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Dragon Fruit Cultivation, Profitability, and Production Efficiency in Southern Terai, Nepal

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ABSTRACT

In Nepal, dragon fruit farming is promising but faces limited operation due to its high initial cost during the establishment years. However, its market demand and export potential could provide an economic opportunity for farmers. Here, dragon fruit farmers were categorized as 39 small-scale and 25 large-scale farmers based on an average farm size of 20 kattha (6772.6 m^2). A total of 64 dragon fruit farmers were selected randomly from different clusters through a multi-stage sampling technique. The results revealed that the average cost of dragon fruit production per kattha during the establishment year was NRs 259098.58 (1941.89 USD). The gross benefit was NRs 540972.00 (4054.98 USD) in a large-scale farm and NRs 402928.33 (3019.87 USD) in a small-scale farm. Also, an average BC ratio of 1.87 indicated a profitable farming business. Provision of extension services and cooperative engagement were significant among socioeconomic characteristics for the farm category. Land preparation, manure, labor, fertilizers, and plant protection costs were substantial parts of the total cost incurred in dragon fruit cultivation. Pillar and plant protection costs were positively significant in the production function analysis, and the cost of irrigation was negatively significant to gross returns. These findings will encourage the adoption of dragon fruit farming by providing farmers with essential information on production costs and profitability. Market stability, training, extension, and subsidies should be top priorities in authoritative management.

Introduction

Dragon fruit plants (*Hylocereus* spp.) are a fast-growing evergreen cactus with leafless, thin vine-like branches that can reach one and five-tenths to two five-tenths of a meter in height (Hossain et al., 2021). It is a terrestrial with three-winged succulent green stalks (Patel and Ishnava, 2019) and is a native fruit of Central America (Bellec et al., 2006). Dragon fruit thrives in tropical climates with an annual rainfall of approximately 50 cm

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and temperatures ranging from 20 °C to 30 °C (Thokchom et al., 2019). It may even be cultivated effectively in the lower hills and sub-tropical regions of Nepal, reaching a height of 800 m (Dhakal et al., 2021). Dragon fruit is a semi-epiphytic vine plant that can naturally climb on any natural object or trellis, including trees, stone walls, wood, or cement poles because it has aerial roots (Rondón, 1998). Fruiting might begin as early as August or November on this long-day crop, depending on the variety (Barbeau, 1990). It thrives in tropical and sub-tropical climates and needs organic and well-drained soils. The systematic abscission of flowers and immature fruits is caused by excess water (Bellec et al., 2006). The fruit is stunning, with a brilliant red exterior studded with green scales and white or red flesh bursting with tiny black seeds (Patwary et al., 2013). In general, three types of dragon fruits are grown in various places. These are *Hylocereus undatus* (fruit with red skin and white flesh), *Hylocereus costaricensis* (fruit with red skin and white flesh), and *Hylocereus megalanthus* (fruit with yellow skin and white flesh) (Hamidah et al., 2017). Windy locations should be avoided during site selection since strong, continuous gusts might harm the trellises. Following harvest, pruning can improve air and light flow, thus encouraging stem branching and blossoming (Kikon et al., 2021).

Dragon fruit cultivation has increased in recent years because of its health benefits and economic relevance, resulting in its use as a source of functional materials to supply the body with phytochemicals that have high antioxidant capacity (Parmar et al., 2019). Dragon fruit popularity in Asian countries has gained momentum because of its nutritional content, appealing appearance, and color (Harivaindaran et al., 2008). This fruit is considered a superfruit because of its high nutritional content. Dragon fruit is a water-soluble, fiber-rich produce, rich in vitamin C and antioxidants such as betalains, hydroxycinnamates, and flavonoids (Moshfeghi et al., 2013). It has several health benefits, including weight-reducing effects, digestion benefits, lower LDL cholesterol levels in the blood, and a robust immune system (Hossain et al., 2021). The fruits of *Hylocereus undatus* contain fiber, vitamins, calcium, phosphorus, magnesium, phytochemicals, and antioxidants (Mahdi et al., 2018). In 2000 AD, an American engineer in Nepal introduced the white-fleshed dragon fruit *Hylocereus undatus* from Vietnam. Its commercial plantations began in the Kabhre district just after 2014 AD (Atreya et al., 2020). The demand for dragon fruit is increasing in the Nepalese market, with growing awareness about it and its nutritional importance. Dragon fruit has a market price of NRs 500-900 (as of early 2020) in different markets in Nepal (Dhakal et al., 2021). One of the highlights of the fruit that growers prefer is the perennial vine, which begins producing at 15 months and can continue for 15-20 years.

Dragon fruit has tremendous potential for high returns in a few years. The introduction of dragon fruit farming holds great promise for farmers, providing them with a valuable alternative to improve their livelihoods and agricultural practices. Dragon fruit production is profitable, yielding net returns that surpass many other crops. Farmers perceive several benefits from growing dragon fruit, such as ease of cultivation, a shorter flowering period, year-round harvesting, little risk of a failed crop, and a high market price. In the current situation, the government of Nepal is also promoting dragon fruit agriculture by establishing numerous pocket and block zones in various districts of the Terai region. However, applicants for the PMAMP pocket and block programs outnumber available seats. This situation demonstrates that farmers are hesitant to adopt the crop. Farmers do not use economically optimal levels of resources because of a lack of information (Dhakal et al., 2015).

Data on production for many new and growing tropical fruits, including dragon fruit, is often scarce. However, there are indications of expanding dragon fruit cultivation in various countries, such as Vietnam, China, Mexico, Colombia, Nicaragua, Ecuador, Thailand, Malaysia, Indonesia, Australia, and the United States (Paull and Chen, 2019). While the profitability of dragon fruit farming has received attention from researchers, little research exists on optimal resources that farmers should use for maximum profit. Profit maximization with optimal resource utilization is the goal of all agribusiness enterprises. Dragon fruit in Nepal can have very high marketability due to small competition among commercial producers and strong demand (Karunakaran and Arivalagan, 2019).

Thus, this article seeks to estimate the profitability of dragon fruit farming based on production scale and the best resources to use for maximum profit. Furthermore, the commercialization of dragon fruit farming will develop as more people become aware of profitability indices and resource efficiency for this commodity.

Materials and Methods

Study site

Research samples were selected while adhering to the current federal system of Nepal. Research methods could extrapolate the findings to the province level. The research population included dragon fruit farmers in the southern Terai belts of Nepal in the summer of 2022. The sample for the study was selected using a multistage sampling process. Within each province, cluster sampling facilitated the selection of areas with the most dragon fruit farmers. A simple random selection procedure was employed to select different clusters (Iyer et al., 2011; Layade and Adeoye, 2014). Then, a sample from each cluster was selected using systematic random sampling with an interval of one respondent. Every second dragon fruit farmer was selected. Altogether, 64 farmers appeared from the specified communities and served as the study sample, representing 10% of a total study population of 640 (Fig. 1). Based on the average farm size of the sampled dragon fruit farmers, i.e., 20 kattha, 6772.6 m^2, farmers were classified as small-scale and large-scale farmholders.

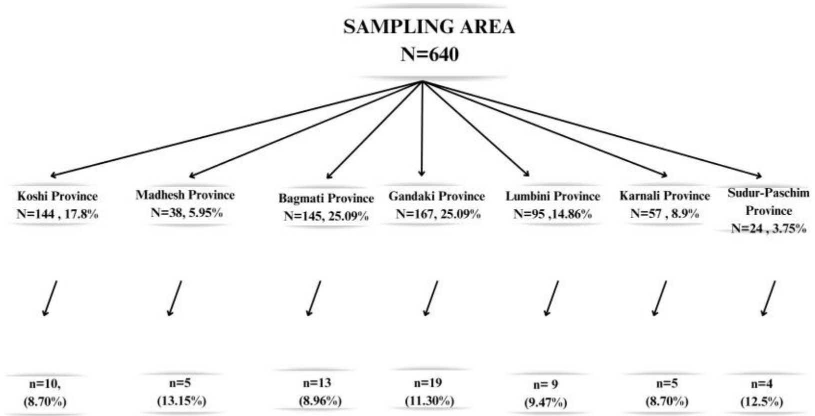

Fig. 1. Sampling technique comprising dragon fruit farmers from all provinces in Southern Terai, Nepal.

Research instruments and design

Statistics on dragon fruit are still not included in official sources published by the Central Bureau of Statistics (CBS) and the pertinent department of agriculture at all levels of government administration because dragon fruit is a newly introduced crop. Field observation included a home survey employing structured and semi-structured questionnaires, focus group discussions, and key informant interviews to collect primary data. Pre-testing of the expected respondents was performed to validate the questionnaire. Secondary data were gathered from government and nongovernmental organization reports, annual agricultural statistical books, newsletters, bulletins, and various scientific publications worldwide.

Data analysis

The survey data were entered in Microsoft Excel, coded, and analyzed using Statistical Package for Social Science (SPSS) version 21 and STATA version 14. The respondent's information included associated costs and returns, the adoption process, perceived benefits of dragon fruit farming, production limits, and perceptions of trends. The economics of dragon fruit production was investigated using cost and return analysis, while simple descriptive statistics, a t-test, and a chi-square test were used in examining sociodemographic and economic factors ($p \leq 0.05$).

Cost, return, and profitability

The cost of production was computed after considering and pricing all variable inputs connected with dragon fruit farming, such as tractor operation on land, human labor, planting materials, pillars, other staking and support costs, fertilizers, manure, irrigation, pesticides, and micronutrient costs at current market rates. For cost calculation, both purchased and owned inputs were included. The total cost was calculated using the following formula:

$$[Total\ cost\ =\ (Total\ variable\ cost\ +\ Total\ fixed\ cost)] \quad (1)$$

The average farm gate price of dragon fruit was multiplied by the volume of dragon fruit sold to determine the gross return. Additional returns from selling planting materials were also included in the gross return. The benefit-cost ratio was assessed to measure the profitability of the farm. The following formula was used for cost-benefit analysis:

$$B/C\ Ratio = \frac{Gross\ Return}{Total\ Cost} \quad (2)$$

Production function analysis

The Cobb-Douglas production function displays the relationship between two or more inputs and the number of possible outputs. The Cobb-Douglas production function helped to identify factors influencing dragon fruit production. The input-output relationship was calculated using the Cobb-Douglas production function in many studies (Bhatta et al., 2020). It was used for computing the effects of different input data on production. The Cobb-Douglas production function was used because it is appropriate for the analysis.

The Cobb-Douglas production function can be expressed below in mathematical form:

Y= ax1β1x2β2x3β3x4β4x5β5x6β6x7β7x8β8x9β9x10β10x11β11x12β12eu (3)

Where Y = returns from dragon fruit farming in Nepalese Rupees (NRs)
X_1 = Land preparation cost in NRs
X_2 = Pillar cost in NRs
X_3 = Manure cost per in NRs
X_4 = Sapling cost in NRs
X_5 = Tyres and stake cost in NRs
X_6 = Human labor cost in NRs
X_7 = Fertilizer cost in NRs
X_8 = Plant protection cost in NRs
X_9 = Pruning cost per kilogram in NRs
X_{10} = Irrigation cost in NRs
X_{11} = Micronutrient cost in NRs
X_{12} = other cost in NRs
e = base of the natural logarithm
u = stochastic random error term

Thus, the production function can be written as follows after the log transformation:

$$\text{Ln } Y = \ln a + \beta 1 \ln x1 + \beta 2 \ln x2 + \beta 3 \ln x3 + \beta 4 \ln x4 + \beta 5 \ln x5 + \beta 6 \ln x6 + \beta 7 \ln x7 + \beta 8 \ln x8 + \beta 9 \ln x9 + \beta 10 \ln x10 + \beta 11 \ln x11 + \beta 12 \ln x12 \quad (4)$$

The output elasticity concerning a certain input was β, which reflected a marginal rise in the return from dragon fruits with an increase in input. It is projected to be positive with them.

Where,
Ln = natural logarithm
a = constant

Results

Establishment cost of dragon fruit

The establishment cost of dragon fruit was estimated by aggregating the costs of various items such as land preparation costs, pit digging costs, sapling costs, staking costs, and costs for plant protection. The various types of costs incurred in the establishment of dragon fruit in sampled households are presented in Table 1. The table reveals that, on average, the total cost per kattha for establishing a dragon fruit farm was NRs 259098.58. Of the total establishment cost, variable costs accounted for NRs 52146.5 per 338.63 m^2. The remaining NRs 206952.46 per 338.63 m^2 of the total establishment cost was fixed.

The highest percentage of the overall sharing percentage for the establishment cost of dragon fruit production was for the cost of pillars (54.37%) under fixed cost, followed by the sapling cost (18.35%). Plant protection costs, fertilizer costs, and miscellaneous costs share 5.30%, 4.89%, and 4.94%, respectively (Fig. 2).

Socioeconomic characteristics of categorical variables by farm category

Table 2 shows the majority of male-headed households in the study area. The Brahmins were the major ethnic group cultivating dragon fruit. Agriculture, business, and private jobs were found to be the major sources of income on both small- and large-scale farms. Overall, 32.81% of the respondents depended on the agriculture sector only. Most of the respondents were found to be literate in the study area and had received some sort of technical training and extension services regarding dragon fruit cultivation practices. In the study area, 40% of the large farm holders and 33.33% of the small landholders had taken out loans for farm establishments. In the study area, 88% of the large-scale farm holders and 66.66% of the small-scale farm holders had received extension services, which is significant at the 5% level. Similarly, 52% of the large-scale and 74.35% of the small-scale farmers were involved in cooperatives, which was also significant at the 5% level. Gender, ethnicity, occupation, education, and loans correlated positively with the farm size but were not significant.

Table 1. Total fixed and variable cost required as establishment cost for dragon fruit per kattha, i.e., 338.63 m^2 of land area.

Items	Cost (NRs.)/Kattha
Fixed Cost	
Land preparation cost	5474.53
Manure cost	5171.31
Pillars cost for staking	140897.7
Tire cost for support	3804.29
Sapling cost	47546.87
Human labor cost for establishment	4057.76
Total Fixed Cost	206952.46
Variable Cost	
Fertilizer cost	12678.14
Plant protection cost	13746.39
Pruning cost	3777.96
Irrigation cost	4137.90
Micronutrient cost	4998.23
Other cost (Miscellaneous)	12807.5
Total Variable Cost	52146.5
Total Establishment Cost	259098.58

Field survey (2022)

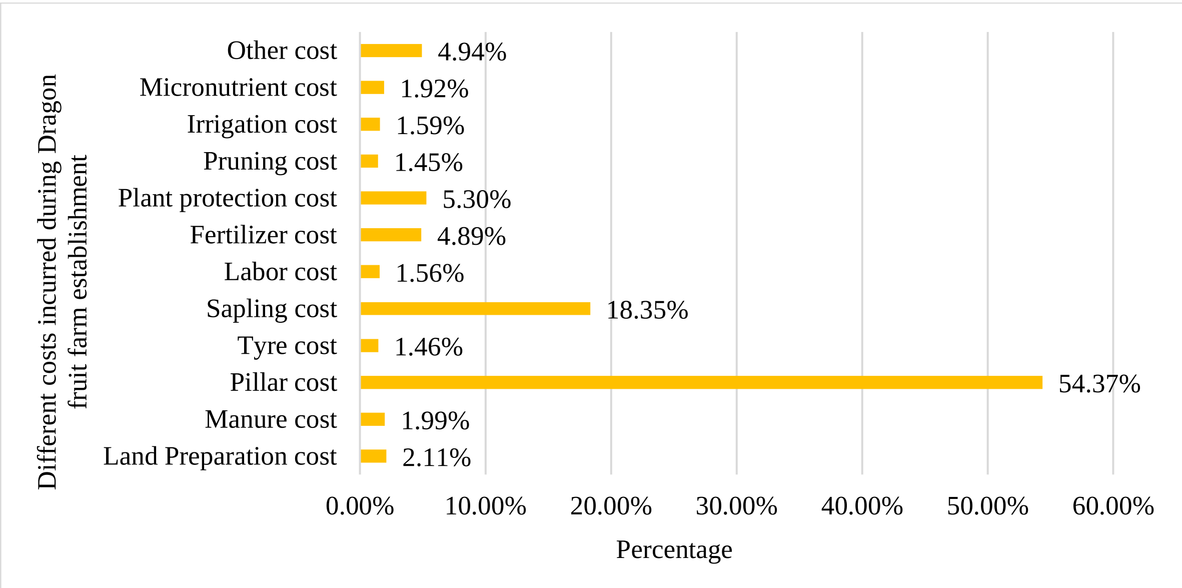

Fig. 2. Different fixed and variable costs incurred during the establishment year of dragon fruit cultivation.

Table 2. Socioeconomic characteristics of dragon fruit farmers for categorical variables based on farm size.

Items	Large scale (25)	Small scale (39)	Overall frequency	Chi-square
		Gender		
Male	24 (96)	37 (94.87)	61 (95.31)	0.043 (df = 1, p-value = 0.835)
Female	1 (4)	2 (5.12)	3 (4.68)	
		Ethnicity		
Brahmin	13 (52)	20 (51.28)	33 (51.56)	3.340 (df = 4, p-value = 0.503)
Chhetri	6 (24)	6 (15.38)	12 (18.75)	
Janajati	5 (20)	6 (15.38)	11 (17.18)	
Madhesi	0 (0)	2 (5.12)	2 (3.12)	
Others	1 (4)	5 (5.12)	6 (9.37)	
		Occupation		
Agriculture	7 (28)	14 (35.89)	21 (32.81)	5.005 (df = 4, p-value = 0.287)
Business	13 (52)	12 (30.76)	25 (39.06)	
Foreign Employment	0 (0)	1 (2.56)	1 (1.56)	
Private job	3 (12)	37 (7.69)	6 (9.37)	
Public service	2 (8)	9 (23.07)	11 (17.18)	
		Education		
Illiterate	8 (32)	9 (23.07)	17 (26.56)	1.660 (df = 3, p-value = 0.646)
Primary level	2 (8)	2 (5.12)	4 (6.25)	
Secondary level	6 (24)	15 (38.46)	21 (32.81)	
University level	9 (36)	13 (33.33)	22 (34.37)	
		Loans taken		
Yes	10 (40)	13 (33.33)	23 (35.93)	0.294 (df = 1, p-value = 0.588)
No	15 (60)	26 (66.66)	41 (64.06)	
		Extension service		
Yes	22 (88)	26 (66.66)	48 (75)	3.698** (df = 1, p-value = 0.054)
No	3 (12)	13 (33.33)	16 (25)	
		Cooperatives		
Yes	13 (52)	29 (74.35)	42 (65.62)	3.376** (df = 1, p-value = 0.066
No	12 (48)	10 (25.64)	22 (34.37)	

Field survey (2022).

Socioeconomic characteristics of continuous variables by farm size

As shown in Table 3, out of the total sample of 64 dragon fruit farmers, 39.06% were large-scale farmers (25) and 60.93% were small-scale farmers (39). Table 4 reveals that the average age of the large-scale farm owner was 47.56 years and that of the small-scale farm owner was 42.56 years. The number of active working members of families operating for large-scale farm owners was 2.68, and those for small-scale farm owners was 2.72. The average land area of large-scale farm owners was found to be 24.36 kattha (8249.02 m^2), whereas the land area of small-scale farm owners was 8.05 kattha (2725.97 m^2), which is significantly different at the 1% level of significance. Similarly, the average total land area of large-scale farm owners was found to be 46.20

kattha (15644.70 m²), whereas the land area of small-scale farm owners was 25.87 kattha (8760.35 m²), which was significantly different at the 5% level of significance. The overall experience in dragon fruit farming was 5.04 years for large-scale owners and 4.30 years for small-scale owners. The gross margin of large-scale farm owners was found to be NRs. 691303.72, while the gross margin of small-scale farm owners was found to be NRs. 405631.64, which was significant at the 1% level.

Cost of production

Table 5 shows the details of dragon fruit production cost during the establishment year. The total cost of dragon fruit production was NRs 245988.9 on small-scale farms and NRs 220191.3 on large-scale farms. Among all costs, land preparation, fertilizer, and plant protection costs were significant ($p \leq 0.01$) pertaining to small-scale and large-scale farm owners. Manure and labor costs were significant at the 10% level. The major share of the establishment cost was pillars and staking, i.e., 51.33% in the case of large-scale farmers and 56.59% regarding small-scale farmers. Their costs were NRs 144658.0 and NRs 138487.18, respectively.

Table 3. Categorization of dragon fruit farmers by farm size.

Types of farmers	Area of dragon fruit cultivation	No. of the sample
Large-scale farmers	More than 20 kattha	25
Small-scale farmers	Less than 20 kattha	39

Note: 1 kattha = 338.63 m² Source: Field Survey (2022).

Table 4. Socioeconomic characteristics of dragon fruit farmers for continuous variables based on farm size.

Items	Large scale (25)	Small scale (39)	Mean differences	t-value	p-value
Age	47.56	42.56	4.99	1.63	0.10
Active population	2.68	2.72	-0.038	-0.136	0.89
Land area for DF (kattha)	24.36	8.05	16.30	9.42***	0.00
Total land holding (kattha)	46.20	25.87	20.32	2.37**	0.02
Years of experience	5.04	4.30	0.73	1.50	0.13
Gross margin (NPR)	691303.72	405631.64	285672.07	5.23***	0.00

Table 5. Total costs incurred in dragon fruit production during the establishment year in NRs.

Items	Large scale (25)	Small scale (39)	Mean differences	t-value	p-value
Land preparation cost	8864.00	3430.00	5234.00	5.62***	0.00
Manure cost	5980.16	4652.16	1327.33	1.85*	0.06
Pillars cost	144658.00	138487.18	6170.82	0.49	0.62
Saplings cost	45696.00	48733.33	-3037.33	-0.82	0.41
Tires cost	3916.80	3732.18	184.62	0.44	0.65
Labor cost	4468.28	3794.62	673.66	1.76*	0.08
Fertilizer cost	21027.40	7326.05	13701.34	5.25***	0.00
Plant protection cost	22777.56	7957.18	14820.38	6.28***	0.00
Pruning cost	3864.00	3722.82	141.17	0.24	0.81
Irrigation cost	3930.84	4270.64	-339.80	-0.78	0.43
Micronutrient cost	4632.88	5232.44	-599.55	-1.32	0.19
Miscellaneous	11956.80	13352.82	-1396.02	-0.41	0.68
Total cost	281772.7	244692.08	-	-	-

Note: ***, **, and * indicate 1%, 5%, and 10% level of significance, respectively. Unit of cost = Nepalese Rupees (NRs.). USD = NRs. 133.26. Source: Field survey (2022).

Benefit-cost analysis

The average cost of production of dragon fruit in the establishment year for large-scale farmers was NRs 281572.72 and NRs 244692.08 for small-scale farmers (p≤0.05) (Table 6). The gross and net revenues of small-scale and large-scale farms were significant (p≤0.01 and p≤0.05, respectively). The B/C ratio was 2.02 and 1.72 for large-scale and small-scale farmers, respectively, which indicates worthy investment and gross returns favoring the investment.

Table 6. Benefit-cost analysis of dragon fruit farmers at different scales of production.

Particulars	Large scale (25)	Small scale (39)	Mean differences	t-test	p-value
Total cost (NRs/kattha)	281572.72	244692.08	36880.64	2.51**	0.01
Gross revenue (NRs/kattha)	540972.00	402928.33	138043.66	3.46***	0.00
Net revenue (NRs/kattha)	259399.28	158236.26	101163.02	2.57**	0.01
B/C Ratio	2.02	1.72	0.22	1.44	0.15

Note: ***, **, and * indicate 1%, 5%, and 10% level of significance, respectively. Field Survey, (2022).

Production function analysis

Table 7 shows the descriptive statistics of variables in the model. To determine the impact of various factors on the gross return of dragon fruit production in the research area, a Cobb-Douglas production model was used. The explanatory variables included in this model were land preparation cost, pillars cost, manure cost, sapling cost, tires and staking cost, labor cost, fertilizer and plant protection cost, pruning cost, irrigation cost, micronutrient cost, and other miscellaneous costs.

The adjusted R2 value of the estimated model for dragon fruit production was 0.18. It means that 18% of the variation was due to the explanatory variables used in this model. The model fits well because the F ratio was significant. The cost of pillars was positively significant (p≤0.01) for gross returns from dragon fruit farming. Similarly, the cost of plant protection was significant (p≤0.05). The irrigation cost was negatively significant at the 10% level. The regression coefficient for the cost of pillars was 0.098, which indicates that by increasing the cost of pillars by 100% as a supporting medium for the vines of dragon fruit, the gross returns could be increased by 0.098%. Similarly, with a 100% increase in insect pest management, gross returns could be increased by 0.335%.

Discussion

Our research showed that determining production costs is crucial in making operational decisions. The investment value in agricultural land is frequently determined by an economic assessment employing cost-benefit analysis. Cost ignorance can lead to unrealistic expectations of profitability and a sense of being threatened by external factors that are impossible to control. Commercial producers use agricultural credit flow cooperative membership to fund their farm companies, receive technical help, and coordinate market information and infrastructure (Dhakal, 2021). Extension contact has a substantial positive connection with knowledge. The respondents' extension contact had a moderately positive relationship with their knowledge of dragon fruit. It implied that farmers who interacted with extension agents more frequently were more knowledgeable about dragon fruit (Ghosh et al., 2023). In a production efficiency analysis, the cost of land preparation, labor, manure, and chemical fertilizers were all positively related to gross returns, which was supported by (Ghimire et al., 2019). The largest projected expenses were related to the price of pillar construction, sapling plantation, onsite preparation, and cultural practices investment in agricultural land (Evans et al., 2010). Mechanization of extended farming methods improves land preparation and boosts production, productivity, and profitability in commercial farms (Gauchan and Shrestha, 2017). Labor costs were found to be significant since a major portion of the farm establishment cost was consumed by it, and regular maintenance of the farm was crucial for sustainable production. Also, Ghosh et al. (2023) stated that labor was not easily accessible throughout the year. This problem was especially apparent in the months of May and June when farmers were busy harvesting rice.

Table 7. Descriptions of variables used in the Cobb–Douglas model for production function analysis of dragon fruit cultivation.

Explanatory variables	Coefficients	Standard error	t-value	p-value
Land preparation cost	-0.024	0.094	-0.26	0.796
Pillars cost	0.098	0.169	3.69***	0.00
Manure cost	0.624	0.124	0.79	0.434
Sapling cost	0.152	0.257	0.62	0.538
Tires and staking costs	0.283	0.187	1.51	0.137
Labor cost	-0.127	0.225	-0.56	0.575
Fertilizer cost	-0.207	0.142	-1.46	0.150
Plant protection cost	0.335	0.136	2.46**	0.01
Pruning cost	0.089	0.121	0.73	0.468
Irrigation cost	-0.315	0.178	-1.77*	0.08
Micronutrient cost	-0.304	0.208	-1.46	0.151
Other costs	-0.086	0.093	-0.92	0.363
Constant	8.041	4.060	1.98	0.053
R-squared	0.3367			
Adj R-squared	0.1806			
Prob > F	0.0288			
F (12, 51)	2.16			

Chemical fertilizers such as urea, potash, di-ammonium phosphate (DAP), and others, as well as organic manures such as vermicompost, chicken manures, and farmyard manure, are used in the field, increasing output and thus gross returns (Bhatta et al., 2023). Micronutrient foliar spraying with enhanced technology is necessary for increased yield and returns in production efficiency analyses (Pathak et al., 2011). Regular irrigation is vital because it allows the plant to create sufficient reserves not only to flower during the optimal period but also to promote fruit growth. However, excessive watering might result in the flowers and immature fruits dropping off because the water requirement of dragon fruit is low (Bellec et al., 2006). Concrete materials are more durable and strong, which supports the vines for a long period and is responsible for the major cost incurred in farm establishment. A similar result was obtained by Kikon et al. (2021) who stated that the majority of the fixed cost incurred in constructing pillars and saplings. Similarly, Acharya et al., 2019; Bolakhe et al., 2022 reported that an increase in plant protection costs could increase the gross returns of the farm. Kikon et al. (2021) reported a positive benefit-cost ratio for dragon fruit farming. They also discovered a positive correlation between total investment and net income.

Farmers who cultivate dragon fruit concurred that pests and illnesses are less likely to affect this crop. They further mentioned that using regional insecticides and modifying cultural customs will make it simple for them to control these pests and illnesses. It also has the benefit of having a lengthy yield. Since they did not need to make the original investment or pay for it each year, several farmers perceived it as advantageous (Ghosh et al., 2023). The high initial investment cost combined with the high labor cost is a significant issue in dragon fruit farming. The producer's next issue was a lack of technical grasp of dragon fruit production due to poor training. Many farmers grow this fruit based on information from other farmers and the media, leaving gaps in their knowledge.

Conclusion

Commercial dragon fruit cultivation has tremendously increased in many South Asian countries, including Nepal, over the years. Dragon fruit farming requires substantial investment, meticulous planning, diligent maintenance, and skilled labor. Given its recent introduction into the country, few people or farmers are familiar with the cultivation procedures and the benefits of consuming this fruit. The average production cost of dragon fruit per kattha (338.63 m2) during the establishment year was NRs 259098.58 (1941.89 USD), and the gross benefit was NRs 540972.00 (4054.98 USD) for a large-scale farm. The average benefit-cost ratio of dragon fruit growers was more than 1.87 in every scale enterprise, demonstrating that dragon fruit farming is a profitable agricultural enterprise. According to the Cobb-Douglas production function study, the cost of pillars and plant protection was positively important to gross returns from dragon fruit farming, whereas irrigation costs were adversely significant. It means higher fixed costs and plant protection costs compensated for gross returns in dragon fruit farming. However, an increase in irrigation costs will lower gross returns. Farmers must emphasize positive contributing variables such as fertilizers, micronutrients, manure, plant protection measures, quality saplings, irrigation, and other inputs to increase the gross income produced by dragon fruit. Similarly, more trustworthy and enhanced technical services through extension services and a marketing framework should be built to support commercialization.

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Conflict of Interest

The authors indicate no conflict of interest in this work.

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