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Research Article

STUDIES ON LATEAGE SILKWORM REARING IN IRRIGATED CONDITIONS FOR ECONOMIC VIABILITY

[1]*S. Susikaran, [2]S. Krishnamoorthi, [3]B. Karthick Mani Bharathi, [3]V. Vasanth, [3]R. Moulidharshan, [3]R. Nandha Kumar, [4]B. Rubeesh Kumar

[1]Directorate of Open and Distance Learning, Tamil Nadu Agricultural University, Lawley Road, Coimbatore, 641 003, Tamil Nadu, India.
[2]Department of Forest Products and Wildlife, Forest College & Research Institute, Tamil Nadu Agricultural University, Mettupalayam, 641 301, Tamil Nadu, India.
[3]Department of Sericulture, Forest College & Research Institue, Tamil Nadu Agricultural University, Mettupalayam, 641 301, Tamil Nadu, India.
[4]Department of Economics, Bharathiyar University, Coimbatore, 641 046, Tamil Nadu, India.

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ABSTRACT

The present study was undertaken to evaluate the infrastructural requirements, cost structure and profitability of large-scale silkworm rearing under controlled irrigated conditions. The research focused on the rearing of double hybrid disease-free layings (dfl's), supported by the establishment of suitable infrastructure and essential equipment for successful lateage rearing. A rearing house inclusive of Chawki and shoot storage facilities was constructed at a cost of ₹3,00,000 and rearing equipment worth ₹58,400 was procured thus leading to a total fixed capital investment of ₹3,58,400. The economic analysis revealed that the total variable cost incurred was ₹2,91,400, with significant expenses attributed to labour (₹1,62,000), DFL procurement (₹64,800), and leaf feeding (₹54,000). When fixed costs (₹35,840) were added, the total cost of production amounted to ₹3,27,240. Cocoon yield was estimated at 80 kg per 100 DFLs resulting in a total yield of 1,440 kg. At an average market rate of ₹350/kg, cocoon sales generated ₹5,04,000 supplemented by ₹80,000 from by-products. The total revenue reached ₹5,84,000 thereby yielding a net profit of ₹2,56,760. The benefit-cost ratio was calculated at 1.78 thereby indicating strong economic viability. The study concludes that with proper infrastructure, efficient resource use and scientific management, lateage silkworm rearing in irrigated conditions is a profitable and sustainable enterprise and well-suited for the agro-climatic conditions of Udumalpet and similar regions in Tamil Nadu.

Keywords: Benefit-cost ratio, Cocoon yield, Economic viability, Irrigated conditions, Lateage silkworm rearing.

INTRODUCTION

Sericulture is the practice of rearing silkworms for the production of silk which plays a vital role in the rural economy of India especially in states like Tamil Nadu where agro-climatic conditions support its growth (Vijayan *et al.,* 2023). Among various practices in sericulture, lateage silkworm rearing is all about rearing silkworms during their later developmental stages and part of life cycle is a critical determinant of cocoon quality and overall silk yield (Datta *et al.,* 2002). This phase requires meticulous attention to environmental conditions, feeding schedules and disease management to ensure economic viability (Saini *et al.,* 2023). The Udumalpet town was situated in the Tiruppur district is known for its semi-arid climate, fertile soils and well-established irrigation systems thus making it a potential hub for sustainable sericulture practices under irrigated conditions (Dandin and Kumari, 2021).

In recent years, the need for optimizing sericulture practices has gained importance due to fluctuating market prices, changing climatic patterns and increasing input costs. Traditional silkworm rearing, often reliant on rain-

*Corresponding Author: S. Susikaran, Directorate of Open and Distance Learning, Tamil Nadu Agricultural University, Lawley Road, Coimbatore, 641 003, Tamil Nadu, India Email: susi.agri@gmail.com.

fed mulberry cultivation is vulnerable to climatic uncertainties that can adversely affect leaf yield and silkworm health (Chowdhury *et al.,* 2013). In contrast, irrigated conditions offer a controlled environment that may support higher productivity, especially during the late instar stages when the nutritional demands of silkworm's peak. Lateage rearing under irrigated conditions thus emerges as a promising strategy to enhance cocoon quality, increase yield and ensure better returns for farmers (Sarkar *et al.,* 2018).

The Udumalpet region with its reliable irrigation sources and growing interest in sericulture provides an ideal setting to study the economic feasibility of lateage silkworm rearing (Chowdhury *et al.,* 2013). Despite its potential, there is a lack of region-specific research on the cost-benefit analysis, ideal environmental conditions and best practices for late-age rearing in irrigated systems. Understanding these aspects is essential to develop scalable and sustainable models for silkworm cultivation that can be adopted by small and marginal farmers in the region (Sakthivel *et al.,* 2012). This study aims to evaluate the effectiveness and economic viability of lateage rearing in irrigated conditions around Udumalpet town. The objectives include analyzing the yield parameters, assessing input-output ratios and identifying the key factors that influence profitability. By providing empirical insights into the technical and economic dimensions of sericulture in an irrigated setting, this research aspires to support policy formulation, extension activities and farmer adoption of improved practices that contribute to rural livelihood enhancement and sustainable silk production in Tamil Nadu.

MATERIALS AND METHODS

The study was conducted in the Udumalpet region of Tamil Nadu, an area with semi-arid climatic conditions and well-established irrigation facilities which provide favourable conditions for mulberry cultivation and silkworm rearing. The main objective was to evaluate the economic viability of late age silkworm rearing under irrigated conditions using scientific rearing practices and appropriate infrastructure (Dasari *et al.,* 2018). A dedicated rearing facility was established, comprising a late age silkworm rearing house that included separate sections for chawki (early instar) rearing and shoot storage. The building was designed to maintain optimal temperature, humidity and hygiene required for healthy silkworm development. Essential rearing equipment and tools were procured to support efficient handling, feeding and disease management throughout the silkworm life cycle (Srinivasa *et al.,* 2014).

The rearing process involved feeding the silkworms with irrigated mulberry leaves thereby ensuring a continuous and high-quality leaf supply that meets the nutritional demands during the late stages of silkworm development (Kallimari *et al.,* 2020). The feeding schedule, environmental parameters such as temperature and humidity and sanitation practices were strictly monitored and maintained throughout the rearing period (Vijayan *et al.,* 2021). Labour requirements were planned based on the intensity of operations needed for silkworm care including feeding, cleaning, disinfection and pest management. Inputs such as disinfectants and other consumables were used as per recommended sericulture protocols (Kumar *et al.,* 2022). Data on inputs, operational costs, cocoon yield and by-product recovery were systematically recorded. The questionnaire encompassed a range of parameters including costs associated with building construction, equipment procurement, and silkworm rearing. To ensure the accuracy of the data collected, field visits were carried out to verify responses and directly observe the prevailing rearing practices (Mallick and Sengupta, 2022). Additionally, secondary data were sourced from the official records of the Department of Sericulture, Udumalpet under the Government of Tamil Nadu, as well as from published literature related to the costs of lateage rearing. The economic performance of the rearing system was evaluated by analyzing total cost, fixed cost, variable cost, net returns and benefit-cost ratios. This approach provided a comprehensive understanding of the technical and economic aspects of lateage silkworm rearing under irrigated conditions thus enabling assessment of its feasibility and profitability for farmers in the region.

Fixed Cost

Fixed costs are expenditures that remain constant regardless of the level of production or output. These costs remain constant regardless of the number of silkworms reared or the quantity of cocoons produced. Examples include depreciation on buildings and equipment, rent and interest on fixed capital (Chowdhury *et al.,* 2013).

Variable Cost

Variable costs are expenses that fluctuate in direct proportion to the level of production. In silkworm rearing, these include costs such as mulberry leaf procurement, labour, disinfectants and transportation which increase as the number of silkworms or dfl's increases.

Gross Return

Gross return denotes the total revenue earned from selling the main product as in this case, cocoons and any associated by-products before deducting any costs or expenses (Singh *et al.,* 2010).

Net Return

Net return is the profit earned after subtracting all the costs (both fixed and variable) from the total revenue. It represents the actual economic gain from the silkworm rearing activity.

Benefit-Cost (B: C) Ratio

The benefit-cost ratio is a financial indicator used to assess the profitability of an investment or project. It is

determined by dividing the total benefits (returns) by the total costs incurred. A B: C ratio greater than 1 indicates that the benefits outweigh the costs thus signifying a profitable venture (Raju and Sannappa, 2018).

RESULTS AND DISCUSSION

The successful implementation of lateage silkworm rearing practices particularly under irrigated conditions is heavily reliant on the availability of appropriate infrastructure and equipment. For the rearing of double hybrid disease-free layings (dfl's), significant investments are required in both buildings and rearing assets to create a good environment for silkworm development and to ensure operational efficiency (Vijayan *et al.,* 2021). The following section elaborates on the infrastructure and equipment utilized in the study thus highlighting their roles and economic implications (Chowdhury *et al.,* 2013). The crucial infrastructure investment involving the construction of a dedicated lateage rearing house which includes facilities for chawki (early stage) rearing and shoot storage. The building was designed to accommodate optimal environmental conditions such as temperature, humidity and cleanliness which is crucial for enhancing the survival rate and productivity of silkworms during their most sensitive stages (Manjula and Kumari, 2017). The cost of constructing this rearing house was estimated at ₹3,00,000 thereby forming the bulk of the fixed capital investment as shown in Table 1.

In addition to the building, various essential rearing equipment were procured thus amounting to a total of ₹58,400. These items were carefully selected to support the day-to-day operations of silkworm rearing, maintain hygiene and provide the necessary micro-climatic conditions (Amarnath and Karthik, 2014). Key equipment included a power sprayer (₹6,500) for disinfecting rearing spaces, a room heater (₹3,000) and humidifier (₹2,500) for regulating environmental parameters and a rotary mountage (₹20,000) for effective cocoon spinning. Basic tools such as knives (₹100), leaf chopping boards (₹200) and litter baskets (₹400) played a vital role in improving operational efficiency and cleanliness (Vijayan *et al.,* 2011). Specialized rearing items like chawki and feeding stands, wooden racks, shoot rearing racks and nylon nets facilitated the handling of silkworms with minimal stress thereby reducing larval mortality. Items like gas flame guns and ant wells helped in pest control, while incubation frames and egg transportation bags ensured smooth handling during the egg-to-larva transition (Caccam and Mendoza, 2010).

Table 1. Building and Rearing assets procurement cost.

Sl. No.	Particulars	Rate (Rs)
A.	**Variable Costs**	
1.	Leaf (1200kg/100dfl's). For 1800dfl's= 21,600 kg leaf *2.5Rs/kg	54,000
2.	Dfl procurement cost for 1800dfl's (1dfl's*15Rs/dfl)	64,800
3.	Disinfectants	4,000
4.	Labour (@ 15 MD/100 dfls). For 1800dfl's= 270 MD @1 MD = 600 Rs	1,62,000
5.	Transportation and marketing	1,000
6.	Other costs	1,000
7.	Interest on working capital	4,600
	Total variable costs	2,91,400
B.	**Fixed costs**	
8.	Depreciation on building and equipments and interest on fixed costs @ 10%	35,840
	Total costs	3,27,240
C.	**Revenue**	
9.	**Cocoon yield**	80kg/100 dfl's
10.	Average cocoon price	350 Rs
11.	Cocoon production	1440 kgs
12.	Income from cocoon	5,04,000
13.	Income from by-products	80,000
	Total revenue	5,84,000
	Net revenue	2,56,760
	Benefit: Cost ratio	1.78

Table 2. Cost and returns structure in silkworm rearing.

Sl. No.	Particulars	Rate (Rs)
A.	**Variable Costs**	
1.	Leaf (1200kg/100dfl's). For 1800dfl's= 21,600 kg leaf *2.5Rs/kg	54,000
2.	Dfl procurement cost for 1800dfl's (1dfl's*15Rs/dfl)	64,800
3.	Disinfectants	4,000
4.	Labour (@ 15 MD/100 dfls). For 1800dfl's= 270 MD @1 MD = 600 Rs	1,62,000
5.	Transportation and marketing	1,000
6.	Other costs	1,000
7.	Interest on working capital	4,600
	Total variable costs	2,91,400
B.	**Fixed costs**	
8.	Depreciation on building and equipments and interest on fixed costs @ 10%	35,840
	Total costs	3,27,240
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9.	Cocoon yield	80kg/100 dfl's
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The total capital outlay for establishing the infrastructure and procuring the equipment stood at ₹3,58,400 as in table 1. Though the initial investment appears substantial, it is justified by the scale of operations for 1800 dfl's @ 300 dfl's per acre in 6 leaf harvests and the long-term economic returns anticipated through improved cocoon yield, better disease management and efficient labour utilization (Diab and Hefny, 2009). Moreover, the infrastructure is durable and offers repeated utility across multiple rearing cycles thereby enhancing overall economic viability. These results suggest that with adequate investment in rearing assets, lateage silkworm rearing in irrigated conditions can be a sustainable and profitable venture in the Udumalpet region. The economic analysis of lateage silkworm rearing under irrigated conditions in the Udumalpet region provides key insights into the cost and returns structure, helping assess the viability and profitability of the enterprise. The rearing was conducted for 1800 double hybrid disease-free layings (dfl's), and the associated costs were categorized into variable and fixed costs, with revenue streams derived from cocoon production and by-products (Chowdhury *et al.,* 2013). The total variable cost incurred was ₹2,91,400. Among the major components, the procurement of mulberry leaf stood as a significant expense, amounting to ₹54,000. Leaf consumption was calculated at 21,600 kg for 1800 dfl's (i.e., 1200 kg/100 dfl's), at a unit cost of ₹2.5/kg. DFL procurement cost at ₹64,800 (1800 dfl's at ₹15 per dfl) (Singh, 2010). Labour constituted the largest share, with 270 man-days (15 MDs/100 dfl's) calculated at ₹600 per day, totalling ₹1,62,000 (Govinrao, 2019). Other operational costs such as disinfectants (₹4,000), transportation and marketing (₹1,000), miscellaneous expenses (₹1,000) and interest on working capital (₹4,600) made up the remaining variable expenditure as in table 2. The fixed cost was estimated at ₹35,840 which includes depreciation on buildings and equipment and interest on fixed capital at a standard rate of 10%. These costs reflect long-term investments that depreciate gradually and are crucial for providing a controlled and hygienic rearing environment (Chowdhury *et al.,* 2013).

The total cost of rearing inclusive of both fixed and variable costs estimated to ₹3,27,240. On the returns side, cocoon yield was calculated at 80 kg per 100 dfl's thus resulting in a total production of 1,440 kg. With an average market price of ₹350 per kg, the gross income from cocoon sales was ₹5,04,000 (Sakthivel *et al.,* 2012). Additionally, income from by-products such as silkworm litter, seri-compost, biogas production and pupae for oil, broiler and fish feeding was valued at ₹80,000 thereby taking the total revenue from silkworm rearing close to an amount of

₹5,84,000 (Chowdhury *et al.,* 2013). The net revenue realized was ₹2,56,760 thus indicating substantial profitability as shown in table 2. The benefit-cost (B:C) ratio stood at 1.61 thus suggesting that for every ₹1 invested, there was a return of ₹1.61. This clearly reflects the economic viability of lateage silkworm rearing in irrigated conditions when supported with scientific management practices, adequate infrastructure and enhanced resource utilization (Vijayan *et al.,* 2021). The high labour cost is offset by the high returns thereby making it a sustainable income-generating activity for farmers in the Udumalpet region of Tamil Nadu (Raju and Sannappa, 2018).

CONCLUSION

The present study on lateage silkworm rearing under irrigated conditions in the Udumalpet town of Tiruppur shows its economic viability and potential for rural livelihood enhancement. The establishment of appropriate infrastructure including a well-equipped rearing house and essential tools costing ₹3,58,400, forms the backbone for successful silkworm cultivation at a scale of 1800 dfl's. These fixed investments, though substantial initially are one-time costs that ensure long-term utility across multiple rearing cycles. The cost and returns analysis for rearing 1800 dfl's revealed that the total variable cost amounted to ₹2,91,400 with labour and dfl's procurement being the major contributors. When including fixed costs (₹35,840), the total expenditure reached ₹3,27,240. On the revenue side, the sale of 1,440 kg of cocoons at ₹350 per kg yielded ₹5,04,000, while an additional ₹80,000 was realized from by-products. This resulted in a total revenue of ₹5,84,000 and a net profit of ₹2,56,760. The benefit-cost ratio of 1.78 clearly demonstrates that the enterprise is profitable and economically sound. These findings affirm that lateage silkworm rearing, when practiced under irrigated conditions with scientific management and appropriate capital investment can yield substantial returns. The model is particularly relevant for regions like Udumalpet, where irrigation facilities are accessible and there is potential to scale up operations for enhanced income generation. Therefore, this practice can be promoted as a sustainable and economically viable option for sericulture farmers aiming to improve productivity and profitability.

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