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Economic Analysis of Dragon Fruit Production in Dang Nepal

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ABSTRACT

This study assessed the production status, marketing system, and economic viability of dragon fruit cultivation in Dang district from November 2024 to January 2025, based on a survey of 44 purposively selected farmers in Lamahi and Tulsipur. The total production cost per hectare was NRs 3,593,364.90. Despite high initial investment, dragon fruit farming proved economically viable, with a benefit-cost ratio of 2.59, net present value of NRs 760,551.54, and an annual net profit of approximately NRs 1,200,000 per hectare. The payback period was 1.09 years, and the break-even point was 91.81 kg per Katha (3.1 hectares). Direct marketing channels yielded the highest producer share (87.5%), while intermediary-based sales reduced it to 41.2%. Regression analysis identified land preparation, irrigation, and labor as major determinants of costs, whereas subsidies significantly reduced production costs. However, profitability was constrained by weak supply chains, unorganized markets, and post-harvest losses.

Keywords: Benefit-cost, dragon fruit, marketing, productivity, supply chain

INTRODUCTION

Dragon fruit (*Hylocereus undatus* (Haw.) Britton and Rose), an emerging high-value fruit crop in Nepal, is a member of the family Cactaceae, and is a semi-epiphytic climber well adapted to tropical and subtropical climates. Originally native to Central America (Le Bellec *et al.*, 2006), the dragon fruit is now widely cultivated in the warmer regions of Nepal, with commercial plantations expanding from Kavre to the country's eastern and western parts (Atreya *et al*., 2020). Fruit weighs on average in the range of 300-800 grams, containing small black seeds in pulp, and because it flowers at night, the plant is also called the queen of the night. The taste ranges from sweet to sour, and the fruit is consumed both raw and processed, such as in jam, jelly, and wine. This contains a rich volume of Vitamin C and antioxidants that help prevent various diseases such as cancer, diabetes, and high blood pressure, and also improve the digestive system (Chen *et al.*, 2024). Over the past few decades, serious climatic changes have been noted in Nepal; presently, along with the

increase in temperature, the rainfall pattern is erratic, and prolonged dry seasons have dire consequences for agricultural productivity (NPC, 2022). Dang District is particularly hit hard by these changes; it has observed frequent drought events and water scarcity that affect the farming communities of the area (IKI, 2022). Given its low water requirements and adaptability to adverse conditions, dragon fruit presents a viable alternative for marginal farmers in Nepal, offering a sustainable means to maintain livelihoods amidst changing climatic conditions (Wakchaure *et al*., 2023). According to Atreya *et al.* (2020), the growing interest in dragon fruit cultivation in Nepal has resulted from its tolerance of water and nutrient scarcity, ease of orchard management, and the potential for higher annual yields. However, despite the potential, several factors work against the large-scale commercialization of dragon fruit in Nepal: the fruit crop is relatively new, commodity-based technology and high-yielding varieties are not available, and quality grafted saplings are not available. Expansion is dominated by an unknown seedling variety, which may lead to inconsistent yield and fruit quality (Atreya *et al*., 2020). Somewhat, relatively high initial investment costs (Mehta *et al*., 2024) create a financial barrier, especially for small farmers, and thus, institutional and financial support is needed. Uncertainty in market prices and stiff international competition further complicate commercialization efforts. Besides, the lack of appropriate management technologies, post-harvest handling techniques, and processing industries has limited the potential for value addition and storage (Atreya, 2020). Given its agro-climatic suitability for many fruits of high value and increasing demand, dragon fruit cultivation can give a substantial improvement in rural livelihoods, contribute toward economic growth, and assure agricultural diversification in Nepal.

MATERIALS AND METHODS

The study was conducted in Dang District of Lumbini Province, Nepal. A total of 44 dragon fruit farmers were purposively selected, including 34 households from Tulsipur Municipality and 10 from Lamahi Municipality, all engaged in commercial or semi-commercial cultivation. The study applied multiple analytical approaches to evaluate economic viability, financial feasibility, and market performance. Cost and return analysis were used to calculate total cost, gross return, net profit, and return on investment to assess profitability.

Financial feasibility analysis included indicators such as Net Present Value (NPV), Payback Period, Break-even Quantity, and Benefit-Cost Ratio (BCR) to determine long-term viability and investment recovery. Marketing analysis examined price spread and producers' share to understand market efficiency and farmers' earnings. Regression analysis was conducted to identify key factors influencing production costs, while problem ranking using an index method helped prioritize the major constraints faced by farmers.

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Table 1. Analysis type, indicators, formulae / methods used in the study

Analysis Type	**Indicators**	**Formula / Method**
Cost & Return Analysis	Total Cost (TC)	TC = TFC + TVC
	Gross Return (TR)	TR = Price × Quantity sold
	Net Profit	Net Profit = TR − TC
	Return on Investment (ROI)	ROI (%) = (Net Profit / Initial Investment) × 100
Financial Feasibility Analysis	Net Present Value (NPV)	NPV = ∑ (Net Cash Flow × Discount Factor)
	Payback Period	Based on cumulative cash flow recovery
	Break-even Quantity	Fixed Cost / (Selling Price − Variable Cost/ kg)
	Benefit-Cost Ratio (BCR)	BCR = Gross Return / Total Cost
Marketing Analysis	Price Spread	Consumer Price − Farm-gate Price
	Producer's Share	(Farm-gate Price / Retail Price) × 100
Regression Analysis	Cost Determinants	$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots + \beta_nX_n + \varepsilon$
Problem Ranking	Problem Index	$I = \sum (S_iF_i) / N$
Cumulative Investment = Initial investment + ∑Annual costs		

Conversion applicable: Note: 1 ha = 28.59 Katha, 20 katha = 1 Bigha)

RESULTS AND DISCUSSION

Economics of dragon fruit

Cost of production

The initial investment for dragon fruit is quite high when compared to other conventional crops due to the requirement of special equipment, such as pillars and tires, which support the growing dragon fruit. Likewise, the working capital is necessary for irrigation, fertilization, plant protection, labor, marketing, and transport, as shown in the table 2. The total cost of production was calculated by combining both fixed and variable costs. The total cost (A), which includes all production-related expenses, was estimated at Rs. 116,662.87 per Katha per year. In addition, the cost of agricultural machinery (B) was considered separately, amounting to Rs. 4,722.45 in the first year. Since machinery costs are distributed over five years, the annualized cost was calculated as Rs. 944.49. Therefore, the overall total cost of production was obtained by adding (A) and the annual machinery cost (B), resulting in Rs. 117,607.36 per Katha per year. This indicates that the average annual cost of dragon fruit production per Katha is Rs. 117,607.36.

Price trend of dragon fruit

The trend of price for dragon fruit can be observed declining according to the information provided by the farmers, which is supported by various reports. From a peak of NRs 900-1000 per kilogram (Rijal, 2019), it declined to NRs 500-900 in different markets of Nepal in the year 2020 (Dhakal *et al.,* 2021). As of 2023, the price ranged from NRs 500-800 in Nawalparasi (The Rising Nepal, 2023), which then plummeted to NRs 300-350 in just a

year (Koirala, 2024). Similarly, as of recently, the price of dragon fruit has been reported to be an average of 350 NRs per kilogram by the respondents. This price decline can be attributed to increased supply, poor storage facilities, and market saturation. The farmers have indicated that initially, dragon fruit was a high-value exotic crop, and therefore, there was high demand and premium prices. However, as production increased and imports from neighboring countries increased at half the price tag, the price stabilized and later declined.

Table 2. Initial Investment for dragon fruit orchard in the study area Dang

Cost components	**Fixed Capital (NRs/Katha)**	**Working Capital (NRs/Katha)**
Land preparation	5,000	-
Trellis and support system (Pillars, wires, Tires, etc.)	40,000	-
Cuttings/Saplings	16,700	-
Irrigation system (Drip irrigation)	8,300	1000
Fencing	6700	-
Storage	3300	-
Fertilizers and Manure	-	3300
Plant protection	-	1700
Labor cost	-	5000
Marketing and Transport	-	2500
Miscellaneous Expense	3300	1700
Total Estimated Cost	**83,300**	**15200**

Average dragon fruit production in the study area, Dang 024/25

Table 3 shows that dragon fruit is cultivated on an average of 1 Katha with 40–50 plants, producing about 400–500 kg per Katha. Overall, 44 Katha with 1,800–2,200 plants yielded 17,000–20,000 kg, indicating good production potential and income generation capacity.

Cash flow and benefit-cost ratio of dragon fruit production

Based on the cost calculation from the initial year, the project seems to be a loss, but it is well known that dragon fruit starts to fruit after year one, and upon proper management, the yield increases (CABI, 2020). The dragon fruit business is undertaken by technically sound farmers, and the production of up to 1500 kg/Katha can be achieved (Goenaga *et al.*, 2020). The selling prices can be raised to Rs. 400/kg in favorable conditions.

The analysis assumes that variable costs increase by 5% annually due to rising input prices, while the initial investment is reduced by 10% through efficient resource management and a one-time subsidy of Rs. 50,000. The total fixed cost is estimated at Rs. 162,744.37, and a salvage value of 20% of this amount (Rs. 32,548.87) is considered at the end of the project. Different production levels (500, 800, 1200, and 1500 kg per Katha) are evaluated using the Discounted Cash Flow (DCF) method, which accounts for costs and returns over multiple years.

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Table 3. Total Annual Cost of Production in the study area Dang

S.N.	Description	Quantity	Per unit cost (Rs)	Average cost (Rs/Katha)
A.	**Fixed cost**			
1	Land tax	Lump sump	-	484.62
2	Depreciation (Annual)	Lump sump		8,106
3	Interest on Fixed capital	10%		8330
	Total	**16,920.62**		
B.	**Variable Cost**			
1	Land preparation and transplanting	6	610.27 per day	3679.49
2	Cuttings	40-50 cuttings	180 per cutting	47546.47
3	Manure (Self-made)	Lump sump		5171.31
	Manure (Purchased)	152 Kg	21 per Kg	2692.31
3	Urea	5-6 Kg/ plant	19.03	443.61
4	DAP	5-6 Kg/ plant	48.67	1246.15
5	Potash	3-4 Kg/ plant	34.92	1231.15
6	Irrigation	Lump sump		4137.90
7	Hoeing	Lump sump		3200.00
8	Plant protection	Lump sump		5287.38
9	Harvesting	Lump sump		5200.00
10	Transportation	Lump sump		4500.00
11	Agricultural Tools	Lump sump		6700.00
12	Labor cost	Lump sump		7500.00
	Interest on working capital	10 %		9815.53
Total Variable Cost				**107848.25**

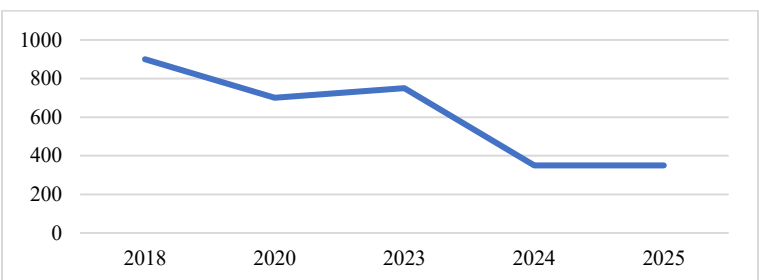


Figure 1. Price of Dragon fruit per kilogram throughout the years in the study sites (Source: Field Study)

Cash flow and return on investment

It can be observed in Table 4 that the ROI in the first year is negative (-8.38%), which implies that the cumulative investment exceeds the net profit. However, by the second year, it reaches 53.84%, showing an increase in recovery of more than half the investment. Continuing the upward trend, by the third year, ROI crossed 100%, *i.e.,* (117.44%),

indicating that the dragon fruit cultivation has fully repaid the investment and is generating profit. A substantial return can be observed by the fourth year with 182.64% ROI.

Table 4. Average Dragon Fruit Production

Total production area (Katha)	Total No. of plants cultivated	Total Production/Yield now (kg)	Avg. production area (Katha)	Avg. No. of plants cultivated per Katha	Avg. Yield per Katha (kg)
44	1800-2200	17000-20000	1	40-50	400-500

Average Return on Investment (ROI)

The average return on investment (ROI) was calculated by dividing the average net profit by the initial investment and multiplying by 100. Using the values from the study, the average net profit of Rs. 128,192.51 was divided by the initial investment of Rs. 98,500, resulting in an ROI of 130.1%. This indicates that dragon fruit cultivation generates returns equivalent to approximately 1.3 times the initial investment annually, reflecting strong profitability.

Table 5. Cash Flow and Return on Investment

Year	**Description**	**Cash Outflow (Rs)**	**Yield (kg/Katha)**	**Gross Income (Rs)**	**Cash Inflow (Rs)**	**Net Profit (Rs)**	**Cumulative Investment (Rs)**	**ROI (%)**
0	Initial Investment	98,500	–	–	–	-98,500	98,500	–
1	Production Year 1	119,778.83	500	200,000	200,000	80,221.17	218,278.83	-8.38
2	Production Year 2	119,778.83	800	320,000	320,000	200,221.17	338,057.66	53.84
3	Production Year 3	119,778.83	1,200	480,000	480,000	360,221.17	457,836.49	118.44
4	Production Year 4 + Salvage Value	119,778.83	1,500	600,000	632,548.87	512,770.04	577,615.32	182.64

Average Return on Investment (ROI)

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Discounted cash flow analysis table

The discounted cash flow analysis shows that dragon fruit cultivation is financially viable, with a Net Present Value (NPV) of Rs. 760,551.54. The total discounted benefits (Rs.

1,238,630.85) significantly exceed the total discounted costs (Rs. 468,175.35), resulting in a Benefit-Cost Ratio (BCR) of 2.59. This indicates strong profitability over time, driven by increasing yields, improved market prices, reduced initial investment through subsidies, and efficient resource management.

Table 6. Combined discounted cash flow analysis table

Year	Net Cash Flow (Rs)	Discount Factor (10%)	Discounted Net Benefit (Rs)	Discounted Cost (Rs)	Discounted Benefit (Rs)
0	-98,500	1.000	-98,500	98,500.00	–
1	80,221.17	0.909	72,920.84	106,004.57	181,800
2	200,221.17	0.826	165,382.68	96,365.55	264,320
3	360,221.17	0.751	270,526.08	87,599.98	360,480
4	512,770.04	0.683	350,221.94	79,705.25	432,030.85
Total	–	–	**760,551.54 (NPV)**	**468,175.35**	**1,238,630.85**

Payback Period and Break-Even Point (BEP)

Payback period represents the total minimum time taken to generate enough cash flow to recover the initial investment costs. From Table 7, it is conspicuous that by the end of year 1, the initial investment is still not recovered with a cumulative net cash flow of Rs -18,278.83; meanwhile, by the end of year 2, the cumulative net cash flow is Rs 181,942.34, suggesting the initial investment is fully recovered. In this study, the payback period falls between Year 1 and Year 2. It was calculated using the remaining investment at the end of Year 1 (Rs. 18,278.83) divided by the net cash flow in Year 2 (Rs. 200,221.17), resulting in 0.091 years. Adding this to the first year gives a total payback period of 1.091 years, which is approximately 1 year and 1.1 months. This indicates that the initial investment is recovered quickly, demonstrating strong financial viability.

Table 7. Cumulative Net Cash Flow

Year	Net Cash Flow (Rs)	Cumulative Net Cash Flow (Rs)
0	-98500	-98500
1	80,221.17	-18,278.83
2	200,221.17	181,942.34
3	360,221.17	542,163.51
4	512,770.04	1,054,933.55

Break-Even Point (BEP)

The break-even point (BEP) represents the level at which total revenue equals total cost, resulting in no profit or loss. It can be expressed in terms of time or production quantity. In terms of time, the BEP is equivalent to the payback period, calculated as 1.091 years. In terms of quantity, the BEP was determined using fixed costs and the difference between the selling price and variable cost per kilogram. Using a fixed cost of Rs. 16,920.62, a selling price of Rs. 400 per kg, and a variable cost of Rs. 215.7 per kg, the break-even

quantity was calculated as 91.81 kg. This indicates that a farmer needs to produce and sell at least 91.81 kg of dragon fruit to cover all production costs.

Regression analysis of cost of production

A multiple linear regression analysis was conducted to identify factors that influence the cost of dragon fruit production. The variables, including land preparation, cuttings, irrigation, and labor, are the most significant factors influencing the cost of production.

Table 8. Regression results for cost of production

Variable	Coefficient	Std. Error	t-value	p-value
Intercept	5200	190	27.37	0.000***
Land Preparation	0.5	0.1	5	0.000***
Cuttings	0.3	0.05	6	0.000***
Manure	0.2	0.04	5	0.000***
Fertilizer	0.1	0.03	3.33	0.001**
Irrigation	0.4	0.06	6.67	0.000***
Plant Protection	0.3	0.05	6	0.000***
Harvesting	0.2	0.04	5	0.000***
Transportation	0.1	0.03	3.33	0.001**
Labor	0.5	0.1	5	0.000***
Farming Area	0.2	0.04	5	0.000***
Yield	-0.1	0.02	-5	0.000***
Subsidy	-0.4	0.07	-5.71	0.000*

*(*p < 0.10, **p < 0.05, ***p < 0.01)*

These findings indicate the significant impact that the high initial establishment costs have on the overall cost of production of dragon fruit. Likewise, the subsidy shows a significant negative relationship with the cost of production ($p<0.001$), *i.e.,* a 1 Rs increase in subsidy leads to a 0.4 Rs reduction in the total cost, assuming that other factors remain constant. These highlight the importance of the role of the Agriculture Knowledge Center's subsidy programs that provide financial assistance of up to Rs 2 lakh based on expenditure cost. In addition, the negative coefficient for yield indicates that higher yields reduce the per-unit production cost. Similar findings were reported by Mehta *et al.* (2024) in their study conducted in the southern Terai region of Nepal.

Marketing channel, price spread, and producer's share

Six primary marketing channels were identified in the study area of Tulsipur and Lamahi, Dang. Most of the farmers leveraged the nearby highway area to sell their produce; similarly, consumers also preferred to buy directly from the farm gate. Their dragon fruits were mostly sold at the nearby city, Ghorahi, and within the markets of the study site. The fruits are transported to major cities including Kathmandu, Narayanghat, Pokhara, Butwal, and Nepalgunj. The last channel identified was with the involvement of the Middleman.

Table 9. Marketing channels in the study area

Channels	Actors Involved
Channel I	Farmer-Consumer (Highway area) (F-C)
Channel II	Farm gate sale (F-C)
Channel III	Farmer-Retailer-Nearby Market (F-R-C)
Channel IV	Farmer-Wholesaler-Nearby City-Retailers (F-W-R-C)
Channel V	Farmer-Wholesaler-Big cities (F-W-R-C)
Channel VI	Farmer-Middlemen-Wholesalers (F-M-W-C)

Furthermore, price distribution and market margins were analyzed to understand the economic dynamics across various market channels, which is described in the table 9. The analysis of marketing channels shows that as the number of intermediaries increases, the price spread and market margin also rise, while the producer's share declines. The highest price spread (Rs. 500) and market margin were observed in longer channels like F-M-W-C, indicating higher consumer prices but lower returns to farmers, who still receive a base price of Rs. 350. In contrast, the direct marketing channel (F-C) had the lowest price spread (Rs. 50) and market margin, allowing producers to receive the highest share (87.5%) while consumers pay lower prices. Channels with more intermediaries, such as F-W-R-C and P-M-W-C, showed reduced producer shares of 53.80% and 41.20%, respectively.

Constraints related to production and marketing

Farmers identified the lack of region-specific cultivation practices as the primary production challenge, followed by high initial investment and limited access to high-quality planting materials; irrigation was the least concern due to low water requirements. In marketing, major issues included price fluctuations, declining consumer preference due to mild taste, post-harvest losses, and inadequate storage, transport, and processing facilities. Additionally, competition from imported dragon fruit, especially from Vietnam and Thailand, further reduces the market share of local producers.

Table 10. Pricing structure across market channels

Channel	Producer Price (Rs)	Consumer Price (Rs)	Total Market Margin (Rs)	Producer Share (%)
F-C	350	400	50	87.5
F-C	350	450	100	77.8
F-R-C	350	550	200	63.6
F-W-R-C	350	650	300	53.8
F-W-R-C	350	750	400	46.7
F-M-W-C	350	850	500	41.2

Table 11. Major constraints in Dragon fruit production

S.N.	Production-related Problem	Rank
1	High initial investment costs	II
2	Inadequate irrigation facilities	V
3	Lack of access to quality planting materials	III
4	Pest and Disease outbreaks	IV
5	Lack of region-specific protocols of cultivation	I
S.N.	**Marketing-related Problem**	**Rank**
1	High price fluctuation	I
2	Poor storage and transportation facilities	III
3	Post-harvest losses	IV
4	Competition from imported dragon fruit	II
5	Intermediaries	V

CONCLUSION

Dragon fruit cultivation in Dang demonstrates strong economic potential due to its climate resilience and growing market demand. The study confirms its long-term profitability, with a benefit–cost ratio of 2.59, NPV of NRs 760,551.54, a short payback period (1.09 years), and an average ROI of 130.1%. However, profitability is influenced by high initial investment, labor dependence, and key cost factors such as land preparation, irrigation, and labor. Marketing inefficiencies and longer supply chains reduce producer share, while direct selling enhances farmer returns. Addressing constraints related to input availability, post-harvest management, and market infrastructure through targeted policy support and investment is essential to fully realize the potential of dragon fruit cultivation and promote sustainable agricultural diversification.

AUTHORS' CONTRIBUTIONS

Rojan Karki: Conceptualization; Data curation; Software; Formal analysis; Visualization; Writing-review and editing.
Bharat Bikram Rawat: Investigation; Methodology, Writing-original draft.
Rajendra Bhari: Conceptualization; Validation.
Koshila Giri: Writing-review and editing, Formal analysis.

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