

RESEARCH PAPER

# Economics of Orchid Cultivation in Kurseong and Mirik Blocks of Darjeeling District of West Bengal

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## ABSTRACT

Orchid cultivation has emerged as a promising high-value floriculture enterprise in the hill regions of India. This study evaluates the economic viability and resource-use efficiency of orchid cultivation in the Mirik and Kurseong blocks of Darjeeling district, West Bengal. Primary data were collected from 50 orchid growers through a structured survey using a multistage sampling technique. Financial feasibility was assessed using discounted cash flow measures including Net Present Value (NPV), Benefit–Cost Ratio (BCR), Average Annual Net Returns, and Payback Period. Resource-use efficiency was estimated using a Cobb–Douglas production function. The results reveal that the total discounted cost of cultivation was ₹ 25,54,367.19 per hectare in Mirik and ₹ 30,91,034.32 per hectare in Kurseong. The net present value of orchid cultivation was ₹ 44,73,575.31 in Mirik and ₹ 37,80,891.84 in Kurseong, with benefit–cost ratios of 1.57 and 1.85 respectively, indicating strong financial feasibility. The payback period ranged between 2.2 and 3.15 years, suggesting relatively quick recovery of initial investment. Production function estimates show that fertilizers, manure, and labour significantly influence orchid productivity, while excessive sapling density may reduce yield due to crowding effects. The findings suggest that orchid cultivation can substantially enhance farm income in the hill regions. However, high initial investment and technical requirements remain key constraints. Policy interventions such as subsidized credit, technical training, and improved market infrastructure are essential for promoting sustainable expansion of orchid cultivation in Darjeeling.

## HIGHLIGHTS

- Orchid cultivation economics, Floriculture profitability, Net present value, Benefit–cost ratio, Resource-use efficiency, Farm income diversification.

**Keywords:** Orchid cultivation, floriculture economics, cost–benefit analysis, net present value, production function, Darjeeling

Floriculture has emerged as one of the most dynamic segments of high-value agriculture, contributing significantly to farm diversification, employment generation, and rural income enhancement. In recent decades, the floriculture industry has experienced rapid expansion due to increasing domestic demand for ornamental plants, rising urbanization, and growing export opportunities. In India, floriculture has evolved from a traditional backyard activity to a commercially viable agribusiness supported by technological advancements, improved logistics,

and expanding international markets (Singh *et al.* 2020; Vahoniya *et al.* 2018). The sector plays an important role in promoting sustainable livelihoods, particularly in regions where climatic conditions favour the cultivation of ornamental crops. According to the Agricultural and Processed Food

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Products Export Development Authority (APEDA, 2024), India exported floriculture products worth approximately ₹ 717.83 crores (USD 86.63 million) during 2023–24, reflecting the increasing global demand for Indian floricultural commodities.

Among ornamental crops, orchids occupy a unique position due to their remarkable diversity, aesthetic appeal, long shelf life, and high market value. Orchids represent one of the largest families of flowering plants and are widely traded in international floriculture markets (Tiwari *et al.* 2024). Globally, orchids account for a significant share of the cut-flower and potted plant markets, particularly in countries such as Thailand, the Netherlands, Taiwan, and Singapore where commercial orchid cultivation has been successfully integrated with export-oriented floriculture systems (Hegde, 2020; Kumar *et al.* 2024). The increasing popularity of orchids in landscaping, decoration, and gift markets has further stimulated demand for these flowers worldwide.

India possesses rich orchid biodiversity with nearly 1,200 species distributed across diverse ecological zones ranging from tropical forests to temperate Himalayan regions (Hegde, 2020). The Himalayan belt, especially the northeastern states and hill districts of West Bengal, provides highly suitable ecological conditions for orchid cultivation due to moderate temperature, high humidity, and abundant rainfall. These favourable agro-climatic conditions enable the successful cultivation of commercially important orchid genera such as *Cymbidium*, *Dendrobium*, *Vanda*, *Paphiopedilum*, *Phaius*, and *Odontoglossum* (Chakraborty, 2019). In recent years, the hill regions of Darjeeling and Kalimpong have emerged as important centres for orchid production in eastern India.

The Darjeeling hills possess significant potential for floriculture development due to their unique topography, favourable climate, and proximity to major urban markets such as Kolkata and Siliguri. Traditionally, farmers in these regions relied primarily on tea plantations and subsistence agriculture. However, declining profitability of conventional crops and increasing market demand for ornamental flowers have encouraged farmers to diversify into high-value floriculture enterprises (Kumar *et al.* 2024). Orchid cultivation, in particular, has gained popularity among farmers due to its

high economic returns and suitability for protected cultivation systems such as polyhouses and shade-net structures.

Despite the promising economic potential of orchids, commercial cultivation requires substantial initial investment in infrastructure, planting materials, irrigation systems, and skilled labour. Orchids are highly sensitive plants that require careful management of nutrients, humidity, and light conditions to ensure optimal growth and flowering (Tiwari *et al.* 2024). Consequently, small and marginal farmers often face challenges in adopting orchid cultivation due to limited access to capital, technical knowledge, and marketing infrastructure. Furthermore, empirical studies examining the economics and resource-use efficiency of orchid cultivation in the hill regions of West Bengal remain relatively limited.

Economic evaluation of horticultural enterprises is crucial for assessing their profitability, investment feasibility, and long-term sustainability. Investment appraisal techniques such as Net Present Value (NPV), Benefit–Cost Ratio (BCR), and Payback Period are widely used in agricultural economics to evaluate the financial viability of perennial crops and long-term agricultural investments (Singh *et al.* 2020). Similarly, production function analysis provides valuable insights into the productivity and efficiency of different inputs used in agricultural production systems. The Cobb–Douglas production function, in particular, has been extensively applied in agricultural economics to estimate input elasticities and returns to scale in crop production (Vahoniya *et al.* 2018).

Given the increasing importance of floriculture in hill agriculture, a systematic economic analysis of orchid cultivation is essential for understanding its profitability and identifying key factors influencing productivity. In this context, the present study examines the economics of orchid cultivation in the Mirik and Kurseong blocks of Darjeeling district in West Bengal. The study specifically aims to (i) analyse the cost structure and profitability of orchid cultivation using discounted cash flow techniques, and (ii) evaluate the resource-use efficiency of major production inputs using a Cobb–Douglas production function. The findings are expected to provide valuable insights for policymakers, researchers, and extension agencies interested in

promoting sustainable floriculture development in the Himalayan region.

## MATERIALS AND METHODS

The present study was conducted in the Mirik and Kurseong blocks of Darjeeling district, located in the Himalayan hill region of West Bengal, India. The region is characterized by a temperate climate, moderate rainfall, and high humidity, which provide favourable conditions for the cultivation of ornamental crops, particularly orchids.

The study is based primarily on primary data collected through a farm-level survey of orchid growers. A well-structured and pre-tested interview schedule was used to gather detailed information on input use, costs, returns, and production practices. A multistage sampling technique was employed for selecting the sample respondents. Darjeeling district was purposively selected due to its prominence in floriculture and orchid cultivation. Two blocks, namely Mirik and Kurseong, were selected purposively based on the concentration of orchid growers. In each block, one nuclear village along with two adjoining villages were selected to form a cluster. A complete list of orchid growers in each cluster was prepared. From each block, 25 growers were selected using Simple Random Sampling Without Replacement (SRSWOR). Thus, a total of 50 orchid growers constituted the final sample. Since orchids are perennial crops with long gestation periods, discounted cash flow techniques were used to evaluate the financial viability of orchid cultivation. The following indicators were estimated:

### Net Present Value (NPV)

NPV measures the difference between the present value of benefits and costs.

$$NPV = \sum (Bt - Ct) / (1 + i)^t$$

$t = 1$  to  $n$

### Benefit–Cost Ratio (BCR)

$$BCR = \sum Bt / (1 + i)^t \div \sum Ct / (1 + i)^t$$

$t = 1$  to  $n$

Where,

$Bt$  = Benefits in year  $t$

$Ct$  = Costs in year  $t$

$i$  = Discount rate

$t$  = Time period (year)

$n$  = Total life of the project

A BCR greater than 1 indicates financial feasibility.

### Average Annual Net Return

Average annual net return was obtained by dividing the NPV by the annuity factor corresponding to the lifespan of the orchard.

### Payback Period

The payback period measures the time required to recover the initial investment.

$$P = \frac{I}{E}$$

Where

$I$  = Initial investment

$E$  = Average annual net returns

### Cobb–Douglas Production Function

Resource-use efficiency was analysed using a Cobb–Douglas production function expressed as:

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} e^{\mu}$$

Log-linear form:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \mu$$

Where,

$Y$  = Yield (₹/ha)

$X_1$  = Fertilizers

$X_2$  = Human labour

$X_3$  = Manure

$X_4$  = Saplings

$\mu$  = error term

The sum of production elasticities indicates returns to scale.

**Table 1:** Size-class wise and year wise Discounted Total Cost, Gross Returns and Discounted Net Returns for Orchids in Mirik Block of Darjeeling, Size class- (Pooled)

Years	Total Cost	D.F	Discounted Total Cost	Gross Returns	DF	Discounted Gross returns	Discounted Net Returns
1 (2018-19)	2726090.40	0.89	2434009.28	2853929.52	0.89	2548151.355	114142.07
2 (2019-20)	46604.33	0.80	37152.69	1881768.22	0.80	1500134.106	1462981.42
3 (2020-21)	44836.39	0.71	31913.66	1514117.22	0.71	1077718.729	1045805.07
4 (2022-22)	42638.33	0.64	27097.43	1508733.25	0.64	958827.2578	931729.83
5 (2022-23)	42638.33	0.57	24194.13	1662083.95	0.57	943111.0673	918916.93
Total/Average	2902807.78		2554367.19	9420632.16		7027942.515	4473575.32

## RESULTS AND DISCUSSION

The economic viability of orchid cultivation was evaluated using discounted cash flow techniques, which are commonly applied for assessing long-term agricultural investments involving perennial crops and protected cultivation systems (Singh *et al.* 2020). The year-wise discounted costs and returns for orchid cultivation in the Mirik block are presented in Table 1. The results indicate that orchid cultivation involves substantial initial investment, particularly during the establishment year when infrastructure development, planting materials, and shade structures are installed.

During the first year of cultivation, the total cost amounted to ₹ 27,26,090.40 per hectare, with a discounted value of ₹ 24,34,009.28. The relatively high establishment cost is typical for orchid cultivation because farmers must invest in poly-house structures, irrigation systems, and high-quality planting materials. Similar findings have been reported in previous studies on protected floriculture, which highlight the capital-intensive nature of orchid production systems (Kumar *et al.* 2024; Tiwari *et al.* 2024).

From the second year onwards, operational costs declined significantly while gross returns increased due to the maturation of orchid plants and improved flowering performance. The discounted net returns increased sharply to ₹ 14,62,981.42 in the second year, reflecting the transition from the establishment phase to the productive stage of cultivation. Orchid plants generally require one to two years to reach full flowering potential, after which productivity stabilizes and returns become more consistent (Hegde, 2020).

By the fifth year, the discounted net returns reached ₹ 9,18,916.93 per hectare, demonstrating the long-

term profitability of orchid cultivation in the region. Overall, the total discounted cost of cultivation in Mirik block was ₹ 25,54,367.19 per hectare, whereas the total discounted gross returns amounted to ₹ 70,27,942.52. This resulted in discounted net returns of ₹ 44,73,575.32, clearly indicating the strong financial viability of orchid cultivation. These results are consistent with earlier studies which emphasize the high profitability of commercial floriculture enterprises under favourable agro-climatic conditions (Vahoniya *et al.* 2018).

**Table 2:** Average Annual Net Returns, Net Present Value and B:C Ratio for Orchids in Mirik Block of Darjeeling, Size class- (Pooled)

Average Annual Net Returns (₹)	12,41,013.33
Net Present Value (NPV) (₹)	44,73,575.31
B:C Ratio	1.57
Payback period	2.20

The overall financial performance indicators of orchid cultivation in Mirik block are summarized in Table 2. The estimated average annual net return was ₹ 12,41,013.33 per hectare, indicating substantial income generation potential for farmers engaged in orchid cultivation. The Net Present Value (NPV) was estimated at ₹ 44,73,575.31, suggesting that the present value of expected future returns significantly exceeds the total investment cost. In investment analysis, a positive NPV indicates that the enterprise is economically viable and capable of generating surplus income over time (Singh *et al.* 2020).

Similarly, the Benefit–Cost Ratio (BCR) of 1.57 indicates that every rupee invested in orchid cultivation generates a return of ₹ 1.57. The payback period of 2.20 years further suggests that the initial investment can be recovered within a relatively

short time. These findings demonstrate that orchid cultivation can serve as a profitable alternative agricultural enterprise in the hill regions of West Bengal, contributing to farm income diversification and rural economic development.

The resource-use efficiency of orchid cultivation in Mirik block was analysed using a Cobb–Douglas production function, and the estimated coefficients are presented in Table 3. The regression results indicate that manure and fertilizers significantly influence orchid productivity. The elasticity coefficient of manure (0.4541) suggests that a one percent increase in manure application leads to a 0.454 percent increase in yield, highlighting the importance of organic nutrient management in orchid production systems. Orchids are known to respond positively to organic matter because it improves soil structure, nutrient availability, and moisture retention (Tiwari *et al.* 2024).

**Table 3:** Estimates of Regression co-efficient of Production function of Orchids in Mirik Block of Darjeeling District (2022-23)

Sl. No.	Particulars	Elasticity co-efficients (N = 25)
Dependent Variable Yield (Y)		
Independent Variables Inputs		
1	Intercept	$b_0$ 4.5288
2	Fertilizer ( $X_1$ )	$b_1$ 0.2114**
3	Labour ( $X_2$ )	$b_2$ 0.0663
4	Manure ( $X_3$ )	$b_3$ 0.4541***
5	Saplings ( $X_4$ )	$b_4$ -0.4109**
7	$R^2$	0.8995
8	Adjusted $R^2$	0.8794
9	Returns to scale	1.3416

Note: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%.

Fertilizer application also had a positive and statistically significant effect on orchid output, although its elasticity coefficient (0.2114) was relatively smaller than that of manure. The results imply that balanced nutrient management combining both organic and inorganic fertilizers is essential for achieving optimal productivity in orchid cultivation. Similar conclusions have been reported in floriculture studies where integrated nutrient management significantly improves flower yield and quality (Kumar *et al.* 2024).

However, the negative elasticity coefficient for saplings (-0.4109) indicates that excessive planting density may reduce productivity due to overcrowding and competition for nutrients, light, and moisture. This finding highlights the importance of maintaining optimal plant spacing to ensure adequate growth conditions for orchid plants.

The coefficient of determination ( $R^2 = 0.8995$ ) indicates that approximately 89.95 percent of the variation in orchid yield is explained by the included explanatory variables. The estimated returns to scale value of 1.3416 indicates increasing returns to scale, suggesting that proportional increases in input use could lead to more than proportional increases in output. This implies that expansion of orchid cultivation with improved management practices could significantly enhance production efficiency.

The economic performance of orchid cultivation in the Kurseong block is presented in Table 4. Similar to Mirik block, the first year recorded negative net returns due to high establishment costs associated with infrastructure development and planting materials. The discounted net return during the first year was negative because orchid plants require

**Table 4:** Size-class wise and year wise discounted total cost, gross returns and discounted net returns for Orchids in Kurseong Block of Darjeeling, Size class- (Pooled)

Years	Total Cost	D.F	Discounted Total Cost	Gross Returns	DF	Discounted Gross returns	Discounted Net Returns
1 (2018-19)	3204961.19	0.89	2861572.50	2507239.58	0.89	2238606.77	-622965.72
2 (2019-20)	41120.17	0.80	32780.75	1756250.00	0.80	1400071.75	1367291.00
3 (2020-21)	41119.24	0.71	29267.86	1312500.00	0.71	934211.58	904943.72
4 (2022-22)	41120.17	0.64	26132.61	1650000.00	0.64	1048604.83	1022472.22
5 (2022-23)	32816.17	0.57	18620.78	1565625.00	0.57	888377.67	869756.89
Total/Average	3461958.44	0.89	3091034.32	2416040.21	0.89	2157178.76	933855.56

time to reach full flowering capacity. However, from the second year onwards, profitability improved substantially as operational costs declined and flower production increased.

The gradual increase in net returns across subsequent years reflects the long-term income-generating potential of orchid cultivation. These findings are consistent with earlier research indicating that perennial horticultural enterprises often involve high initial investment but yield substantial returns over time (Singh *et al.* 2020).

**Table 5:** Average Annual Net Returns, Net Present Value and B:C Ratio for Orchids in Kurseong Block of Darjeeling District, Size class- (Pooled)

Average Annual Net Returns (₹)	10,48,856.19
Net Present Value (NPV)	37,80,891.84
B:C Ratio	1.85
Payback period (year)	3.15

The financial feasibility indicators for Kurseong block are summarized in Table 5. The estimated average annual net return was ₹ 10,48,856.19 per hectare. The Net Present Value (NPV) of ₹ 37,80,891.84 further confirms the economic viability of orchid cultivation in this region. The Benefit–Cost Ratio (1.85) indicates that the enterprise generates returns significantly higher than the investment cost. Moreover, the payback period of 3.15 years suggests that farmers can recover their initial investment within a reasonable time frame.

The production function estimates for Kurseong block are presented in Table 6. The regression results indicate that manure and saplings significantly influence orchid productivity in this block. The elasticity coefficient of manure (0.4424) indicates that organic nutrient management plays a crucial role in improving orchid yield.

Interestingly, the coefficient of fertilizer (-0.4058) was found to be negative and statistically significant, suggesting that excessive fertilizer application may adversely affect orchid productivity. This result highlights the importance of balanced fertilizer management in orchid cultivation, as over-application of chemical fertilizers can lead to nutrient imbalances and reduced plant growth.

The estimated coefficient of determination ( $R^2 = 0.8504$ ) indicates that approximately 85 percent of

variation in orchid yield is explained by the selected explanatory variables. The estimated returns to scale value of 0.9467 suggests slightly decreasing returns to scale, implying that proportional increases in inputs may result in less than proportional increases in output. This indicates that efficiency improvements through better management practices may be more beneficial than simply increasing input use.

**Table 6:** Estimates of Regression co-efficient of Production function of Orchids in Kurseong Block of Darjeeling District (2022-23)

Sl. No.	Particulars	Elasticity co-efficient (N=25)	
Dependent Variable: Yield (Y)			
Independent Variables: Inputs			
1	Intercept	$b_0$	6.5759
2	Fertilizer ( $X_1$ )	$b_1$	-0.4058**
3	Labour ( $X_2$ )	$b_2$	0.2295
4	Manure ( $X_3$ )	$b_3$	0.4424***
5	Saplings ( $X_4$ )	$b_4$	0.5683**
7	$R^2$		0.8504
8	Adjusted $R^2$		0.8205
9	Returns to scale		0.9467

*Note:* \*\*\*Significant at 1% level of significance, \*\*Significant at 5% of significance, \*Significant at 10% level of significance.;  $R^2$ =Co-efficient of multiple determinations.

Overall, the empirical results confirm that orchid cultivation is a profitable and economically viable enterprise in the hill regions of Darjeeling district. With appropriate management practices, orchid farming can significantly enhance farm income, promote diversification of hill agriculture, and contribute to sustainable rural development.

## CONCLUSION

The present study examined the economic viability and resource-use efficiency of orchid cultivation in the Mirik and Kurseong blocks of Darjeeling district, West Bengal. The results clearly demonstrate that orchid cultivation is a profitable and economically viable agricultural enterprise in the hill regions.

The financial analysis revealed that orchid cultivation generates substantial returns despite high establishment costs. The net present value and benefit–cost ratios for both study blocks were found to be significantly greater than one, confirming the financial feasibility of the enterprise. The relatively

short payback period further indicates that the initial investment can be recovered within a few years of cultivation.

The production function analysis revealed that manure and fertilizers are key inputs influencing orchid productivity. Efficient management of these inputs can significantly enhance yield and profitability. However, the study also highlights that excessive use of fertilizers and higher sapling density may negatively affect production due to nutrient imbalance and plant competition.

Despite its strong economic potential, orchid cultivation faces several constraints, including high initial capital requirements, lack of technical knowledge, limited availability of quality planting materials, and inadequate marketing infrastructure. These challenges often discourage small and marginal farmers from adopting orchid cultivation on a larger scale.

To promote sustainable growth of orchid cultivation, policy support is essential. Government initiatives such as subsidized credit facilities, training programs on scientific cultivation techniques, and strengthening extension services can enhance farmers' capacity to adopt improved practices. In addition, the development of efficient marketing channels, cold chain infrastructure, and cooperative marketing systems can help farmers obtain better prices for their produce.

Overall, orchid cultivation has considerable potential to contribute to income diversification, employment

generation, and rural economic development in the hill regions of West Bengal. With appropriate policy support and technological interventions, the floriculture sector can play a significant role in strengthening the agricultural economy of Darjeeling district.

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