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Determination of cost and profitability of bivoltine sericulture in Karnataka

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Abstract

Sericulture is an agro based rural industry, it offers a promising substitute to traditional farming, providing quick returns with minimal upfront investment for farmers. One of the key advantages of sericulture is its ability to generate reliable income. The costs associated with producing income play a crucial role in determining whether a venture results in profit or loss. To gain a better understanding of this aspect, a comprehensive study was conducted to assess the costs involved in bivoltine silkworm cocoon production spanning 15 districts of Karnataka. An investigation into production of cocoon indicates that the major components of cost are labour (40.62%) and chawki worms (32.72%) with farmyard manure, fertilizers and pesticides coming next (19.16%). Rearing consumables (3.99%), rent for mountages along with fuel (3.51%) are very small expenses. The total cost can be split into paid-out costs (57.20%) and unpaid costs (42.80%). From the economic point, the production cost per kilogram of bivoltine cocoons is Rs. 371 and the market price averages Rs. 489 per kg. The profit per hectare is Rs. 1,77,915 and the cost-benefit ratio is a positive one at 1:1.32. To further enhance profitability for sericulture farmers, there is significant scope to adopt sustainable techniques, implement mechanization, and provide targeted training. Specifically, minimizing the substantial costs associated with labor and purchasing of chawki worms from private chawki rearing centers (CRC's) will be crucial for maximizing profit margins.

Keywords: Bivoltine cocoon, costs and returns, economics of sericulture, paid out and unpaid cost

Introduction

Indian rural economy is popularly dependent on farming and its allied industries. Farmers are availing low income due to small piece of land, low crop yield, Additionally, factors such as limited availability per each family, inadequate crop yields, limited cropping seasons, and reliance on unpredictable weather including rain pattern and number of rainy days in a year. Therefore, agriculture being confined to have made villages to look for supporting rural industries, such as sericulture. Sericulture and other agriculture commodity production are adopted ecological conditions are favourable. In India, sericulture is a cottage based rural industry and provides sufficient work for the men and women for the cultivation of mulberry and silkworm rearing. Recently, by the advancement of research and development institutions both in mulberry cultivation and silkworm rearing, the industry is now practised as a main profession and as a major economic return source by mitigating the expenditure.

Rearing of monophagous economic insect, raw silk production from rearing a silkworm has emerged as a viable rural enterprise for the last of couple of decades in India. It is characterized by short gestation period, an opportunity for the unskilled rural population, and significant employment opportunities, and rapid returns on low capital investment. India is the second largest raw silk producer in the world after China. Major portion of the production is utilised for the domestic consumption. As mentioned above, sericulture is a labor-intensive, agro based industry with minimal financial expense, making it advantageous for small and marginal land holders (Santosh Kumar Dewangan, 2018; Shabir Ahmad Bhat *et al.* 2024) ^[9, 10]. Its high income return character is promising avenue for the poverty alleviation by creating employment prospects, empowering women and economically deprived groups, and promoting comprehensive development including the mitigation of rural migration to the cities (Kritika Sharma and Bhumika Kapoor, 2020) ^[20].

As mentioned, that sericulture blends both scientific knowledge and traditional skills, focusing on the several interconnected activities, including the cultivation of mulberry

(*Morus alba*) as the primary food source to monophagous silkworm (*Bombyx mori* L.), the systematic rearing of silkworms to obtain high-quality cocoons. The reeling of silk filaments from the cocoons, the spinning and weaving of silk yarn, and succeeding process to produce silk fabric (Kumar *et al.*, 2019) [7]. Among these activities, cultivation of mulberry and silkworm rearing are the primarily agricultural components carried out by farmers.

The agrarian economy in India, often faces challenges related to inadequate market prices for its produce. This issue arises due to multiple factors, and the pricing of cocoons is no exception. Therefore, estimating the cost for the production of one kilogram cocoon is essential to assess the economic feasibility and sustainable livelihood opportunity. A clear understanding of the economics of cost of cocoon production is important for sericulturists, researchers, experts from industry, policymakers. Detailed cost analysis enables to inform farmers regarding pricing, efficient resource utilization, minimising cost, and improvement of yield and profitability. Moreover, reliable cost information benefits all stakeholders, from sericulturists to silk fabric manufacturers by supporting the establishment of competitive market prices and strengthening the growth of the global silk trade.

The cost of cocoon production of crossbreed silkworm was evaluated by Mahadeva *et al.*, (2025) [8]. However, the cost of bivoltine silkworm hybrid cocoon production is very scanty. In this context, an effort has been conducted to evaluate the costs associated with bivoltine cocoon production from the sericulturist's perspective.

Materials and Methods

The data were collected from 1105 bivoltine (BV) silkworm rearing (FC₁ [CSR₆ X CSR₂₆] X FC₂ [CSR₂ X CSR₂₇]) farmers, covering an area of 888 hectares of mulberry cultivation by using a random sampling method. The Google Farms and a printed list of questionnaires were used by the officials of Department of Sericulture, Government of Karnataka to collect the data. A personal interview with BV farmers were conducted to avail the information to ensure comprehensive coverage of all sericulture-related activities. The questionnaires were prepared to fulfil the factors to cover as suggested by Basavaraja (2015) [2] (Table-1).

The following factors of cocoon cost calculations were followed as recommended as per Mahadeva *et al.*, (2025) [8].

- 1. Amortized cost:** To distribute the cost of long-term investments over their useful life, the total investment in mulberry garden establishment, silkworm rearing house construction, and rearing basic infrastructure was divided by the expected number of feasible years of use. This introduces the concept of depreciation to encourage reinvestment. A 12% interest rate was then applied to this annualized amount.
- 2. Rental value of mulberry garden (per Acre):** To provide a holistic economic valuation and ensure long-term competitiveness, the prevailing estimated rental income for agricultural land in the state was considered as the rental value for the mulberry garden.
- 3. Imputed value of family labour:** Assigning a monetary value to the work of unpaid family members is essential for a realistic analysis of farm profitability as many farm households mainly depend on family workers without pay. This was

calculated using the opportunity cost the standard wages the farmer and household members would have earned had they engaged in other agricultural work instead of sericulture.

- 4. Minimum profit:** Agriculture carries high inherent risks due to fluctuating markets, weather, and input costs. To ensure sustainable livelihoods of sericulture farmers and to attract reinvestment, a baseline minimum profit margin of 10% was incorporated into the total calculations.
- 5. Anticipated loss:** To maintain realistic financial estimations against uncontrollable factors like pests and silkworm diseases and weather in rearing house, a standard 7% loss in silkworm cocoon yield was factored into the production costs, even under the assumption of a successfully harvested, healthy successful silkworm crop.
- 6. Cost of production/kilogram of bivoltine cocoons:** The cost to production of one kilogram of bivoltine cocoons was calculated by dividing the total production cost (Table-1) by the average cocoon yield per 100 Disease Free Layings (DFLs).

In addition to the parameters listed in Table-1, additional data were collected on the adoption of modern sericulture techniques, including popular mulberry varieties *viz.*, V₁, Vishala and G series, water source for irrigation (borewell, channel, and open well), irrigation method (drip irrigation, ridges and furrow method, and sprinklers) and silkworm rearing type (shoot-feeding with a tray system). Statistically study's objectives were met by calculating mean and percentage as suggested by Basavaraja (2015) [2].

Results AND Discussion

The current study was carried out in 180 Technical Service Centres (TSCs) spanning in 15 districts (Bangalore City, Bangalore Rural, Kolar, Chikkaballapur, Chitradurga, Davangere, Ramanagara, Shimoga, Tumkur, Chamarajanagar, Hassan, Mandya, Mysore, Belgaum, and Kalaburagi) of Karnataka. Which is vital for policy-makers and sericulturists increase the profitability and sustainability of sericulture. In Karnataka, 1,48,704 farmers are involved in sericulture with a tune of mulberry cultivation in 1,16,898 (Anonymous, 2024) [1].

Economics of bivoltine silkworm cocoon production

This study encompassed 888 hectares of mulberry cultivation and surveyed 1,105 bivoltine silkworm rearers, representing 0.76% of the total area under mulberry cultivation and 0.74% of the overall sericulture farming in a state. It is confirmed that sericulture as a highly labour-intensive and economically vibrant sector, generating 276 man-days of employment/acre/annum. This states that sericulture is a one of the top employment-generating agricultural and agro-based industries positions. The average labour charges were recorded at Rs. 440/person/day (Table-2).

The major outlines detailing the cocoon production costs associated with mulberry cultivation and silkworm rearing is Rs. 4,51,045. The total expenditure for cocoon production can be categorized into paid-out costs and unpaid costs. Paid-out costs refer to the actual amount paid by the sericulture farmer towards the mulberry garden maintenance including labour charges, purchase of FYM, chemical

fertilizers, pesticides, and annual tax for the land. The expenditure towards the silkworm rearing (labour charges, purchasing chawki silkworms, rearing consumables like bed and room disinfectants, electricity charges, mountages charge, and marketing expenses). Out of Rs. 4,51,045 expenditures, Rs. 2,58,001 was spent as a paid-out cost, which was accounting for the 57.20%. Further, unpaid costs represent the amount retained by the farmer without direct payments to others. These include the amortized establishment cost of mulberry garden and silkworm rearing, rental value of the mulberry garden, imputed value of family labour, and managerial costs. The unpaid cost in the present study is of Rs. 1,93,044, which is up to the tune of 42.80% of total production cocoon cost (Table-2). It means, 42.80% of the total spending on cocoon production remains with the farmer as unpaid costs. This retained costs serves as a strong incentive for others to adopt sericulture.

The analysis further reveals that sericulture is highly input and labour-intensive sector. The primary drivers of the total production costs with expenditure towards labour cost reaches to Rs. 1,21,440 representing over 40.62% of the total production cost, procurement of chawki worms (young silkworms) expenditure costs Rs. Rs.97,832 (32.72%), farmyard manure, fertilizers, and pesticides costs of Rs. 57,294 (19.16%), rent for mountages and fuel expenses of Rs. 10,500.00 (3.51%), and a rearing consumable of Rs. 11,915.00 (3.99%) (Table-2). It is important note that 73.34% of total production costs were paid towards labour charges (40.62%) and purchase of chawki worms (32.72%) (Table-2). There is a noteworthy scope for mechanization to lower both production costs and the dependency on manual labour. Farmers can reduce their dependence on private chawki (young age silkworm) rearing centres by adopting scientific, in-house rearing methods. Implementing techniques like black boxing, controlled hatching, and adult rearing minimizes external expenses, thereby increasing farmer's overall profitability.

The data regarding cocoon yield and economic returns demonstrates the financial viability of bivoltine silkworm rearing. The present study recorded an average cocoon yield of 81.00 kg/100 DFLs. Sericulture farmers rear a total of 1,242 DFLs per acre/annum, distributed as 207 DFLs across 6 distinct silkworm crops. Economically, the cost of production stands at Rs. 371 per kg, while the cocoons fetch an average market price of Rs. 489 per kg. Consequently, the average annual gross income reported by farmers is Rs.6,28,960 per acre. This operation yields a net profit of Rs.1,77,915 per acre and establishes a strong cost benefit ratio was 1:1.32 (Table-3).

Susikaran (2020) observed 1:2.11 cost-benefit ratio by marginal farmers (total production cost Rs. 3,28,962.53/ha/year, and total income was Rs. 3,66,357.67/ha/year), 1:2.15 by small farmers (total production cost Rs. 3,70,544.47/ha/year, and total income Rs. 4,25,594.43/ha/year), and 1:2.31 cost-benefit ratio by medium farmers (total production cost Rs. 3,96,102.52/ha/year, and an income of Rs. 5,19,466.78/ha/year) However, Choudhari *et al.* (2021) [3] provided contradictory estimates in Parbhani District, Maharashtra. They reported a total cost of Rs. 1,33,507.20 for rearing 672.51 DFLs in 4.16 batches per year with a gross return of Rs. 2,79,442.42 and a net profit of Rs. 1,45,935.21, and the production cost of Rs. 215.82/kg cocoon. Mahadeva *et al.*, (2025) [8] evaluated the cost of

crossbreed silkworm cocoon production and it was primarily disseminated into 44.72% as a labour charge, 29.12% towards Chawki worm cost, 18.82% to FYM, chemical fertilizers and pesticides of 4.10% for expenditure towards the rent of mountages and fuel expenses, and 3.24% expenditure spent towards rearing consumables. They also categorised total expenditure paid-out costs (55.58%) and unpaid costs (44.42%). Rs. 326 was the cost of production per kg of crossbreed cocoons and the average market price for cocoons was Rs. 419 per kg. The total income/hectare for the sericulturists was Rs. 1,22,790, with a cost-benefit ratio of 1:1.29.

Hajare, (2008) [4] reveals that sericulture generates 170 man days of work, while alternative crop combinations like soybean-wheat generates 66 man days, soybean-gram generates 61 man-days and cotton-pigeon pea generates 65 man days of work. Usha Rani (2007) [12] has shown that 96.36 man days of employment were created from the establishment of one acre of mulberry garden to rear 300 DFLs of silkworms in 2 months.

Joycy Rani *et al.* (2024) [5] assessed the production and profitability of silkworm cocoon in 11 mega clusters of Karnataka during 2021-22, comprising sample of 220 farmers. They emphasized that sericulturists typically manage seven crops annually, with 85.09 kg of average cocoon per 100 DFLs. The total annual cost incurred for rearing 1,285 DFLs is calculated at Rs. 4,11,500.95/acre. Of this total, operational expenses represent the majority at Rs. 2,67,697 (65.05%), with labour alone accounting for 30.78%. Total fixed costs amount to Rs. 1,43,803, which includes a 22.50% (Rs. 92,583.86) depreciation cost on rearing assets and infrastructure. Economically, the cost of production was Rs. 354/kg against a strong average market selling price of Rs. 609.64/kg. Consequently, substantial net profit of Rs. 2,87,448/acre/year, reflecting a strong cost-benefit return of 1.64 for the investment of one rupee.

These variations highlight the differences in from region-to-region of economics of cocoon production and the number of silkworm cocoon crops per year. By emphasizing the need for localized cost calculations to optimizing the success in sericulture.

Sericulture practices adopted by farmers

Statistics on mulberry varieties (V1, Vishala, and G series), water source for irrigating mulberry garden (borewell, channel, and open well), irrigation method (drip irrigation, ridges & furrow method, and sprinklers), and rearing type (shoot feeding with tray system) were collected from sericulture farmers (Table-4). 1,103 farmers (99.82%) cultivated V1 mulberry variety for silkworm rearing. The Vishala and G series mulberry variety was cultivated by two farmers by each one. 1,075 farmers relied on borewell water (97.29%) to irrigate their mulberry plantation. Whereas, 10 farmers used channel water (0.90%) and 20 farmers depended on open well water (1.81%). 863 farmers (78.10%) adopted a drip irrigation system followed by 184 farmers (16.65%) were following ridges and furrow method and 58 farmers (5.25%) were using sprinkler irrigation system. It is important to observed that all 1,105 farmers (100%) are following mulberry shoot harvesting and tray system for silkworm rearing. This data indicates that V1 mulberry variety is cultivated by majority of the farmers. They use borewell water resource to irrigate their mulberry farms, and a good number of farmers are adopted a drip

irrigation method. It is important to note that shoot harvesting method and tray system of silkworm rearing were adopted by farmers which are advanced technologies developed by the Research and Development Institutes.

Inference and suggestions

The study indicates the sericulture is emerged as an economically viable, and sustainable enterprises in rural Karnataka. With high employment generation, low investment requirements, and quick returns, sericulture proves to be a profitable alternative to traditional agriculture for small and marginal farmers.

Key findings indicate that

- 99.82% of the surveyed farmers were cultivating an improved V1 mulberry variety and 97.29% of them were dependent on borewell water to irrigate their mulberry farms. Among them, 78.10% were using drip irrigation facilities.
- Rs. 371 was the total production cost/kilogram of bivoltine silkworm cocoon. The average market price for selling BV cocoon was Rs. 489 per kg, with 1:1.32 cost-benefit ratio.
- It is worth to mention that the 42.80% of the total expenditure remains unpaid cost.
- In Karnataka, 276 man-days of employment/acre/year were generated due to sericulture. Which is significantly better than other agricultural and agro-based industries.
- The average labour wages were Rs.440 per day, further highlighting the sericulture role in rural employment and income generation.

- The expenditure of 40.62% and 32.72% was spent towards the labour charges and purchasing a chawki worms from private CRCs respectively. This is an avenue to look for mechanization and scientific silkworm rearing techniques to increase the profitability to sericulture farmers.

Policy implications

- Expanding drip irrigation:** Drip irrigation is already utilized by majority of the successful sericulture farmers. However, the remaining farmers must be educated to adopt the drip irrigation. It will ease the labour saving and also optimise the natural water resources utilisation.
- Advancing scientific young age silkworm rearing techniques:** Presently, farmers are procuring young age silkworms from private CRCs, which is drives up overall production costs. A comprehensive training programs in self-rearing techniques will make them to overcome this dependency.
- Leveraging sericulture as a poverty alleviation program:** This study confirms that sericulture is a powerful engine for generating rural employment, empowering women, and securing livelihoods for small land holding farmers. Expanding these programs can provide consistent, year-round income and significantly alleviate rural economic distress.
- Implementing region-specific cost strategies:** The cost-benefit ratios fluctuate significantly across different areas; it is essential to develop localized production and marketing strategies to maximize both resource efficiency and regional competitiveness.

Table 1: List of various factors considered for the calculation of cost of bivoltine cocoon production (1 kg)

Sl. No.	Particulars
A	Mulberry Cultivation Cost
	1 Labour Charges (Removal of weak branches & weeding, Irrigation, Ploughing, Pruning, Input application and Spraying) approximately 13 days/crop
	2 Cost of Farm yard manure (10 tons as per recommendations)
	3 Cost of Fertilizers (NPK)
	4 Cost of Pesticides (Pests and Diseases management)
	5 Amortized establishment cost - Establishment cost of mulberry garden - Tractor tilling-4 hrs., Harrowing-2 hrs., Final land preparation by Bullock power, making trenches with tractor (hr). - Mulberry saplings cost - Labor Charges (Planting mulberry saplings-20 man days (MD), Fertilizer application-2 MD, Irrigation-10 MD, Hoeing/Weeding-3 times 20 MD). - Borewell, irrigation facilities and garden implements - Miscellaneous expenditure.
	6 Land revenue/Tax
B	Silkworm Rearing
	1 Labour Charges (Mulberry shoot harvesting, feeding silkworm, bed cleaning, selecting ripened silkworm larvae and monitoring the spinning, cocoon harvesting, cocoon marketing) approximately 38 days
	2 Cost of Silkworm Chawki worms
	3 Rearing consumables (Old Newspapers, Room Disinfectants, Bleaching Powder, Lime Powder and Bed Disinfectants)
	4 Electricity (fuel) charges
	5 Mountages rent
	6 Amortized establishment cost - Construction of Silkworm Rearing building (1064 sq ft/100 dfls) - Silkworm Rearing implements - Leaf chopping board, Leaf chopping knife, Leaf Chamber, shoot rearing stand (1200 sq ft/100 dfls), Electric power sprayer for disinfection, Room heater + Thermostat, Bed cleaning net 15 Nos. (2x'), Wet & Dry thermometer, Egg carrying box, Pot incubator, Plastic ware.
C	Rental value of mulberry garden 1 acre
D	Imputed value of family labour (MD)
E	Managerial Cost [Minimum Profit - 10% of (A+B+C+D) + Anticipated loss - 7% of paid out cost of (A+B+C+D) + Marketing Cost]
F	Total Production Cost - A+B+C+D+E

Table 2: Economics of cost of production of Bivoltine silkworm cocoon.

Sl. No.	Particulars	Quantity	Rate	Amount	Paid out Cost	Unpaid Cost
A	Mulberry Cultivation and Silkworm rearing Cost					
	1	Amortized establishment cost	--	--	71,051	--
	2	Labour Charges (Man Days)	174	440	76,560	76,560
	3	Cost of Farm yard manure (Ton)	10	3,100	31,000	31,000
	4	Cost of Fertilizers	--	--	21,294	21,294
	5	Cost of Pesticides	--	--	5,000	5,000
	6	Land revenue/Tax	--	--	500	500
	7	Cost of Chawki worms	2013	48.60	97,832	97,832
	8	Rearing consumables	--	--	11,915	11,915
	9	Electricity (fuel) charges	--	--	6,000	6,000
	10	Mountages rent	--	--	4,500	4,500
B	Rental value of mulberry garden			20,000	--	20,000
C	Imputed value of family labour (MD)	102	440	44,880	--	44,880
Total (A+B+C)		--	--	3,90,532	2,54,601	1,35,931
E	Managerial Cost	--	--	60,513	3,400	57,113
F	Total Production Cost	--	--	4,51,045	2,58,001	1,93,044

Table 3: Economics of cost of production of bivoltine silkworm cocoon.

Sl. No.	Particulars	Data
1	No. of data collected (Sericulture farmers)	1105
2	Area under mulberry (in acre)	2221
3	Area under mulberry (in hectare)	888
4	No. of crops brushed/year	6
5	Average Chawki brushed/acre/crop	207
6	Chawki brushed/acre/Year	1242
7	Average cocoon rate/kg/year (Rs.)	489
8	Average cocoon yield per 100 DFL's	81.00
9	Average income/ha (Rs.)	6,28,960
10	Cost of Cocoon Production (Rs./kg)	371
11	Cost: Benefit	1:1.32

Table 4: Details of the adoption of new techniques for the mulberry cultivation and silkworm rearing.

Sl. No.	Particulars	Numbers
1	Mulberry variety	
	V1	1103 (99.82)
	Vishala	1 (0.09)
	G Series	1 (0.09)
2	Source of Irrigation	
	Bore well	1075 (97.29)
	Channel	10 (0.90)
	Open well	20 (1.81)
3	Type of irrigation methods	
	Drip Irrigation	863 (78.10)
	Ridges & Furrow Method	184 (16.65)
	Sprinklers	58 (5.25)
4	Rearing Type	
	Shoot Rearing	1105 (100)

data in parenthesis is%

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