

Production trends vary by both cultivation experience and land area. Farmers with 2 years of experience show the strongest increase, while those with 4 years report higher decline. Most farmers cultivate 1 bigha, where production is largely stable. The 1.5 bigha group shows better growth, but the sample is small, so findings should be interpreted cautiously.

## 3.3 Future Plans of Farmers

Based on the Focus Group Discussions conducted across the study villages, farmers expressed a strong interest in improving the future prospects of apple ber cultivation through better market opportunities and higher returns. Most farmers indicated that they plan to continue cultivation if reliable buyers, fair prices, and stronger market linkages are ensured. Many participants showed willingness to explore value addition activities such as drying, grading, packaging, and processing, provided adequate training, equipment, and technical support are made available. Some groups also highlighted the potential of collective action through farmer groups or SHGs for marketing and small-scale processing. Farmers emphasised that with better access to inputs, post-harvest facilities, and organised market channels, apple ber can become a more profitable and sustainable livelihood option in the coming years.

## 3.4 Grower Segmentation and Production Performance

This section brings together the farmer profile (Chapter 2) and production results (Sections 3.1 and 3.2) to show how performance differs across grower groups.

| Dimension | Grower group | Growers (share) | Production finding |
|---|---|---|---|
| Area under apple ber (Table 2.2) | Up to 1 bigha | 34 (50.7%) | Mostly stable output: 41.5% of one-bigha growers reported no change (Table 3.3) |
| | 1.01 to 3 bighas | 25 (37.3%) | Growers with 1.5 bighas most often reported increases (5 of 9; 55.6%) |
| | Above 3 bighas | 8 (11.9%) | Not separately reported in Table 3.3 |
| Cultivation experience (Table 2.3) | Up to 2 years | 12 (17.9%) | Second-year growers most likely to report increases (9 of 17; 52.9%) |
| | 3 to 5 years | 31 (46.3%) | Three-year growers evenly split; four-year growers most likely to report decline (4 of 7; 57.1%) |
| | 6 years and above | 24 (35.8%) | Not separately reported in Table 3.3 |
| All growers | | 67 | Mean output 36.1 kg (2023), 99.8 kg (2024), 97.0 kg (2025); 31.3% increase, 32.8% decline, 35.8% no change |

**Table 3.4 Grower segments and production performance**

Three points follow. First, apple ber is a smallholder crop: half of growers cultivate one bigha or less, and output for most of them has been stable rather than rising. Second, output tends to rise as young orchards come into bearing, but a notable share of older plantings report decline, which points to the need for continued pruning, pest management and nutrient support once initial project support ends; the study did not test the causes. Third, average production is pulled up by a few larger producers: the standard deviation exceeds the mean in every year, so a typical grower produces less than the averages in Table 3.1 suggest.

These subgroup results rest on small numbers and should guide where support is targeted rather than be read as firm conclusions.

# Chapter 4: Income Analysis of Apple Ber Farmers

## 4.1 Income Distribution and Adoption

Income from apple ber cultivation is growing but remains uneven across households, depending largely on production volume, market timing, and selling channel. Farmers with higher yields, better fruit quality, or the ability to sell during lean supply periods are likely to earn stronger returns, while those selling during peak harvest often face lower prices due to market glut. The production trend observed among respondents indicates that apple ber is becoming an important supplementary income source for rural households.

In terms of adoption, the spread of apple ber cultivation across the surveyed villages and the rising production levels in recent years indicate positive farmer acceptance of the crop. Support received for saplings and basic inputs has helped expand cultivation, while continued participation suggests confidence in the crop's profitability and adaptability. However, adoption outcomes vary by management practices, access to labour, and market conditions. Overall, the findings show that apple ber has gained traction as a livelihood option, though better market systems and post-harvest support are needed to translate adoption into more equitable income gains.

## 4.2 Income vs Production Relationship

Using the average production figures reported by farmers and an average farm-gate selling price of ₹35 per kg (based on trader interviews and farmer responses), the estimated gross income from apple ber cultivation increased sharply after 2023. Mean production rose from 36.1 kg in 2023 to 99.8 kg in 2024, increasing estimated gross income from ₹1,263 to ₹3,493 per farmer. In 2025, with average production of 97.0 kg, estimated income remained high at ₹3,394. This suggests that apple ber cultivation has become a more meaningful supplementary income source, although actual earnings vary by quality, market timing, and selling channel.

## 4.3 Income vs Market Access vs Selling Channel

The findings indicate that farmer income from apple ber is closely influenced by market access and the channel through which produce is sold. Farmers with easier access to nearby markets or multiple selling options are better positioned to compare prices and secure higher returns. In contrast, those dependent on a single buyer or trader often have limited bargaining power. Survey data show that 31.3% of farmers sold exclusively through traders/middlemen, while 26.9% used village or local markets, and 14.9% used both channels. Traders generally offer convenience and immediate cash payment, but often at lower farm-gate rates during peak arrivals. Farmers using local markets or mixed channels are more likely to benefit from competitive pricing, especially for better quality produce. Overall, improved market access, collective selling, and diversified channels can significantly enhance income realisation.

| Market channel | Based on market rate | Fixed by trader | Negotiated | Other | Total |
|---|---|---|---|---|---|
| Other | 2 (11.76%) | 2 (11.76%) | 1 (5.88%) | 12 (70.59%) | 17 |
| Traders/middlemen | 11 (52.38%) | 8 (38.10%) | 2 (9.52%) | 0 (0.00%) | 21 |
| Traders/middlemen + Other | 0 (0.00%) | 0 (0.00%) | 1 (100.00%) | 0 (0.00%) | 1 |
| Traders/middlemen + Village/local market | 1 (50.00%) | 1 (50.00%) | 0 (0.00%) | 0 (0.00%) | 2 |
| Village/local market | 15 (83.33%) | 0 (0.00%) | 3 (16.67%) | 0 (0.00%) | 18 |
| Village/local market + Traders/middlemen | 4 (50.00%) | 2 (25.00%) | 2 (25.00%) | 0 (0.00%) | 8 |
| Total | 33 (49.25%) | 13 (19.40%) | 9 (13.43%) | 12 (17.91%) | 67 |

**Table 4.1 Market channels and price determination**

The table indicates that price determination varies by market channel. Farmers selling through village/local markets largely depend on prevailing market rates (83.33%), suggesting relatively transparent pricing. In contrast, those selling through traders/middlemen face greater trader control, with 38.10% reporting prices fixed by traders. Farmers using mixed channels show more balanced outcomes between market-based and negotiated pricing. Among those using "other" channels, 70.59% fall under alternative pricing arrangements. Overall, nearly half of all farmers (49.25%) sell at market rates, while trader influence remains significant in intermediary-led channels.

# Chapter 5: Harvesting Practices and Market Distress

## 5.1 Harvesting Pattern and Labour Use

A uniform harvesting pattern was observed among apple ber growers. All respondents (100%) reported the harvest season as December to February, confirming this as the

principal harvesting window in the study area. Likewise, hand picking was the universal harvesting method, indicating a preference for manual harvesting to minimise fruit damage and maintain quality. In terms of labour use, harvesting was largely household-driven, with 43 farmers (64.2%) relying on family members. Another 23 farmers (34.3%) used a combination of family and hired labour, particularly during peak harvest periods when labour demand increases. Only 1 farmer (1.5%) depended solely on hired labour. These findings suggest that apple ber harvesting remains predominantly labour-intensive and family-managed, with limited dependence on external labour.

| Indicator | Category | No. of Farmers | Percent (%) |
|---|---|---|---|
| Harvest Period | December to February | 67 | 100.0 |
| Harvest Method | Hand Picking | 67 | 100.0 |
| Labour Used for Harvesting | Family Members | 43 | 64.2 |
| | Both Family & Hired Labour | 23 | 34.3 |
| | Hired Labour Only | 1 | 1.5 |
| Total | | 67 | 100.0 |

**Table 5.1 Harvesting methods**

Information from existing farmers indicates that apple ber cultivation follows a relatively low-input and labour-efficient system. The initial establishment cost ranges between ₹7,000 and ₹10,000, making it accessible for smallholders. The crop begins bearing fruit approximately one year after planting, suggesting a quick return cycle compared to many perennial crops.

During the harvest season, farmers reported a daily harvest of 10-20 kg, with an estimated seasonal yield of 150-200 kg per farmer. Harvesting is carried out in small, regular quantities rather than bulk collection, indicating a gradual harvesting pattern aligned with fruit ripening.

In terms of labour and resources, most farmers rely on locally available inputs and institutional support (such as from SeSTA[1]) for planting material and initial setup. Household labour is used for routine activities, which reduces dependence on hired labour and keeps operational costs relatively low.

Overall, the system reflects a low-cost, smallholder-friendly model with manageable labour requirements and steady seasonal output.

## 5.2 Coping Strategies During Distress

For apple ber farmers, the main challenge begins after harvest, when the fruit must be sold quickly before quality declines. With 97% of farmers lacking storage facilities, most produce moves directly from tree to trader or local buyer. During peak harvest, this creates a crowded market situation where prices fall and farmers have little bargaining power. FGDs show that farmers cope by choosing nearby buyers instead of distant markets, as transport costs and uncertain prices increase risk. Thus, coping remains largely defensive, focused on avoiding loss rather than maximising profit. Better storage, collective transport, and assured market linkages are needed.

[1]SeSTA refers to Seven Sisters Development Assistance, a development organisation working in Northeast India to promote sustainable livelihoods, community institutions, women's collectives, and rural enterprise development.

# Chapter 6: Post-Harvest Handling and Loss Assessment

## 6.1 Post-Harvest Use of Produce

Post-harvest handling practices indicate that apple ber produce is managed largely through immediate sale or short-term holding, with very limited value addition at the farm level. Most farmers rely on family labour (64.2%) for post-harvest activities, while 34.3% combine family and hired labour during peak periods. The fruit is highly perishable, as a majority of respondents reported a storage or ripening window of only 2 to 4 days, while only 10.5% of farmers are able to hold the fruit for up to one month during ripening. Post-harvest quality management remains weak, with only 4.5% of farmers practising sorting and none reporting grading practices. These findings suggest that produce is primarily marketed in fresh form, with minimal storage or processing, thereby limiting opportunities for better price realisation and value addition.

| Indicator | Category | Frequency | Percent (%) |
|---|---|---|---|
| Labour Used in Harvest / Post-Harvest Handling | Family Members | 43 | 64.18 |
| | Both Family & Hired Labour | 23 | 34.33 |
| | Hired Labour Only | 1 | 1.49 |
| Storage / Ripening Duration | 1 Month (ripening) | 7 | 10.45 |
| | 2-3 Days | 14 | 20.90 |
| | 2-4 Days (combined responses) | 45 | 67.17 |
| | 3-4 Days | 1 | 1.49 |
| Sorting Practice | Yes | 3 | 4.48 |
| | No | 64 | 95.52 |
| Grading Practice | Yes | 0 | 0 |
| | No | 67 | 100 |

**Table 6.1 Various practices during harvesting**

Sorting and grading are critical because apple ber has a short marketable life, with most farmers storing or ripening fruits for only 2 to 4 days. However, only 4.48% practise sorting and none practise grading, showing a major post-harvest gap. Without sorting, damaged, overripe, and good-quality fruits get mixed, reducing overall market value. Grading helps separate premium fruits by size, freshness, and appearance, allowing better price realisation. Lower-grade fruits can be sold separately or used at home, reducing wastage and improving farmer income.

## 6.2 Seasonal Market Pressure Analysis

Seasonal market pressure strongly affects apple ber farmers, particularly during the peak harvest period when large volumes enter the market at the same time. Survey findings show that 97.0% of farmers have no storage facility and sell immediately after harvest, while only 4.48% undertake any sorting and none reported formal grading practices. As a result, farmers have little scope to delay sales or wait for better prices. The average selling price reported was around ₹35.75 per kg, with prices ranging from ₹35 to ₹60 depending on season, quality, and buyer demand; some farmers also reported not receiving payment for their produce. Nearly half of the farmers (49.25%) stated that prices are based on prevailing market rates, while 19.40% said prices are fixed by traders, showing weak farmer bargaining power.

FGDs and market interactions further revealed that buyers are generally available during peak season, especially local traders and middlemen, but prices fall sharply due to oversupply. Farmers from several villages mentioned that their main challenge is not selling the produce, but selling at a fair price. Traders often purchase directly from villages, saving farmers transport costs, but this convenience also limits competition and price negotiation. In lean periods, prices improve, yet most farmers cannot hold produce because of perishability and lack of storage. Farmers therefore suggested better market linkages, storage facilities, collective selling, and access to distant markets as key solutions to reduce seasonal pressure and improve returns.

| Storage type | Frequency | Percent |
|---|---|---|
| No storage (sold immediately after harvest) | 65 | 97.01 |
| Other | 2 | 2.99 |
| Total | 67 | 100.00 |

**Table 6.2 Storage type for apple ber**

| Storage days | Frequency | Percent |
|---|---|---|
| 2-4 days | 26 | 38.81 |
| 4-6 days | 41 | 61.19 |
| Total | 67 | 100.00 |

**Table 6.3 Storage days for apple ber**

## 6.3 Stages of Loss and Selling Difficulty

Post-harvest losses in apple ber occur across multiple stages of the value chain, beginning from harvest and continuing through storage, transport, and final market sale. At the harvest stage, losses arise mainly from bruising, over-ripened fruits, and delayed picking during peak season. Since harvesting is largely manual and family-managed, labour shortages during peak periods (owing to the remoteness of the area and fewer people available for the work) can also lead to fruits remaining longer on trees, affecting quality. The labour shortage could be tackled by the following:

1. Harvest fruits in batches as they ripen instead of waiting for bulk collection.
2. Form village-level women/youth harvesting groups during peak season.
3. Jointly hire labour and share costs across nearby orchards, and set up village collection points so farmers spend less time on transport and selling.

At the storage stage, losses are particularly significant due to the highly perishable nature of the fruit. Survey findings show that most farmers can store produce for only a few days, while only 10.5% reported holding fruit for up to one month. During FGDs, farmers noted that the absence of cool storage, shade facilities, and proper packaging leads to rapid softening and spoilage, especially during warmer days.

At the market stage, oversupply during the peak season often results in distress sales and unsold produce. Farmers stated in FGDs that when many growers bring fruit on the same day, traders lower prices sharply, forcing immediate sale because storage options are limited. Unsold fruits are either taken back home, fed to livestock, or discarded.

| Stage | Major Causes of Loss | Evidence from Survey / FGD |
|---|---|---|
| Harvest | Bruising, delayed picking, over-ripening | Manual family labour system dominates |
| Storage | Rapid spoilage, softening, moisture loss | Most farmers store only a few days |
| Transport | Compression damage, poor roads, long travel | Farmers reported rough handling |
| Market | Distress sale, unsold produce, price fall | Peak season glut discussed in FGDs |

**Table 6.4 Major causes of loss**

The most critical losses occur between the storage and market stages, where perishability, weak storage systems, and price pressure combine to reduce both quantity sold and farmer income.

## 6.4 Post-Harvest Loss Pathway: Harvest to Market

Rising production has not been matched by systems to store, sort, grade or use the fruit. This section traces how losses build up as fruit moves from harvest to market, and how they reduce both quality and income.

| Stage | What happens | Evidence | Effect on quality and income |
|---|---|---|---|
| Harvest | All growers harvest by hand between December and February, mostly with family labour; labour shortages at peak delay picking | 100% harvest December to February; 64.2% use only family labour (Table 5.1); FGDs | Bruising and over-ripe fruit; the whole area's supply arrives at once |
| Storage | Fruit is sold almost immediately because it cannot be held | 97.0% have no storage (Table 6.2); fruit holds for a few days; 10.4% can hold up to one month during ripening (Table 6.1) | No choice over when to sell; sale at peak-season prices |
| Sorting and grading | Good, damaged and over-ripe fruit are sold together | 4.5% sort; 0% grade (Table 6.1) | Lots priced to the weakest fruit; no premium for quality (Section 9.1) |
| Transport | Fruit is carried loose over poor roads | Compression damage and rough handling reported (FGD) | Visible damage lowers price; distant markets become risky |
| Market | Simultaneous arrivals create a glut | Peak-season glut and distress sales (FGD, KII) | Low prices; unsold fruit consumed, fed to livestock or discarded |

**Table 6.5 Post-harvest loss pathway**

**Surplus and the utilisation gap.** Each season, output exceeds what local markets absorb at fair prices. With no storage, aggregation or processing, surplus fruit is sold cheaply, consumed at home, shared with relatives, fed to livestock or left unused (Section 7.1). The gap is therefore not a lack of production but a lack of systems to hold, sort, aggregate and route fruit. As output has risen since 2023 without these systems, each additional kilogram adds to the peak-season glut.

**Implications.** The first constraints in the pathway, timing and quality, can be addressed through low-cost measures such as village collection points, crates, shade and simple sorting, before any processing is attempted (Section 12.4). Because losses and surplus volumes were not measured, their scale and the likely return on these measures cannot yet be estimated. Recording losses at each stage during the next harvest is a priority.

# Chapter 7: Surplus Management and Value Addition Gap

## 7.1 Surplus Availability

The study findings indicate that surplus availability is a common feature of apple ber cultivation, particularly during the peak harvesting season when production rises sharply within a short period. Many farmers reported that fruit output often exceeds the quantity that can be immediately sold or consumed at the household level. This seasonal surplus is largely driven by simultaneous harvesting across villages, resulting in temporary oversupply in local markets.

Discussions with farmers during FGDs revealed that while surplus production reflects the crop's good yield potential, it also creates management challenges because of the fruit's short shelf life and limited storage options. In the absence of timely buyers or organised aggregation systems, farmers are often compelled to sell quickly at lower prices. Some respondents also noted that surplus fruits are occasionally distributed among relatives, fed to livestock, or left unutilised when market demand is weak.

The presence of recurring surplus indicates both a challenge and an opportunity. While unmanaged surplus contributes to wastage and reduced returns, it also signals potential for better collective marketing and, in time, village-level value addition. Discussions with KVK Gossaigaon qualify this potential: earlier processing trials for apple ber failed because of fungal spoilage linked to the fruit's high moisture content (see Section 7.6.3).

| Aspect | Observation |
|---|---|
| Peak Period of Surplus | Main harvest season (December to February) |
| Main Cause | Simultaneous harvesting and market oversupply |
| Common Current Uses | Quick sale, household use, distribution, livestock feed |
| Key Constraints | Short shelf life, limited storage, weak market absorption |
| Opportunity Area | Better fresh-fruit handling and collective marketing; processing subject to technical validation |

**Table 7.1 Various aspects and observations on apple ber surplus**

## 7.2 Existing Local Processing Practices

The study findings indicate that there are currently no established local processing practices for apple ber in the surveyed villages. Farmers largely market the produce in fresh form immediately after harvest, with very limited storage and no organised conversion into value-added products such as dried fruit, jam, pickle, candy, juice, or pulp. Survey responses and field interactions suggest that once harvested, the fruit is either sold directly in local markets, consumed at the household level, shared within the community, or disposed of when market demand is weak.

The absence of processing activities appears to be linked to several constraints, including lack of technical knowledge, non-availability of simple processing equipment, limited awareness of commercial opportunities, inadequate packaging systems, and uncertainty regarding market demand for processed products. Women's groups and households also reported that although interest exists, no structured training or enterprise support has yet been introduced in the area.

This gap is significant because apple ber is a highly perishable fruit with a short marketable life. Without local processing options, farmers remain dependent on fresh fruit sales during

the peak season, when prices are often lowest. Small-scale community processing such as solar drying, preserves, candy making or pulp extraction could in principle reduce wastage and enhance incomes, but these options first need to be tested for Thai apple ber (Section 7.6).

## 7.3 Farmer Interest in Value Addition

The study findings indicate a strong interest among farmers in value addition of apple ber and in training for it, particularly as a response to seasonal price fluctuations, short shelf life, and recurring surplus during the peak harvest period. Survey responses suggest that many farmers are open to exploring processing options if they are practical, low-cost, and supported through training or collective systems. Farmers increasingly recognise that selling only fresh fruit during the peak season often results in lower prices, while processed products could help generate better returns and reduce wastage.

| Support needed by the farmers | Frequency | Percent |
|---|---|---|
| Market linkage | 40 | 59.7 |
| Training | 4 | 5.97 |
| Market linkage + Collective processing unit | 12 | 17.91 |
| Market linkage + Training | 5 | 7.46 |
| Market linkage + Training + Collective processing unit | 1 | 1.49 |
| Collective processing unit | 1 | 1.49 |
| Market linkage + Packaging and branding support | 2 | 2.99 |
| Market linkage + Collective processing unit + Packaging and branding support | 2 | 2.99 |
| Total | 67 | 100 |

**Table 7.2 Support needed by the farmers in apple ber cultivation**

During Focus Group Discussions (FGDs), respondents expressed interest in products such as dried apple ber, jam, pickle, candy, juice, and pulp, especially those that can be prepared using simple household or community-level methods. Women participants showed particular enthusiasm for processing activities that could be managed through Self Help Groups (SHGs) and for receiving training, as these could create local income opportunities while utilising surplus fruit. Farmers also indicated that value addition would be more attractive if linked with assured markets, packaging support, and training on hygiene and product preparation.

Insights from trader and market interviews further reinforce this potential. Traders reported that consumers value fruit quality, convenience, and longer shelf-life products, especially when fresh arrivals decline. Market actors noted that products such as dried fruit, jam, or packaged ready-to-eat items may find demand beyond the peak season, provided quality and branding are maintained. They also highlighted that better size, cleanliness, and presentation already influence fresh fruit prices, suggesting similar opportunities for processed products.

| Factors Encouraging Adoption of Value-Added Products | Frequency | Percent |
|---|---|---|
| Better price than fresh fruit | 27 | 40.3 |
| Collective marketing support | 11 | 16.42 |
| Better price + Collective marketing support | 15 | 22.39 |
| Better price + Processing equipment + Collective support | 3 | 4.48 |
| Better price + Processing equipment | 1 | 1.49 |
| Processing equipment + Collective support | 4 | 5.97 |
| Training & technical support + Market assurance + Better price | 1 | 1.49 |
| Training & technical support + Collective support | 3 | 4.48 |
| Market assurance + Collective support + Better price | 1 | 1.49 |
| Better price + Training & technical support | 1 | 1.49 |
| Market assurance + Better price | 1 | 1.49 |
| Total | 67 | 100 |

**Table 7.3 Factors that encourage value addition in apple ber**

## 7.4 Gap Between Surplus and Utilisation

The survey data indicate a mismatch between seasonal production levels and the current capacity to utilise apple ber fruit efficiently. Average production increased from 36.1 kg in 2023 to 99.8 kg in 2024, and remained high at 97.0 kg in 2025, showing that output has expanded substantially in recent years. At the same time, post-harvest handling systems remain weak. Only 3 farmers (4.5%) reported practising any sorting, while none of the respondents (0%) reported grading practices. Most farmers also indicated that fruit can be stored for only a few days, with only 10.5% able to retain produce for as long as one month.

These figures suggest that while production is rising, the ability to preserve quality, extend shelf life, or channel surplus into higher-value uses remains highly limited. During FGDs, farmers explained that when many growers harvest simultaneously, local markets become saturated and prices fall sharply. In the absence of storage or processing options, surplus fruit is often sold quickly at low prices, consumed domestically, shared informally, or wasted.

The data therefore show that the key issue is not lack of production, but inadequate systems for utilisation. Strengthening storage, sorting, grading and aggregation, and in time village-level processing where it proves feasible, could help convert seasonal surplus into a reliable source of additional income. These conclusions are based on farmers' accounts; the quantity of surplus and the share lost or sold at distress prices should be recorded during the next harvest to size any intervention.

## 7.5 Required Support Systems and Feasible Models for Scaling

The study findings indicate that farmer interest in apple ber value addition exists, but adoption will depend on the availability of practical support systems. Survey responses and FGDs consistently suggest that growers are willing to explore processing options if they receive training, equipment support, packaging assistance, and reliable market linkages. At present, rising production levels, limited storage duration, and the absence of grading or processing systems mean that farmers remain dependent on fresh fruit sales during peak season, when prices are lowest.

### *7.5.1 Required Support Systems*

Farmers and women's groups need training in post-harvest handling, hygiene, packaging, and enterprise management. Low-cost equipment such as crates, sealers and weighing machines would support fresh-fruit marketing, while processing equipment such as solar dryers and pulpers should be introduced only once suitable methods are validated. Studies from other settings show potential for ber jam, candy, dried slices, and beverages with extended shelf life; these have not yet been demonstrated for Thai apple ber in the study area. Packaging, branding, and direct market linkages are also important, as trader interactions confirmed that quality and presentation strongly influence prices. Group-based models through SHGs or farmer collectives can reduce costs and improve scale, while financial and institutional support would help enterprises during the initial phase.

### *7.5.2 Feasible Models for Scaling*

Solar drying by SHGs and cluster-level jam, preserve or pulp units have been suggested as possible models, but neither has yet been tested on Thai apple ber under local conditions; Section 7.6 assesses their feasibility. In the short term, fresh fruit aggregation and grading centres can improve returns through better sorting and packaging. The most effective long-term approach would be a hybrid model, where premium fruit is sold fresh while surplus or lower-grade fruit is processed, once a reliable processing method is established.

## 7.6 Value-Addition Feasibility Assessment

This section brings together the evidence on value addition and separates five questions: whether farmers want it, what technical challenges it faces, what KVK's experience shows, which products are possible, and which processing models are realistic.

### *7.6.1 Farmer Interest*

Interest is clear but conditional. Asked what support they need, 92.5% of growers (62) named market linkage, alone or with other support; 23.9% (16) named a collective processing unit; 14.9% (10) named training; and 6.0% (4) named packaging and branding (Table 7.2). Asked what would encourage them to adopt value-added products, 74.6% (50) cited a better price than fresh fruit and 55.2% (37) cited collective marketing support; fewer cited processing equipment (11.9%), training (7.5%) or market assurance (4.5%) (Table 7.3). These percentages count each grower who mentioned an option, alone or in combination. In FGDs, women expressed interest in dried fruit, jam, pickle, candy, juice and pulp, provided methods are simple, training is given and markets are assured.

Farmers therefore want better prices and markets first. Processing appeals as a route to better prices, not as an end in itself.

### *7.6.2 Technical Challenges*

Thai apple ber poses specific difficulties for processing. Its high moisture content makes products prone to fungal growth, and the fresh fruit holds for only a few days, so raw material must be processed quickly after harvest. No processing takes place locally at present, and farmers report lacking the knowledge, simple equipment, packaging and hygiene practices needed (Section 7.2). Any product would also need packaging, labelling and food-safety compliance before it could be sold beyond the village.

### *7.6.3 KVK Experience*

The most direct technical evidence comes from KVK Gossaigaon. The KVK scientist reported that value-addition methods for apple ber had already been tried and had not

succeeded: the products developed fungal growth within a short period because Thai apple ber has a higher moisture content than common ber, and its shelf life could not be extended sufficiently. This finding carries substantial weight. The studies on ber jam, candy, tutti frutti and dehydration listed in the references were conducted in other settings and, in several cases, on other ber types; they show what may be possible, not what has been achieved with Thai apple ber in Debitola's humid conditions.

### *7.6.4 Potential Products*

| Product or process | Evidence of interest | Technical issue for Thai apple ber | Status |
|---|---|---|---|
| Sorted and graded fresh fruit | Traders pay more for quality (Section 9.1) | None specific | Feasible now; price premium to be measured |
| Dried slices or powder (solar drying) | FGD interest; traders see possible off-season demand | High moisture; fungal spoilage reported in KVK trials | Requires technical validation |
| Osmotic dehydration, candy, tutti frutti | FGD interest; studies from other settings | Moisture and shelf life not tested locally | Requires technical validation |
| Jam, preserve, pulp | FGD interest | Not tested locally; hygiene, packaging and licensing needed | Requires technical validation and market testing |
| Juice, pickle | FGD interest | Not tested locally | Requires technical validation |

**Table 7.4 Status of evidence for candidate apple ber products**

### *7.6.5 Realistic Processing Models*

The evidence supports a fresh-first approach in three steps, linked to the roadmap in Section 12.4:

- **Phase I:** sort fruit at village collection points so that better grades are sold fresh and lower grades are sold separately or used at home.
- **Phase II:** run small, supervised trials with KVK on the most promising methods, such as solar drying or osmotic dehydration, measuring moisture, shelf life, product quality, cost per kilogram and buyer acceptance.
- **Phase III, only if trials succeed:** establish a small SHG pilot unit sized to the surplus actually available and linked to identified buyers.

A hybrid model, in which premium fruit is sold fresh and surplus or lower-grade fruit is processed, remains a sound long-term aim, but its processing component is not yet proven.

### *7.6.6 Where Opportunities Exist and Where Constraints Remain*

Opportunities exist now in better handling, sorting and grading of fresh fruit, which buyers already reward. Processing remains constrained by an unresolved technical problem, moisture-driven spoilage, and by the absence of cost, shelf-life and demand data. Before any investment in processing, the following should be established: a method that achieves acceptable shelf life for Thai apple ber under local conditions; production cost per unit and break-even volume; confirmed demand and price from identified buyers; the volume and quality of surplus available; and the training, equipment, hygiene and licensing requirements for SHGs. Commercial-scale processing is not recommended on the current evidence.

# Chapter 8: Input Supply and Market System Analysis

## 8.1 Input Availability, Constraints and Cost Categories

Data collected through interviews and FGDs indicate that the foundational inputs for apple ber cultivation, including saplings, fertilisers, pesticides, labour, and irrigation support, were largely facilitated through SeSTA, which significantly reduced initial barriers for farmers and enabled wider adoption of the crop. This institutional support appears to have played an important role in the expansion of apple ber cultivation across the surveyed villages.

However, despite basic input availability, farmers continue to face operational constraints that affect productivity and cost efficiency. During field discussions, farmers noted that replacement saplings, additional fertilisers, pest-control materials, and irrigation maintenance are not always easily accessible once the initial support phase is over. Labour shortages during pruning and harvesting periods were also mentioned as a recurring challenge.

In terms of cost perception, apple ber cultivation can be classified as a moderate-cost enterprise. Since core establishment inputs were externally supported, recurring costs are mainly linked to labour, orchard maintenance, supplementary fertilisers, pest management, and transport. These costs rise as orchards mature and production volumes increase. For smallholders, such expenses remain manageable, but without continued technical and market support, profitability can be affected.

Based on farmer interviews and FGDs, the average initial establishment cost of apple ber cultivation is estimated at around ₹7,000-10,000 per farmer, mainly covering saplings, pit preparation, basic inputs, fencing/support, and initial labour. Since key inputs such as saplings, fertilisers, pesticides, labour, and irrigation support were facilitated by SeSTA, the actual out-of-pocket cost for farmers was considerably reduced.

Farmers estimated an average seasonal production of around 150-200 kg. At a conservative selling price of ₹30-35 per kg during peak season, gross seasonal income may range between ₹4,500 and ₹7,000. If farmers were able to sell better-quality fruits during periods of lower supply at ₹60-80 per kg, the gross return could increase to around ₹9,000-16,000 per season. These estimates are assessed alongside the survey data, market conditions and sustainability risks in the business case in Section 12.2.

| Particular | Estimated Value |
|---|---|
| Initial establishment cost | ₹7,000-10,000 |
| Average seasonal production (farmer estimate) | 150-200 kg |
| Peak season price | ₹30-35/kg |
| Estimated gross income at peak price | ₹4,500-7,000 |
| Better/lean season price | ₹60-80/kg |
| Potential gross income at better price | ₹9,000-16,000 |

**Table 8.1 Estimated cost-benefit profile of apple ber cultivation**

Overall, the findings suggest that apple ber cultivation has benefited strongly from SeSTA-led input support, but long-term sustainability will depend on strengthening access to follow-up inputs, technical guidance, irrigation upkeep, and affordable seasonal services for farmers.

## 8.2 Market Channels Used by Farmers

The findings show that apple ber farmers use multiple marketing channels, with traders/middlemen being the most common outlet (31.3%), followed by village or local markets (26.9%). Another 14.9% (10 farmers) use both traders and local markets, and one farmer combines traders with other channels, indicating efforts to access better prices through multiple routes. A sizeable share (25.4%) reported other informal channels such as direct local sales or seasonal buyers.

Overall, the results suggest that while farmers have several selling options, a large dependence on intermediaries limits bargaining power and price control. Strengthening direct market access, collective sales, and organised aggregation could improve farmer returns.

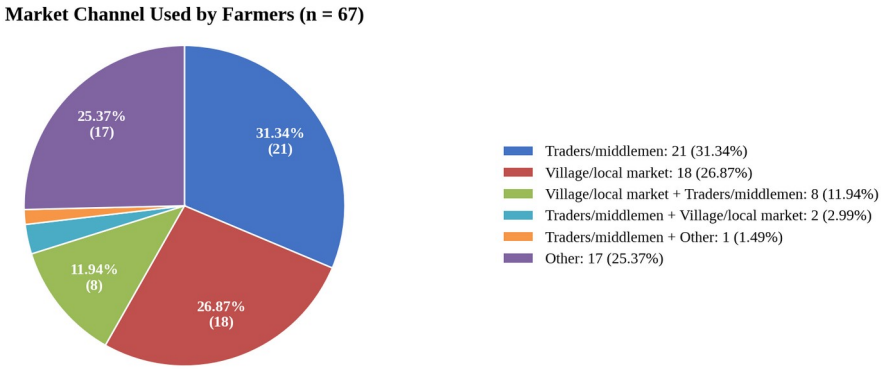



**Fig 8.1 Various market channels used by the farmers**

## 8.3 Price Discovery Mechanism

The findings show that apple ber prices are primarily determined by prevailing market conditions, with 49.3% of farmers reporting sales based on the market rate. This indicates that daily arrivals, demand, fruit quality, and seasonal supply strongly influence prices. Another 19.4% stated that prices are fixed by traders, reflecting the influence of intermediaries where farmers have limited bargaining power. Around 13.4% of respondents reported negotiated prices, usually in cases of better-quality produce or repeat buyer relationships. The remaining 17.9% followed other informal methods, including local arrangements or advance understanding with buyers.

FGD and trader interactions further confirmed that prices fall sharply during peak harvest arrivals and rise during lean supply periods. Overall, the price discovery system remains largely informal and supply-driven, highlighting the need for better market information, grading systems, and collective selling mechanisms to improve farmer returns.

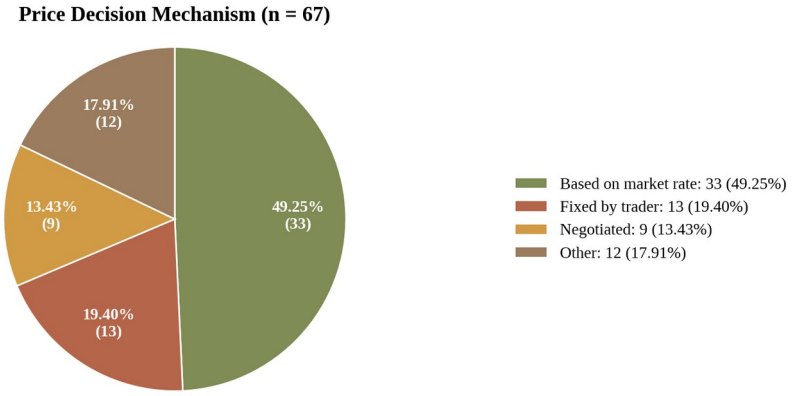



**Fig 8.2 Price decision mechanism by the farmers**

### 8.4 Major Market Challenges

The main market challenge for apple ber farmers is sharp price fluctuation during peak harvest, when high arrivals reduce prices and force distress sales. This is intensified by the fruit's short shelf life, as most farmers can store produce for only a few days. Dependence on traders/middlemen (31.3%) further limits bargaining power, while only 13.4% reported negotiated pricing. Farmers also face transport constraints and weak grading systems, with 0% grading and only 4.5% sorting, reducing chances of premium prices. Overall, seasonal oversupply and weak market systems are the key barriers to better returns.

## Chapter 9: Market Linkage and Demand Assessment

### 9.1 Trader Perspectives

Discussions with traders indicate that apple ber has a steady market demand, but prices are highly dependent on seasonal supply, fruit size, freshness, and appearance. During peak harvest months, when arrivals are high, prices often fall sharply, while lean-season supply can raise prices significantly. Traders generally prefer larger, uniform, and undamaged fruits, which sell faster and fetch better rates.

Most traders source produce from nearby villages and surrounding production areas, with some also mentioning competition from outside markets. They noted that farmers often sell quickly due to limited storage, which increases trader advantage during glut periods. Traders also expressed that graded, properly packed, or processed products such as dried fruit or jam could attract wider markets if quality and consistency are maintained. Overall, trader feedback suggests that better handling, sorting, and staggered marketing could improve returns across the value chain.

### 9.2 Buyer Preferences

Market preference for apple ber is strongly linked to quality, fruit size, freshness, and stage of ripeness. Trader consultations showed that larger, clean, undamaged, and uniform fruits fetch better prices and sell faster in the market. Freshness is especially important because apple ber is highly perishable, and delayed sale quickly reduces firmness and appearance.

Survey data show that most produce remains marketable for only a short period of a few days, while only 10.5% of farmers could retain fruits for as long as one month. This highlights the importance of quick marketing after harvest. In addition, all respondents reported that

harvesting occurs in batches over several weeks, which helps stagger supply and allows farmers to sell fruit at different ripeness stages rather than all at once.

### 9.3 Seller and Commission Agent Dynamics

Wholesalers and commission agents from Siliguri mentioned that they source apple ber from across West Bengal, including parts of Murshidabad. Production in those areas is so high that they rarely need suppliers from outside, though they would accept produce from other areas if farmers were ready to sell through them. During the season (December to March), they receive 3-5 tonnes of apple ber daily from farmers, at prices of ₹30-40 per kg depending on quality and size. The commission agent acts as an intermediary, linking farmers to the market and earning a margin while paying farmers for their produce. The agents also mentioned that they earlier supplied apple ber to Dhubri, Assam, but this has stopped because Dhubri now has enough production of its own and supplies outside the area.

### 9.4 Integrated Value-Chain Analysis

This section brings together the findings on market channels (8.2), price discovery (8.3), market challenges (8.4) and trader, buyer and commission-agent perspectives (9.1 to 9.3).

**Product flow.** Apple ber moves from household orchards to consumers through a short, informal chain: growers harvest and sell, usually without sorting; local traders and middlemen buy at the farm gate or in villages; village and weekly markets offer direct sale; and wholesalers and commission agents in larger markets such as Siliguri link regional supply to retailers. There is no aggregation, grading, cold storage or processing stage. Growers sell through traders only (31.3%), village markets only (26.9%), both (14.9%) or other channels (25.4%) (Table 4.1).

**Price discovery.** Nearly half of growers (49.3%) sell at the prevailing market rate, 19.4% say traders fix the price, 13.4% negotiate and 17.9% use other arrangements (Table 4.1). The mechanism differs by channel: among growers selling only to traders, 38.1% said the trader fixed the price, compared with none of those selling only in village markets, where 83.3% sold at the market rate. The study did not record prices by channel, so it cannot show that village markets pay more; the difference is in who sets the price.

**Trader roles.** Traders provide a real service: they buy in the village, pay immediately and spare growers the cost and risk of transport. That convenience also gives them a strong position in the peak season, when growers who cannot store fruit must sell (Section 9.1).

**Buyer preferences.** Buyers prefer large, uniform, clean and undamaged fruit at the right stage of ripeness, which sells faster and at better prices (Section 9.2). Current practice, with almost no sorting or grading, does not allow growers to capture this premium.

**Market constraints.** The core problem is seasonal oversupply rather than a lack of buyers. Buyers are available throughout the harvest, but prices fall when arrivals peak, and growers sell to the nearest buyer because fruit cannot be held. Regional markets offer limited relief: Siliguri commission agents already receive 3 to 5 tonnes a day from West Bengal and no longer supply Dhubri, which now produces enough for its own needs (Section 9.3). Expanding production without new outlets risks deepening the glut.

| Opportunity | What the evidence supports | Conditions and risks |
|---|---|---|
| Aggregation at village collection points | Reduces individual transport and selling time; enables bulk sale | Needs a reliable buyer and someone responsible for the point |
| Sorting and grading | Buyers pay more for uniform, undamaged fruit; current sorting is 4.5% | Needs simple grade standards, crates and training; premium not yet measured |
| Collective selling through SHGs | Can strengthen bargaining power with traders | Depends on group capacity and agreed rules for pooling and payment |
| Diversified channels (Bongaigaon, Guwahati, institutional buyers) | Siliguri and Dhubri are near saturation | Transport cost, quality and volume requirements untested; pilot consignments needed |
| Market price information | Price-setting is informal and supply-driven | Needs a simple, regular source of daily prices |

**Table 9.1 Opportunities to strengthen the apple ber value chain**

# Chapter 10: Women and SHG Participation

## 10.1 Women's Role in Production Activities

The study clearly shows that women play a central role in apple ber cultivation across the surveyed villages. Since all respondents were women (100%), the crop appears to be strongly associated with women-led household participation and livelihood management. Survey responses indicate that women are actively involved in key production activities such as planting, weeding, irrigation support, harvesting, sorting, and basic post-harvest handling. Harvest operations are largely family-based, with 64.2% of households relying on family members, further reflecting women's contribution within household labour systems.

FGDs also highlighted that women manage routine orchard care and frequently participate in harvesting during the peak season. In many households, apple ber cultivation provides women with an accessible income-generating activity that can be balanced alongside domestic responsibilities. Overall, the findings suggest that women are not only labour contributors but also key stakeholders in sustaining production and future value addition initiatives.

## 10.2 Role in Decision-Making (Sale and Price)

| Decision on sale | Frequency | Percent |
|---|---|---|
| Female members | 6 | 8.96 |
| Joint decision | 61 | 91.04 |
| Total | 67 | 100 |

**Table 10.1 Decision on sales and the authority**

As all survey respondents were women, it is evident that women are directly engaged not only in production activities but also in household-level decisions concerning orchard management, harvesting schedules, and sale of produce. Discussions in the field suggest that decisions such as when to harvest, where to sell, and how to utilise earnings are often taken jointly within the household, while in many cases women themselves manage routine operational choices due to their close involvement in cultivation.

Women were also found to play a key role in allocating labour, handling post-harvest activities, and deciding whether produce should be sold immediately or retained for short-term sale. In households linked with Self Help Groups, women showed greater confidence in participating in income-related decisions and exploring value addition opportunities.

## 10.3 Women-led Value Addition Potential and Challenges

As all respondents were women (100%), and harvesting activities are largely managed through family labour (64.2%) or a combination of family and hired labour (34.3%), women already contribute significantly to production and handling processes. In addition, 79.1% of households reported that women either fully or partially manage income from apple ber, while sale-related decisions are predominantly joint (91.0%). This suggests an existing foundation for enterprise participation.

The strongest opportunity lies in activities that can be carried out near the household, such as sorting, packaging, and collective marketing through SHGs, and, once processing methods are validated, drying, candy making and jam preparation. These activities align with women's current involvement and can convert seasonal surplus into higher-value products.

However, several challenges remain. The survey shows that only 4.5% of farmers currently practise sorting and 0% grading, indicating limited exposure to quality-based market systems. FGDs also highlighted constraints such as lack of training, limited access to equipment, time burden from domestic responsibilities, mobility restrictions for market travel, and uncertainty about market demand for processed products.

Women and SHGs are the natural base for the collective functions the value chain lacks. Their roles build on what women already do in cultivation, harvesting and household sale decisions, but interest does not by itself make an enterprise viable. Each role below depends on training, resources and a viable market, and is linked to the roadmap phase in which it could be introduced (Section 12.4).

| Role for women and SHGs | Current base | What is needed | Roadmap phase |
|---|---|---|---|
| Aggregation at collection points | None at present | Collection point, crates, shade, agreed rules | I |
| Sorting and grading | 4.5% sort; none grade | Simple grade standards; training; price feedback from buyers | I |
| Collective marketing and negotiation | Sale decisions mostly joint (91.0%) | Group selling agreements; trusted lead members; buyer contacts | I to II |
| Record-keeping | Not reported | Bookkeeping and digital payment training | II |
| Packaging and local branding | None at present | Packaging materials, design and quality control | II |
| Processing | None at present | Only after KVK trials succeed (Section 7.6) | III, conditional |
| Enterprise management | None at present | Enterprise training, finance and licensing | III, conditional |

**Table 10.2 Roles for women and SHGs in the apple ber value chain**

Village collection points would also ease two constraints women reported: restrictions on travelling to markets and the time burden of domestic work.

# Chapter 11: Conclusion

The study finds that apple ber is steadily emerging as a viable livelihood crop in the surveyed villages of Debitola block, Dhubri, Assam. Increasing average production and continued farmer participation indicate that the crop has gained acceptance as a practical source of supplementary income. Its adaptability, relatively low maintenance needs, and market demand make it a promising option for smallholder farmers in the region.

However, the benefits of cultivation are currently constrained by weak post-harvest systems, seasonal price fluctuations, and limited market power. Most farmers continue to depend on fresh fruit sales during peak harvest periods, when prices are lowest, while storage, grading, and local processing remain largely absent. KVK reported that earlier processing trials failed because the high moisture content of Thai apple ber led to fungal growth and limited shelf life, so processing remains unproven locally.

Rubber is also being planted widely in the area, and some farmers are shifting towards it as a higher and more stable long-term income source. Apple ber's advantage lies in quicker returns and seasonal cash flow. It is best positioned as a complementary enterprise that diversifies household income, and its long-term place will depend on whether it remains profitable once project support ends (Section 12.2).

The study also highlights the important role of women, who are central to cultivation, handling, and household decision-making. This creates strong potential for women-led aggregation, collective marketing and, once technically validated, value addition through SHGs and collective enterprise models.

# Chapter 12: Recommendations and Action Plan

## 12.1 Strategic Direction

The study's findings can be read as a livelihood pathway in which income is limited by its weakest link.

| Link in the pathway | Current position | Strength |
|---|---|---|
| Production | Average output rose from 36 kg (2023) to 97 kg (2025); wide variation; one-third of growers report decline | Moderate |
| Post-harvest management | 97.0% have no storage; 4.5% sort; none grade; fruit holds for a few days | Weak |
| Market access | Buyers available, but prices fall at peak; trader price-setting; regional markets near saturation | Weak |
| Value addition | No local processing; KVK trials failed due to fungal spoilage | Not yet feasible |
| Income enhancement | About ₹3,400 gross per grower per season; net income unknown | Modest |

**Table 12.1 The apple ber livelihood pathway**

**Farmers' aspirations.** Farmers want to continue and, in some cases, expand cultivation, provided buyers are reliable and prices fair. They prioritise market linkages, better prices and fewer losses over further production increases, and favour collective marketing through SHGs or farmer groups (Section 3.3).

**Interest in value addition.** Interest is real but conditional: 92.5% name market linkage as a needed support and 74.6% are motivated mainly by the prospect of a better price than fresh fruit (Section 7.6.1). Processing itself remains technically unproven (Section 7.6.3).

**Strategic direction.** The two weakest links, post-harvest management and market access, are where action should begin. The evidence supports a fresh-first strategy in three phases: strengthen handling and collective selling of fresh fruit; widen market outlets and build women's groups' capacity; and pursue processing and commercial integration only once technical and market tests succeed (Section 12.4). Women and SHGs are central actors at each phase (Section 10.3).

## 12.2 Business Case and Sustainability

**Production economics.** Farmers estimate the initial cost of establishing an orchard at ₹7,000 to 10,000, covering saplings, pit preparation, basic inputs, fencing and initial labour (Section 8.1). SeSTA supplied much of this, so farmers' out-of-pocket costs have been low. Recurring costs, mainly family labour, maintenance, supplementary fertiliser, pest management and transport, were not measured.

**Income under different market conditions.** The survey average and farmers' own estimates of seasonal output give different income estimates, set out in Table 12.2.

| Scenario | Output | Price | Gross income per season | Basis |
|---|---|---|---|---|
| A. Survey average, 2025 | 97 kg | ₹35/kg | ₹3,394 | Survey mean (Table 3.1); price from traders and farmers |
| B. Farmer-estimated output, peak price | 150 to 200 kg | ₹30 to 35/kg | ₹4,500 to 7,000 | FGD estimate (Table 8.1) |
| C. Farmer-estimated output, lean-season price | 150 to 200 kg | ₹60 to 80/kg | ₹9,000 to 16,000 | FGD estimate; not currently achievable |

**Table 12.2 Gross income scenarios (before recurring costs)**

Scenario A is the most reliable because it rests on the survey. It indicates a modest supplementary income of about ₹3,400 a season for the average grower, with wide variation; at this level, gross income would recover the establishment cost in roughly two to three seasons, before recurring costs. Scenario C should not be treated as an achievable target under current conditions: it assumes higher output than the survey average and sale at lean-season prices, while fruit holds for only a few days and the whole area harvests at once. The realistic near-term gain lies in better prices within the season through grading and collective sale, and its size should be measured rather than assumed.

**Dependence on institutional support.** Apple ber expanded with substantial support from SeSTA for saplings, fertilisers, pesticides, labour and irrigation. Farmers report that replacement saplings, fertilisers, pest control and irrigation maintenance are harder to obtain once initial support ends, and labour shortages recur at pruning and harvest (Section 8.1). Because recurring costs and net income were not measured, the study cannot yet show whether cultivation remains profitable without support.

**Sustainability risks.**

| Risk | Evidence | Mitigation |
|---|---|---|
| Loss of input and technical support after the project phase | Follow-up inputs harder to obtain (Section 8.1) | Link growers to KVK and the Horticulture Department; build SHG input procurement |
| Declining output in older plantings | 57.1% of fourth-year growers report decline (Table 3.3) | Training in pruning, pest and nutrient management |
| Deepening peak-season glut | Synchronised harvest; Siliguri and Dhubri near saturation (Section 9.3) | Aggregation, grading, new outlets; plan area expansion against market capacity |
| Competition from rubber | Some farmers shifting to rubber, seen as more stable (Chapter 11) | Position apple ber as complementary, quick-return income rather than a replacement |
| Unproven processing | KVK trials failed (Section 7.6.3) | Treat processing as a research question until trials succeed |

**Table 12.3 Key sustainability risks**

**Conditions for long-term viability.** Apple ber is likely to remain viable for smallholders if growers retain access to follow-up inputs and technical advice, distress sales are reduced through aggregation, grading and collective selling, outlets are found beyond saturated local and Siliguri markets, and any expansion of planted area keeps pace with market capacity.

## 12.3 Recommendations

a. Provide short-term training on orchard management, pruning, nutrient application, pest control, harvesting, sorting, and basic packaging to improve yield and fruit quality.

b. Set up village-level collection points, promote plastic crate handling, shaded storage, and low-cost temporary storage during peak harvest (Section 6.3).

c. Train SHGs in food safety, bookkeeping, packaging, and digital payments so they can collectively procure and market fruit, and in processing once suitable methods are validated.

d. Connect farmers with local markets, traders, retailers, weekly markets, institutional buyers, and urban centres such as Dhubri, Bongaigaon, Guwahati, and Siliguri.

e. Introduce grading, standard packaging, farmer aggregation, and a seasonal marketing calendar to improve bargaining power and reduce distress sales.

A coordinated institutional approach will be essential for sustainable scaling. SeSTA and local development partners may continue to play a catalytic role in technical guidance, community mobilisation, and enterprise incubation. Line departments such as Horticulture, Agriculture, Rural Livelihood Missions, and Food Processing agencies should be converged for infrastructure and subsidy support.

## 12.4 Three-Phase Roadmap for Scaling and Commercial Integration

The roadmap is phased around the December to February harvest season. Timings are indicative, and each phase depends on the results of the one before.

| Phase and timing | Action | Lead | Supporting | Priority | Evidence basis |
|---|---|---|---|---|---|
| **Phase I: Strengthen the fresh-fruit system** (before and during the next harvest; 0 to 12 months) | Training in orchard management, pruning, pest control and harvest handling | SeSTA, KVK | Horticulture Department | High | One-third report declining output |
| | Village collection points with crates and shade, run by SHGs | SeSTA, SHGs | Line departments | High | 97.0% have no storage; transport damage |
| | Simple sorting and grading standards and training | SeSTA, KVK | Traders | High | 4.5% sort, none grade; quality drives price |
| | SHG-led collective selling with a harvest calendar | SHGs, SeSTA | | High | Synchronised harvest; trader price-setting |
| | Record losses, prices by channel and recurring costs | SeSTA | Research partners | High | Losses and net income unknown |
| **Phase II: Widen markets and build group capacity** (second season; 12 to 24 months) | Pilot consignments to Bongaigaon, Guwahati and institutional buyers, recording prices and costs | SeSTA | Marketing Board, traders | High | Siliguri and Dhubri near saturation |
| | Simple daily price information for growers | SeSTA | Government | Medium | Informal, supply-driven pricing |
| | SHG training in record-keeping, digital payments, packaging and local branding | SeSTA | State Rural Livelihood Mission | Medium | No existing group enterprise systems |
| | Technical trials of processing methods for high-moisture fruit | KVK | Research institutions | Medium | KVK trials failed; feasibility unproven |
| **Phase III: Conditional scaling and commercial integration** (24 months onwards, subject to Phase II results) | Small SHG processing pilot, only if trials succeed and buyers are identified | SHGs, SeSTA | KVK, Food Processing Department, banks | Conditional | Depends on technical validation |
| | Block-level aggregation, formal market tie-ups and FPO linkage if volumes justify it | SeSTA | Line departments, FPOs | Medium | Requires proven aggregation in Phases I and II |
| | Plan any expansion of planted area against market capacity | SeSTA | Horticulture Department | Medium | Risk of deepening the peak-season glut |

**Table 12.4 Three-phase action roadmap**

Credit support through banks, revolving funds, and livelihood schemes should support these phases. With sustained institutional backing, apple ber can evolve into a regionally significant horticulture-based livelihood model for western Assam.

## References


1. Kalita, P., Das, R., and Sharma, H. (2021). Studies on physico-chemical characters of Thai apple ber (*Ziziphus mauritiana* Lamk.) grown in Assam. *Journal of Pharmacognosy and Phytochemistry*, 10(3), 357-362. https://www.phytojournal.com/archives/2021/vol10issue3/PartC/10-2-357-450.pdf
2. Dalal, N., Yadav, S., and Kumar, R. (2019). Development and nutritional evaluation of value-added products from ber (*Ziziphus mauritiana*). *International Journal of Current Microbiology and Applied Sciences*, 8(1), 1-8. https://www.ijcmas.com/8-1-2019/Nidhi%20Dalal%2C%20et%20al.pdf
3. Singh, M., Patel, R., and Choudhary, P. (2021). Standardization of tutti frutti from apple ber (*Ziziphus mauritiana*). *The Pharma Innovation Journal*, 10(12), 366-370. https://www.thepharmajournal.com/archives/2021/vol10issue12/PartS/10-8-366-120.pdf
4. Kumar, A., Verma, S., and Meena, D. (2021). Effect of osmotic dehydration on quality and storage stability of apple ber products. *International Journal of Food Science and Nutrition*, 6(5), 721-726. https://www.foodsciencejournal.com/assets/archives/2021/vol6issue5/6-5-12-721.pdf
5. Hossain, M., Rahman, T., and Ali, S. (2023). Indian jujube: A potential fruit tree to improve livelihood. *Plants*, 12(18), 3274. https://pmc.ncbi.nlm.nih.gov/articles/PMC10440574/
6. Indian Council of Agricultural Research. (n.d.). Mainstreaming of potential fruit crops in Northeast India. *Indian Horticulture*. ICAR.
7. Sharma, V., Joshi, R., and Gupta, P. (2025). Assessment of ber cultivars for value addition through dehydration. *Journal of Horticultural Processing Research*. Advance online publication.


## Annexures

- Questionnaire

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