



Growth trends, marketing efficiency and market opportunities for pineapple (*Ananas comosus*) production in Manipur

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ABSTRACT

Pineapple [*Ananas comosus* (L.) Merr.] is a crucial cash crop that contributes significantly to the livelihood and income of tribal and smallholder farmers in Manipur. The present study was conducted from 2024 to 2025 in Imphal-East, Senapati and Kangpokpi districts to examine the growth trends, marketing efficiency and market opportunities for pineapple in Manipur. A total sample of 450 respondents was selected using purposive random sampling for the study. Primary data was collected through personal interview using a pre-structured interview schedule, while secondary data on area, production and productivity was obtained through official publications. Compound annual growth rate (CAGR), coefficient of variation (CV), price spread, producer's share in consumer's rupee (PSCR), shepherd's marketing efficiency index, Acharya's modified marketing efficiency index and SWOT analysis were used. The results indicated a declining trend in area and production, whereas productivity showed a positive growth trend. The marketing channel results for Channel I (producer → consumer) was the most efficient, with a producer-share in the consumer's rupee (PSCR) of 84.00% and a modified marketing efficiency (MME) of 5.25. The SWOT analysis revealed traditional, chemical-free farming practices as a major strength, lack of transportation and market infrastructure as key weaknesses, eagerness to undergo the value-addition process using juice and canning units as an important opportunity and regional bandh/blockades and price instability as major threats. This study highlights the need of local processing facilities, improved market infrastructure and direct marketing systems to enhance farmers' income and promote sustainable pineapple production in Manipur.

Keywords: CAGR, Likert scale, Pineapple, Price spread, SWOT analysis

Pineapple [*Ananas comosus* (L.) Merr.] is the third most important tropical fruit in the world and one of the most commercially important fruit crops cultivated in India (Sivakkolundu 2021). India contributes nearly 7% of global pineapple production, producing about 1,798.7 thousand annually. The Northeastern Region (NER) is the major production area, as it hosts 64.40% of the total acreage and 46.81% of the total pineapple production in India (DA&FW 2021). Among the NER states, Manipur is one of the leading producers of pineapple owing to its favourable agro-climatic conditions and acidic soil profile, which are well suited for cultivating the *Kew* and *Queen* varieties (Devi and Devi 2022). During 2020–21, the state produced 1,34,820 MT of pineapple from 12,120 ha of cultivated area (DA&FW 2024). The cultivation of Pineapple is mainly in the hill districts, where it serves as an important source of income and livelihood for tribal and smallholder farming households. Recent studies have

shown that pineapple cultivation in Manipur is economically profitable, but the benefits to the farmers may differ across marketing channels due to differences in marketing costs, price spread and the producer's share in the consumer's rupee (Singh 2022; 2023). Growth analyses also indicate that changes in pineapple production have been driven more by expansion in cultivated area than by improvements in productivity, while technological gaps, poor access to quality planting materials and limited extension support continue to restrict yield improvement (Dimashree *et al.* 2023, Singh *et al.* 2023). These findings suggest that increasing production alone cannot substantially improve farmers' income unless supported by efficient marketing systems.

The marketing system of pineapple in Manipur presents several challenges. Nearly 64% of the produce moves through traditional marketing channels involving women traders (locally known as *Lalonbi*) and retailers before reaching consumers (Devi *et al.* 2021). While this system has long supported local trade, the involvement of several intermediaries reduces the producer's share in the consumer's rupee. High transportation costs, poor road connectivity, unregulated markets and weak bargaining power further reduces farmers' returns (Thakur *et al.* 2023).

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The growing demand for processed pineapple such as juice, canned slices and dried fruit has also created new market opportunities. Manipur enjoys extended fruiting season of nearly eight months, offering considerable scope for processing and value-added enterprises. Yet, the absence of processing facilities, cold storage infrastructure and organised market linkages results in substantial post-harvest losses and prevents farmers from realising higher returns (Devi *et al.* 2023, MoFPI 2023).

Several studies have examined pineapple production, profitability and marketing in Manipur and other parts of Northeast India. However, studies on production trends, marketing efficiency and market opportunities of pineapple in Manipur remains limited. Therefore, the present study analysed the growth trends in area, production and productivity, evaluates marketing efficiency and identifies market opportunities to strengthen value chain and improve pineapple growers' income and livelihood.

MATERIALS AND METHODS

The study was conducted during 2024–25 in the state of Manipur, which is one of the major pineapple producing states in the Northeastern region of India. Among the districts of Manipur, Imphal-East, Senapati and Kangpokpi were purposively selected for the study based on their extensive area and pineapple production. These districts are known to participate in local and regional fruit markets and are actively engaged in the commercial cultivation of pineapples. Respondents were selected using a multistage random sampling technique. With the consultation of officials of the Department of Horticulture and Soil Conservation, Government of Manipur and KVKs, villages with relatively more pineapple farmers were determined. Pineapple growers were selected using purposive random sampling with a total of 450 respondents. Primary and secondary data were used in this study. Primary data were gathered through personal interviews using a pre-tested interview schedule. To ensure clarity, reliability and appropriateness of the questions prior to the survey, necessary modifications were incorporated based on expert suggestions. Secondary data on the production and productivity of pineapple in the area were obtained from the Department of Horticulture and Soil Conservation, Government of Manipur, research journals, books and other relevant published works.

For further clarity, the data were taken and analysed as per the channel of movement of produce from farmer to consumer which were named as channel-I, channel-II and channel-III (Fig. 1).

To analyse the growth performance of pineapple cultivation in Manipur, compound annual growth rate (CAGR) was estimated using the following formula:

$$CAGR (\%) = \left[\left(\frac{\text{Ending value}}{\text{Starting value}} \right)^{\frac{1}{n}} - 1 \right] \times 100$$

Where n , Number of years.

The instability in the area, production and productivity was measured using the coefficient of variation (CV), which was calculated as follows:

$$CV (\%) = \left(\frac{\text{Standard deviation}}{\text{Mean}} \right) \times 100$$

Market efficiency, price spread and producer's share in consumer rupee across various marketing channels were evaluated using standard agricultural marketing tools. The total marketing cost was estimated by considering the cost incurred by producers and intermediaries during the movement of produce from the producer to the consumer using the formula:

$$C = C_f + C_{m1} + C_{m2} + C_{m3} \dots + C_{mn}$$

Where C , Total marketing cost; C_f , Cost incurred by the producer (farmer) from the time the produce leaves the farm until it is sold; C_{mn} , Cost incurred by the n^{th} middleman during the buying and selling processes.

Price spread = Consumer price – Net price of producer

$$\text{Producer's share in consumer rupee (PSCR) (\%)} = \left(\frac{\text{Net price received by the producer}}{\text{Consumer price}} \right) \times 100$$

Modified marketing efficiency (MME) suggested by Acharya (2011) was estimated as:

$$MME = \frac{NP}{(MC + MM)}$$

Where MME, Modified marketing efficiency; NP, Net price; MC, Total marketing cost; MM, Net marketing margin.

The Shepherd's index of marketing efficiency (Shepherd 1965) was calculated as follow:

$$ME = \frac{V}{I} - 1$$

Where ME, Index of marketing efficiency; V, Consumer price; I, Total marketing cost.

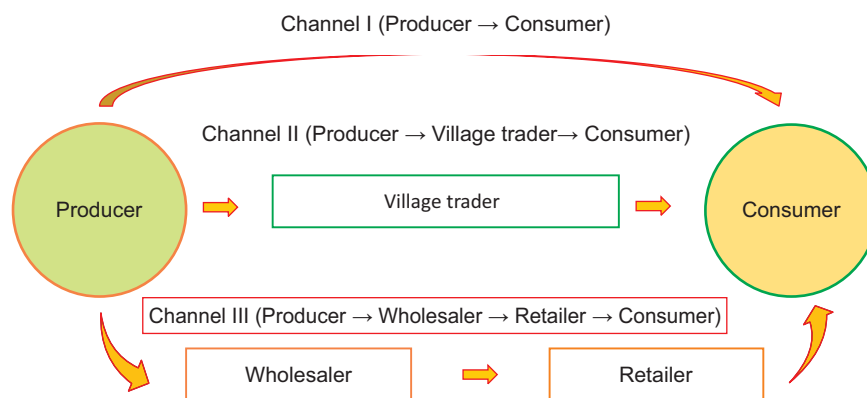


Fig. 1 Flow diagram of channel I, channel II and channel III .

To analyse the strengths, weaknesses, opportunities and threats associated with the pineapple cultivation in Manipur, SWOT analysis was used. Statements within each SWOT element were developed through expert consultation and field observations. The responses were showed on a three-point Likert scale, namely, Agree, Undecided and Disagree. The collected responses were analysed using frequency and percentage to obtain the major perceptions of pineapple growers about pineapple cultivation in Manipur. The results were interpreted and presented using descriptive statistical methods, that is, frequency, percentage, mean, coefficient of variation, marketing efficiency indices and price spread analysis.

RESULTS AND DISCUSSION

Trend in area, production and productivity of pineapple in Manipur: The trends in area, production and productivity of pineapple in Manipur during 2013–23 revealed that although the cultivated area gradually declined over the study period, production remained relatively stable as productivity showed a gradual improvement over the same period. The area under pineapple cultivation decreased from 13.70 thousand ha in 2013–14 to 12.29 thousand ha in 2022–23 after reaching the highest level of 14.27 thousand ha in 2014–15. Thereafter, the cultivated area followed a declining trajectory, reaching its lowest level of 12.12 thousand ha in 2020–21 before recovering marginally during the final two years of the study. Whereas, the productivity increased from 9.95 mt/ha to 10.65 mt/ha despite noticeable year to year fluctuations, attaining a peak of 11.85 mt/ha in 2019–20. Consequently, production fluctuated between 127.03 thousand tonnes and 166.48 thousand tonnes rather than declining in proportion to the reduction in cultivated area, which indicates that improvement in productivity prevents the decline in production despite the decline in cultivated area (Table 1).

Similarly, productivity led trends have been reported in NER, where technological improvements, improved crop management and better resource utilisation have contributed more to production than expansion of cultivated area (Sharma *et al.* 2022, Dimashree *et al.* 2023). Nevertheless, the modest increase in productivity was insufficient to completely offset the continuous decline in cultivated area, suggesting that the long-term growth of pineapple cultivation in Manipur is gradually becoming more dependent on productivity enhancement rather than horizontal expansion. These findings highlight the need for wider dissemination of improved planting materials, scientific crop management practices and effective extension support to sustain productivity while strengthening the production (Singh *et al.* 2023, Hazari *et al.* 2024).

Growth and instability analysis of pineapple in Manipur: The data presented in Table 1 is further supported by the growth and instability estimates shown in Table 2. The CAGR indicates that the area under pineapple cultivation declined by 1.08% per annum, while production showed a decline of 0.41%. However, productivity increased at

Table 1 Area, production and productivity of pineapple cultivation in Manipur

Year	Area (‘000 ha)	Production (‘000 mt)	Productivity (mt/ha)
2013–14	13.70	136.31	9.95
2014–15	14.27	136.75	9.58
2015–16	13.66	128.51	9.41
2016–17	13.36	127.03	9.51
2017–18	14.16	134.06	9.47
2018–19	13.99	131.64	9.41
2019–20	14.05	166.48	11.85
2020–21	12.12	134.82	11.12
2021–22	12.29	130.86	10.65
2022–23	12.29	130.86	10.65

Source: Department of Horticulture and Soil Conservation, Manipur.

an annual rate of 0.68%, indicating that improvements in productivity have contributed to maintaining production despite the decline in cultivated area (Table 2). Similar trends have been observed in other pineapple growing states of the NER, where production growth in past few years has largely been associated with improvements in productivity rather than expansion of cultivated area (Dimashree *et al.* 2023). The coefficient of variation revealed that the variability in area, production and productivity remained below (10.00%), indicating that pineapple cultivation in Manipur was relatively stable over the study period. Productivity showed the highest coefficient of variation (8.47%), followed by production (8.30%) and area (6.28%), suggesting that yield performance fluctuated more than the cultivated area and overall production (Table 2). Similar observations on fluctuations in pineapple productivity to climatic variability, uneven adoption of improved production technologies, limited extension support and inadequate market incentives have been reported by Hazari *et al.* (2024) and Jamir and Ezung (2024). Overall, the findings indicate that future growth in pineapple production in Manipur will depend largely on improving productivity, as further expansion of cultivated area is limited. This highlights the importance of strengthening extension services, promoting improved planting materials and encouraging the adoption of scientific production practices. At the same time, improving marketing efficiency and identifying better market opportunities will be equally important for enhancing farmers' income.

Marketing cost, price spread, producer's share in consumer rupee and marketing efficiency of pineapple marketing channels

Marketing channel-I: In channel-I (Producer→Consumer), the produce was directly sold by the producer to the consumer without the involvement of any

Table 2 Growth and stability analysis of pineapple production with respect to market demand in Manipur (2013–23)

Particulars	Area (‘000 ha)	Production (‘000 mt)	Productivity (mt/ha)
Initial value	13.70	136.31	9.95
Final value	12.29	130.86	10.65
No. of years	10	10	10
CAGR (%)	-1.08	-0.41	0.68
CV (%)	6.28	8.30	8.47

CAGR, Compound annual growth rate; CV, Coefficient of variation.

intermediary. The producer sold pineapple at ₹2,000/q and incurred a total marketing cost of ₹320/q. After deducting the marketing expenses, the net price received by the producer was ₹1,680/q. The price spread was ₹320/q and the producer's share in consumer's rupee was highest (84.00%) in this channel. Similarly, the channel showed the highest marketing efficiency values with Shepherd's index of 5.25 and Acharya's MME of 5.25 (Table 3). The higher efficiency of this channel may be attributed to the absence of intermediaries, as additional market functionaries generally increase marketing costs and margins, thereby reducing the producer's share and overall efficiency of the marketing channel (Abad *et al.* 2024).

Marketing channel-II: In Channel II (Producer → Village trader → Consumer), the involvement of one intermediary resulted in an increase in marketing cost and reduction in producer's share. The producer incurred ₹315/q as marketing cost and received a net price of ₹1,685/q. The village trader incurred an additional marketing cost of ₹415/q, along with a margin of ₹150/q. The produce was finally sold to

consumers at ₹2,565/q. Due to the addition of the village trader's costs and margin, the price spread increased to ₹880/q, while the producer's share declined to (65.69%). The marketing efficiency also declined considerably, with Shepherd's index and Acharya's MME at 2.51 and 1.91, respectively (Table 4). This indicates that the inclusion of even a single intermediary substantially reduces marketing efficiency by increasing the gap between the producer's realisation and the consumer's price.

Marketing channel-III: Channel III (Producer → Wholesaler → Retailer → Consumer), was the longest marketing channel and showed the least efficient performance among all the channels. The producer incurred a marketing cost of ₹400/q and received a net price of ₹1,600/q. The wholesaler incurred ₹405/q as marketing cost and retained a margin of ₹130/q. Similarly, the retailer incurred an additional cost of ₹340.50/q, along with a margin of ₹140/q. Consequently, the final consumer price increased to ₹3,015.50/q. The price spread widened to ₹1,415.50/q, while the producer's share declined to the lowest (53.06%). The marketing efficiency values were also lowest in this

Table 4 Marketing cost, price spread and producer's share in consumer rupee in channel-II (Producer → Village Trader → Consumer)

Particulars	Channel II (₹/q)
Producer sale price to the village trader (₹/q)	2,000.00
Charges incurred	
a. Cost of transportation	160.00
b. Cost of gunny bag	65.00
c. Loading unloading charges	50.00
d. Miscellaneous charge	40.00
Total marketing cost (Producer)	315.00
Net price received by producer	1,685.00
Sale price of the village trader	2,565.00
Charges borne by village trader	
a. Cost of transportation	150.00
b. Cost of gunny bag	50.00
c. Loading unloading charges	55.00
d. Miscellaneous charge	60.00
e. Market fees	100.00
Total marketing cost (Village trader)	415.00
Net price received by village trader	2,150.00
Village traders' margin	150.00
Price spread	880.00
Producer's share in consumer's rupee (PSCR)	65.69%
Marketing efficiency (Shepherd's approach)	2.51
Marketing efficiency (Acharya's approach)	1.91

Table 3 Marketing cost, price spread and producer's share in consumer rupee in channel-I (Producer → Consumer)

S1. Particulars no.	Channel I (₹/q)
1. Producer sale price to consumer (₹/q)	2,000.00
2. Charges incurred	
a. Cost of transportation	150.00
b. Cost of gunny bag	75.00
c. Loading unloading charges	50.00
d. Miscellaneous charge	45.00
3. Total marketing cost (Producer)	320.00
4. Net price received by producer	1,680.00
5. Price spread	320.00
6. Producer's share in consumer's rupee (PSCR)	84.00%
7. Marketing efficiency (Shepherd's approach)	5.25
8. Marketing efficiency (Acharya's approach)	5.25

Table 5 Marketing cost, price spread and producer's share in consumer rupee in channel – III (Producer → Wholesaler → Retailer → Consumer)

Particulars	Channel III (₹/q)
Producer sale price to wholesaler (₹/q)	2,000.00
Charges incurred	
a. Cost of transportation	140.00
b. Cost of gunny bag	60.00
c. Loading unloading charges	50.00
d. Miscellaneous charge	50.00
e. Market fees	100.00
Total marketing cost (Producer)	400.00
Net price received by producer	1,600.00
Sale price by the wholesaler	2,535.00
Charges borne by wholesaler	
a. Cost of transportation	160.00
b. Cost of gunny bag	55.00
c. Loading unloading charges	50.00
d. Miscellaneous charge	40.00
e. Shop rent	100.00
Total marketing cost (Wholesaler)	405.00
Net price received by wholesaler	2,130.00
Wholesaler margin	130.00
Retailer's selling price	3,015.50
Charges borne by retailer	
a. Cost of transportation	100.00
b. Cost of gunny bag	45.00
c. Loading unloading charges	55.00
d. Miscellaneous charge	40.50
e. Market fees	100.00
Total marketing cost (Retailer)	340.50
Net price received by retailer	2,675.00
Retailer's margin	140.00
Price spread	1,415.50
Producer's share in consumer's rupee (PSCR)	53.06%
Marketing efficiency (Shepherd's approach)	1.63
Marketing efficiency (Acharya's approach)	1.13

channel, with Shepherd's index of 1.63 and Acharya's MME of 1.13 (Table 5). The reduced efficiency in this channel was mainly due to the combined effect of additional marketing costs and margins retained by wholesalers and retailers, which increased the difference between the producer's price and consumer's price.

The findings indicate that among the three channels marketing efficiency declined with an increase in the number of intermediaries involved. As the channel length increased from direct marketing to a channel involving wholesalers and retailers, the price spread increased from ₹320/q to ₹1,415.50/q, while the producer's share declined from 84.00% to 53.06% (Fig. 2). Similarly, Shepherd's index declined from 5.25 to 1.63 and Acharya's MME decreased from 5.25 to 1.13. The decline in efficiency was approximately (73.90%) and (78.50%), respectively, indicating that longer marketing channels reduce the economic benefits received by the producers. Similar findings were also reported by Thakur *et al.* (2023), where direct producer-to-consumer channel was the most efficient, while efficiency declined considerably with the addition of intermediaries. Similarly, Kumar and Kumar (2024) also observed that direct marketing resulted in higher marketing efficiency compared to channels involving intermediaries. Shorter channels showed lower price spread, higher producer's share and greater marketing efficiency meanwhile, Chand *et al.* (2020) highlighted that direct marketing channels provide greater returns to producers by reducing intermediary margins.

Overall, the findings indicate that the length of the marketing channels plays an important role in determining marketing efficiency. Shorter marketing channels allow producers to retain a larger share of the consumer's price by reducing additional marketing costs and intermediary margins. Therefore, strengthening direct marketing mechanisms through farmer producer organisations (FPOs), local markets and direct farmer-consumer linkages can improve producer realisation and enhance the efficiency of pineapple marketing in the study area.

SWOT analysis of pineapple cultivation in Manipur : The SWOT analysis revealed that the majority of the respondents (94.89%) adopted traditional, chemical free farming, while 91.56% confirmed that their farm is purely organic with little to no use of chemical fertilisers or pesticides. Further, 83.11% stated their farms as self-sufficient with minimal expenditure and 68.44% practiced intercropping for supplementary income (Supplementary Table 1). Similar observations have been reported in the NER, where pineapple cultivation has largely remained organic and possesses opportunities for certification and premium marketing (Das *et al.* 2021, Devi *et al.* 2021, Singh *et al.* 2022). The presence of organic production systems and favourable geographical positioning further strengthens the possibility of developing value chains for organic pineapple in the region (Datta *et al.* 2020, Das *et al.* 2023). Despite these strengths, the weaknesses highlighted major infrastructural and marketing-related limitations. Lack of transportation facilities was the major constraint, reported by 86.89% of the respondents, followed by inadequate marketing knowledge (79.56%), post-harvest losses before sale (70.44%), high establishment cost (52.44%) and labour scarcity with increasing labour costs (47.56%) (Supplementary Table 1). These findings indicate that the

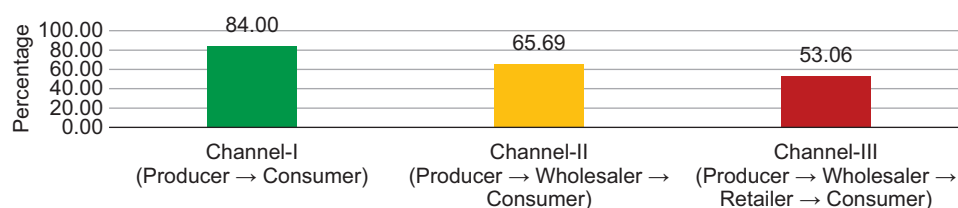


Fig. 2 Producer's share in consumers' rupee across channel I, II and III.

production advantage arising from organic cultivation is constrained by poor market connectivity and weak post-harvest management systems. Similar constraints related to inadequate storage facilities, poor road connectivity and transportation difficulties have been reported among pineapple growers in Manipur (Devi *et al.* 2023). Singh and Sharma (2020) also identified lack of all-weather roads, high transportation charges and limited transport availability as major constraints affecting pineapple growers in the NER.

The opportunity dimension revealed considerable scope for value addition, market diversification and digital marketing. A majority (97.33%) expressed willingness to supply pineapple to juice and canning units if local processing facilities were established. Further, 86.44% of the respondents stated that they are aware of increasing market demand for pineapple, 74.89% reported interest among younger family members in marketing activities and 68.00% expressed willingness to adopt social media and mobile applications for direct selling (Supplementary Table 1). These findings indicate the farmers' readiness to participate in emerging value chains and direct marketing systems. The potential for pineapple processing into products such as juice, jam, jelly, syrups and squash has also been reported in earlier studies by Raleng and Singh (2021) and Sharma *et al.* (2023).

Similarly, digital platforms have shown potential in improving farmer consumer linkages through direct marketing approaches (Krishnan *et al.* 2020). However, limited awareness regarding agro-tourism (31.33%) and the Pradhan Mantri Formalisation of Micro Food Processing Enterprises Scheme (PMFME) (26.22%) suggests the need for improved extension interventions and institutional support. The threat dimension represented the major challenges affecting the sustainability and profitability of pineapple cultivation. Price instability was reported by 93.11% of respondents, followed by frequent bandh and blockades restricting market access (90.89%), dominance of village traders and middlemen in price determination (88.44%), rising transportation costs (85.78%), sunscald incidence due to increasing temperature (61.33%) and stray-animal damage (38.67%) (Supplementary Table 1). Similar marketing constraints involving price fluctuations, middlemen dominance and inadequate transportation have been reported among pineapple growers in Tripura and Manipur by Roy and Ghosh (2022) and Devi *et al.* (2023). The occurrence of sunscald also indicates the emerging influence of climatic variability on pineapple production, as reported by Lal and Sahu (2017).

Overall, the SWOT analysis indicated that pineapple cultivation in Manipur possesses a strong foundation based on traditional organic production practices but remains constrained by inadequate infrastructure, weak market linkages and

climate-related risks. Strengthening transportation facilities, post-harvest management, farmer aggregation through FPOs, decentralised processing units and digital marketing platforms would help farmers convert existing production advantages into improved market opportunities and higher farm returns.

The study concluded that pineapple cultivation is a significant enterprise despite the production and marketing constraints faced by the growers in Manipur. Although the area under cultivation and total production showed a declining trend during the study period, productivity exhibited positive growth, indicating improvements in production efficiency among pineapple growers. Among the marketing channels identified, the producer→ consumer channel was found to be the most efficient, recording the highest producer's share in consumer's rupee and the highest marketing efficiency. The SWOT analysis established traditional chemical-free farming practices and favourable agro-climatic conditions as major strengths, while poor market infrastructure and post-harvest losses, price instability and inadequate transportation remained the key challenges. The findings also highlighted the opportunities for value addition, processing and direct marketing. Strengthening transportation, cold storage facilities, FPOs and market linkage is essential to improve marketing efficiency and enhance the sustainability of pineapple cultivation and enhance the livelihood of pineapple growers in Manipur.

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