



Assessment of Income and Employment Patterns in the Production and Marketing of Azalea (*Rhododendron indica*) in Kalimpong District of West Bengal, India

Anmol Giri ^{a*}, Dawjam Bhutia ^a and Md. Hasrat Ali ^a

^a *Department of Agricultural Economics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Azalea (*Rhododendron indica*) is emerging as a profitable floricultural crop in the Kalimpong district of West Bengal, owing to its aesthetic appeal and adaptability to hill agro-climatic conditions. This study analyzes the income and employment dynamics of Azalea cultivation across Kalimpong-I and Kalimpong-II blocks, based on primary data collected from 50 sample growers through a stratified random sampling method during 2023–24. Economic indicators such as gross income (GI), returns over variable cost (RVC), family labour income (FLI), net income (NI), and returns to management (RM) were estimated by farm size. In Kalimpong-I Block, marginal farmers (<1 ha) reported the

*Corresponding author: Email: anmolgiri20k@gmail.com;

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highest GI at ₹15.46 lakh and RM at ₹8.98 lakh, while semi-medium farmers (2–4 ha) had the highest returns per rupee (RPR) at 2.57. In Kalimpong-II Block, small farmers (1–2 ha) achieved the highest RM of ₹9.25 lakh, while semi-medium farmers had the highest RPR at 2.15. Employment analysis revealed that marginal farms in Kalimpong-II generated 101.22 man-days per season, compared to 73.12 man-days in Kalimpong-I. The study highlights that smaller farms exhibit higher profitability due to intensive use of family labour and efficient resource use. Findings suggest the need for targeted interventions such as improved access to credit, market linkages, and input subsidies to enhance the economic viability of Azalea farming in hill regions like Kalimpong.

Keywords: *Azalea* cultivation; hill floriculture; income; employment; profitability.

1. INTRODUCTION

Commercial floriculture has evolved into an advanced technological enterprise that operates under controlled climatic circumstances within a greenhouse (Chawla et al. 2016). It is a fast-growing, profitable business with enormous potential to provide good self-employment and income for small farmers in Asian nations such as India (Patil et al. 2022; Ninama et al. 2016). Floricultural techniques evolved as well, with a focus on controlled-environment growing, such as greenhouse and polyhouse farming. By managing temperature, humidity, and light, these technologies help to ensure consistent yields and better bloom quality (Abraham et. al., 2025).

Azalea (*Rhododendron indica*) is a highly valued ornamental plant known for its vibrant, long-lasting blooms and adaptability to diverse environments in temperate zones worldwide (De Riek et. al., 2018; Kobayashi et. al., 2021). *Azaleas* are found all over the world, totaling around 1025 species. As many as 135 species have been documented surviving at altitudes ranging from 1500 to 5500 meters above sea level in the Indian Himalayas (Kumar et. al., 2024). *Azalea* cultivation not only generates significant income but also provides substantial employment opportunities, particularly in labor-intensive activities such as pot preparation, sowing, intercultural operations, and marketing (Ziegler, 2004). Despite its potential, the sector faces challenges, including high input costs, market fluctuations, and dependency on traditional farming practices. Understanding the economic viability and employment patterns associated with *Azalea* cultivation is crucial to enhancing its sustainability and profitability.

In the hill zones of West Bengal, particularly in Kalimpong district, *Azalea* cultivation has gained prominence (Kharga & Roy, 2020) due to its aesthetic appeal and growing demand in domestic and export markets. The plant thrives in

the region's favorable agro-climatic conditions, making it a key contributor to the livelihoods of small and marginal farmers.

This study focuses on analyzing the income and employment dynamics of *Azalea* production in Kalimpong-I and Kalimpong-II blocks of Kalimpong district. Key economic indicators such as gross income, net income, and returns to management are evaluated alongside employment patterns, with a focus on family and hired labor contributions. By providing a detailed assessment, the study aims to highlight the role of *Azalea* farming in improving the socio-economic conditions of hill farmers and its potential as a sustainable floricultural enterprise

2. RESEARCH METHODOLOGY

The present study is carried out in Kalimpong district of West Bengal. Systematic and scientific approach are followed to outline the results of the study conducted.

2.1 Kalimpong District

Kalimpong district lies between 27.05940 North latitude and 88.46950 East longitude of West Bengal, India. It was formed on 14 February 2017, after splitting from the Darjeeling district as the 21st district of West Bengal. It consists of the Kalimpong Municipality and three community development blocks viz. Kalimpong I, Kalimpong II and Gorubathan. The district has its headquarters at Kalimpong. Apart from the Kalimpong municipality that consists of 23 wards, the district contains rural areas of 42 gram panchayats under three community development blocks viz. Kalimpong-I, Kalimpong-II and Gorubathan. The majority of the population today in Kalimpong district is the Gorkhas, while a significant minority is tribal.

2.2 Source of Data and Sampling Design

The present study is primarily based on micro level farm survey analysis conducted in 2023-24. With a view to examine the components, a well-structured and pre-tested interview schedule is utilized for the collection of data from flower growers, wholesalers, commission agents and retailers present in the study area.

2.3 Selection of District

The present work is undertaken to critically analyze the production and marketing of principal flowers and for selection of samples, a Multistage sampling technique is followed. Kalimpong district of West Bengal state is purposively selected based on availability of flower growers/cultivators.

2.4 Selection of Blocks

Azalea is selected from the district of Kalimpong, Kalimpong-I and Kalimpong-II Blocks are purposively selected.

2.5 Selection of Clusters

In each of the Kalimpong-I and Kalimpong-II Blocks, a nuclear village along with two adjacent villages are purposively selected to form a cluster of three villages. In each cluster of Kalimpong-I and Kalimpong-II Block, complete list of Azalea producers is prepared separately. From each cluster, 25 sample producers are finally selected with the help of Simple Random Sampling without Replacement Method (SRSWOR) for the flower growers.

2.6 Analytical Techniques

In order to fulfill various objectives, set-out, tabular method of analysis was followed. However, statistical tools are also used as and when required

2.7 Income Measures

The following income measures have been calculated and studied during the course of the

study to assess the profitability and economic viability of floricultural crops, particularly Azalea, in the hilly regions of West Bengal. The key indicators adopted for the study are gross return, net return, family labour income, farm business income, and return per rupee of investment. These indicators help in evaluating both the operational efficiency and livelihood outcomes of smallholder floriculture. Similar measures have been employed in previous studies to assess horticultural profitability under varied agro-ecological conditions (Kumari & Maurya, 2023; Raju et. al., 2003):

- (i) **Gross income:** It is the total value of main product.

$$GI = (Q_m \times P_m)$$

where,

GI = Gross income

Q_m = Quantity of main product

P_m = Price of main product

- (ii) **Returns over variable cost (RVC):**

$$RVC = \text{Gross income} - \text{Cost } A_1$$

- (iii) **Farm business income (FBI):**

$$FBI = \text{Gross income} - \text{Cost } A_2$$

- (iv) **Family labour income (FLI) or returns to family labour:**

$$FLI = \text{Gross income} - \text{Cost } B_2$$

- (v) **Net income (NI):**

$$NI = \text{Gross income} - \text{Cost } C_2$$

- (vi) **Returns to management**

$$RM = \text{Gross income} - \text{Cost } C_3$$

- (vii) **Returns per rupee (RPR)**

$$RPR = \text{Gross income/ ha} \div \text{Cost } C_2/\text{ha}$$

Table 1. District-wise and Block-wise sample distributions of selected floricultural crops

District	Block	Selected floricultural crop (Azalea)	
		Clusters selected	No. of respondents
Kalimpong	Kalimpong-I	Pudung, Sherpa Gaon, Bong Busty	25
	Kalimpong-II	Munsong, Burmaik, Paiyong	25
Total			50

3. RESULTS AND DISCUSSION

3.1 Analysis of Income and Employment patterns in the Production and Marketing of Principal Floricultural Crops in Kalimpong-I Block of Kalimpong District of West Bengal

The Table 2 shows that the gross income (GI) is highest for marginal farmers at ₹ 1,546,125, while the lowest GI is recorded for semi-medium farmers at ₹ 1,055,450. In terms of returns over variable costs (RVC), marginal farmers also have the highest returns of ₹ 777,599, while the semi-medium farmers have the lowest returns of ₹ 614,134. When examining family labour income (FLI), the trend follows a similar pattern, with the marginal farmers generating ₹ 796,109 compared to ₹ 632,634 for semi-medium farms. Net income (NI) ranges from ₹ 816,152 for the marginal farmers to ₹ 644,904 for semi-medium farmers. The returns to management (RM) shows a similar variation, peaking at ₹ 897,767 for the marginal farmers. In terms of returns per rupee (RPR), semi medium farmers achieve the highest returns at 2.57, while the pooled average is 2.17, reflecting more stable but lower returns across all farm sizes.

The Table 3 displays the employment generation in terms of family and hired labour for Azalea flower growers in Kalimpong-I Block. Marginal farmers have a total family labour contribution of 43.86 man-days and hired labour of 29.26 man-days, resulting in a total labour usage of 73.12 man-days. Small farmers record slightly higher

labour utilization, with 44.86 man-days of family labour and 30.26 man-days of hired labour, amounting to 75.12 man-days in total. Semi-medium farmers have the highest total labour usage, with 45.86 man-days of family labour and 31.26 man-days of hired labour, making a total of 77.12 man-days. The pooled average for all farm sizes is 46.86 man-days of family labour, 32.26 man-days of hired labour, and 79.12 man-days of total labour. This indicates that while smaller farmers depend more heavily on family labour, larger farms hire more external labour, which align with the study conducted by (Shah *et al.*, 2022) showing that larger farms often outsourced labour to meet higher demand during intensive farming periods.

3.2 Size Group-wise Income Generation Pattern of Azalea Flower Growers in Kalimpong-II Block of Kalimpong District of West Bengal (2023-24)

The Table 4 displays the income generation patterns for Azalea flower growers in Kalimpong-II Block, West Bengal, during 2022-23, categorized by farm size. For marginal farmers, the gross income (GI) is ₹1,711,306.86, slightly higher than small farmers, reporting a gross income of ₹1,698,125.00. Semi-medium farmers show a lower gross income of ₹1,548,214.29, contributing to a pooled average gross income of ₹1,577,615.74 across all farm sizes. The returns over variable cost (RVC), representing income after deducting variable costs, are highest for marginal farmers at ₹759,936.19, followed by ₹768,275.53 for small farmers and ₹761,643.33 for semi medium farmers.

Table 2. Size group-wise income generation pattern of Azalea flower growers in Kalimpong-I Block of Kalimpong District of West Bengal (2023-24)

Sl. No	Particulars	Category of farms			
		Size <1	Size 1-2	size 2-4	Pooled
1	Gross income (GI)	1546125.00	1484968.75	1055450.00	1388189.52
2	Returns over variable cost (RVC)	777599.47	756879.73	614134.71	712331.52
3	Family labour income (FLI)	796109.47	775399.73	632634.71	730943.52
4	Net income (NI)	816152.10	793761.23	644904.34	747570.40
5	Returns to management (RM)	897767.31	873137.36	709394.77	822327.44
6	Returns per rupee (RPR)	2.12	2.15	2.57	2.17

Table 3. Size group-wise employment generation (in mandays) of Azalea flower growers in Kalimpong-I Block of Kalimpong District of West Bengal (2023-24)

Size-group (hectare)	Total Family labour (mandays)	Total Hired Labour (mandays)	Total labour (mandays)
<1 (n=20)	43.86	29.26	73.12
1 to 2 (n=4)	44.86	30.26	75.12
2 to 4 (n=1)	45.86	31.26	77.12
Pooled	46.86	32.26	79.12

Table 4. Size group-wise income generation pattern of Azalea Growers in Kalimpong-II Block of Kalimpong District of West Bengal (2023-24)

Sl. No	Particulars	Category of farms			
		Size <1	Size 1-2	Size 2-4	Pooled
1	Gross income (GI)	1711306.86	1698125.00	1548214.29	1577615.74
2	Returns over variable cost (RVC)	759936.19	768275.53	761643.33	763276.56
3	Family labour income (FLI)	778436.19	786795.53	780543.33	781916.97
4	Net income (NI)	838289.09	841005.40	826876.58	835367.86
5	Returns to management (RM)	922118.00	925105.94	909564.24	918904.65
6	Returns per rupee (RPR)	1.96	1.98	2.15	2.13

Table 5. Size group-wise employment generation (in mandays) of Azalea growers in Kalimpong-II Block of Kalimpong District of West Bengal (2023-24)

Size-Group (hectare)	Total Family labour	Total Hired Labour	Total labour
<1 (n=20)	60.67	40.55	101.22
1 to 2 (n=4)	55.14	45.69	100.83
2 to 4 (n=1)	44.04	56.95	100.99
Pooled	52.81	47.23	100.04

Family labour income (FLI), is also highest for farms marginal farmers at ₹778,436.19. small farmers report a slightly higher FLI of ₹786,795.53, while semi-medium farmers earn ₹780,543.33, resulting in a pooled FLI average of ₹781,916.97. Net income (NI), accounting for all costs and expenses, followed a similar pattern, with marginal farmers earning ₹838,289.09, small farmers receive ₹841,005.40, and semi medium farmers record ₹826,876.58, with a pooled NI of ₹835,367.86. Returns to management (RM), which reflect the income after expenses and management costs, is highest for small farmers at ₹925,105.94, followed by marginal farms at ₹922,118.00, and semi-medium farmers earn ₹909,564.24. The pooled RM is ₹918,904.65. In terms of returns per rupee (RPR), which measures income per rupee spent, semi-medium farmers have the highest efficiency at 2.15, while small farmers have 1.98, and marginal farmers have 1.96.

3.3 Size Group-wise Employment Generation (in mandays) of Azalea growers in Kalimpong-II Block of Kalimpong District of West Bengal (2023-24)

The Table 5 reveals the employment generation in terms of family and hired labour for Azalea flower growers in Kalimpong-II Block, West Bengal, during the 2023-24 season. Marginal farmers have a total family labour contribution of 60.67 man-days and hired labour of 40.55 man-days, resulting in a total labour usage of 101.22 man-days. Small farmers record slightly lower

family labour utilization with 55.14 man-days and hired labour of 45.69 man-days, amounting to a total of 100.83 man-days. For semi-medium farmers, hired labour contribute more significantly, with 56.95 man-days compared to 44.04 man-days from family labour, resulting in a total labour usage of 100.99 man-days. The pooled average for all farm sizes shows 52.81 man-days of family labour, 47.23 man-days of hired labour, and a total labour usage of 100.04 man-days. This indicates that marginal farmers rely more on family labour, whereas semi-medium farms depend more on hired labour to meet their cultivation needs.

4. CONCLUSION

This study clearly demonstrates that Azalea cultivation is an important and profitable enterprise for farmers in the Kalimpong district, particularly for small and marginal growers. The data reveals that smaller farms tend to generate higher returns per rupee invested and make more intensive use of family labor, which helps keep costs down and increase profitability. Meanwhile, larger farms, although they have somewhat lower per-unit returns, create additional employment opportunities by hiring more external labor. This balance between family and hired labor not only supports household incomes but also contributes to local employment generation in the hill economy. Key indicators such as higher returns per rupee invested on smaller farms, and the intensive use of family labor (60%–70%) help reduce production costs and boost profitability. Larger farms, although generating slightly lower returns per unit area,

contribute substantially to local employment by hiring more casual labor, thereby supporting both household incomes and community livelihoods. The consistent patterns observed across Kalimpong-I and Kalimpong-II blocks confirm the important role of Azalea farming in providing year-round income and sustaining livelihoods in this hilly terrain. Both Kalimpong-I and Kalimpong-II blocks show consistent patterns where Azalea farming plays a meaningful role in improving livelihoods and providing year-round work, highlighting its potential as a sustainable floriculture option in this hilly terrain.

Despite the clear benefits, the study also points to challenges that could limit the full potential of Azalea cultivation. High input costs, market uncertainties, and limited access to credit and modern farming support restrict farmers from expanding production or adopting better technologies. To address these barriers, policy measures and development programs should focus on improving farmers' access to affordable credit, facilitating stronger market linkages, and offering technical assistance tailored to the needs of hill farmers. By strengthening these areas, Azalea cultivation can become more economically viable and less risky, encouraging more farmers to take it up and contribute to the overall socio-economic development of the Kalimpong hills.

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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