P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; SP-Issue 8; August 2024; Page No. 222-225

Received: 06-06-2024
Accepted: 18-07-2024

Indexed Journal
Peer Reviewed Journal

Studies to estimate the impact of mechanization in Grainage and silkworm rearing

[1]Karthick Mani Bharathi B, [2]Harish Reddy C, [2]Dukare Pradip Gulabrao, [2]Kenchappa NM, [3]Pavithra MR, [4]Krishna Kumar S and [5]Tanvi Rahman

[1]Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, Tamil Nadu, India

[2]M.Sc. (Agri) Sericulture, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

[3]Post Graduate Studies, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

[4]Research Fellow, Agricultural Entomology, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

[5]M.Sc. Sericulture & Seri-biotechnology, Project Assistant, Central Sericultural Research and Training Institute, Mysuru, Karnataka, India

DOI: https://doi.org/10.33545/26180723.2024.v7.i8Sd.984

Corresponding Author: Karthick Mani Bharathi B

Abstract

India has the exclusive right to produce the four varieties of silk—mulberry, Tasar, ERI and Muga and is the country that produces the most silk overall, ranking second only to China. Indian silk products are extremely valuable both domestically and internationally. There are many issues facing by farmers today along with the significance of mechanization and the many pieces of equipment used in sericulture. Recent research and technology advancements have made to validate the use of machineries across various sectors of sericulture in order to improve the productiveness because of the growth of the sericulture business in India. The utilization of diverse machinery and equipment in nearly every segment of the sericulture business leads to the optimization of output with superior quality. The sericulture industry's entire competency will be enhanced by technological innovation, automation, training developments and technology promotion. The anticipated amount of man days needed per hectare annually for mulberry garden care is 800. Implementing mechanization in mulberry farming has the potential to decrease mulberry leaf production costs by a minimum of 35-40%. The labor wages associated with various processes contribute for 45–60% of the cocoon's cost. Consequently, in order to lower the cost of producing cocoons, it is necessary to decrease the reliance on labour.

Keywords: Cost, efficiency, Grainage appliances, mechanization, rearing appliances, sericulture

1. Introduction

Sericulture is primarily performed by India's lower segments of society thus making it challenging to use more complex technologies (Gowda *et al.*, 2011) [8]. Nearly 90% of the silk produced worldwide comes from China which leads the world in sericulture (Bharathi *et al.*, 2022) [12]. The utilization of diverse machinery and equipment in nearly every industry area has led to the optimization of production at a superior level (Nikhade and Gunaki, 2020) [21]. India which comes in second place to China in terms of overall output which holds the special right to produce the four varieties of silk: mulberry, tasar, eri and muga (Bindroo and Kishur, 2011) [2].

According to Bali and Chanotra (2019) [26], Three distinct sectors make up the eco-friendly and rural industry of sericulture: moriculture, silkworm rearing, and post-cocoon sector (Hoque and Hasmi, 2002) [10]. These industries are related to one another because they deal with the upkeep and cultivation of host plat mulberry for high-quality leaf production which is used to raise monophagous silkworms (*Bombyx mori* L.) (Bharathi *et al.*, 2024) [13]. Recent technology advancements enabled humans to the use of machinery for their advantage in order to boost the efficiency in doing different operations (Parthiban *et al.*, 2021) [22]. From these leaves, raw silk is extracted through a variety of processes in the post-cocoon industry and silk yarn is made from it (Luo *et al.*, 2020) [18]. This yarn is then subjected to a number of processes including knitting, dying and throwing, to create the finished product, silk fabric as outlined by (Bindroo and Verma, 2014) [3].

In the unique industry of sericulture, mulberry trees are repeatedly trained and pruned to yield crops five or six times a year (Mohandas *et al.*, 2010) [20]. This means that the schedule of operations/activities which includes pruning the garden and harvesting the cocoons must be completed in 60–70 days thus making it a time-oriented practice in the vast holdings where human labour may not be able to ensure the timeliness of all activities (Bharathi *et al.*, 2023) [14]. Pruning a mulberry garden, weeding and cultural operations, harvesting leaves and shoots, applying bed disinfectants, selecting adult larvae for spinning and harvesting cocoons are among the tasks that must be finished in the lowest

amount of time (Dandin and Verma, 2002) [5]. It is problematic when there are many workers available for a short period of time according to Gunasheela *et al.* (2018) [9].

We need to increase worker productivity and production if we are to solve the labour issue (Verma, 2011) [29]. This can be accomplished by adopting suitable tools and machinery by the sericulturists as well as proper mechanization at various stages of mulberry cultivation and cocoon production (Dandin and Verma, 2002) [6].

2. Mechanization in grainage

2.1. Grainage

2.1.1. Wet and dry bulb thermometer

An instrument used to analyse both the temperature and vapor pressure of the surroundings. In sericulture, the wet and dry bulb thermometer plays a vital role in regulating environmental conditions especially humidity, which is crucial for the health of silkworms and silk production. The dry bulb thermometer measures the air temperature while the wet bulb thermometer, which is moistened thus assesses the cooling effect of evaporation. By comparing these readings, sericulturists can determine the relative humidity thereby ensuring optimal conditions for silkworm rearing (Savithri and Sujathamma, 2016) [23]. Effective humidity control helps prevent diseases, boosts silk quality and enhances productivity. Accurate use of these thermometers allows for a controlled environment which is essential for the healthy growth of silkworms and high-quality silk production (Dandin and Verma, 2002) [5]. Approximate unit cost of wet and dry bulb thermometer is Rs. 800 - 5000 /-.

2.1.2. Hygrometer

In sericulture, a hygrometer is vital for regulating the humidity levels crucial for the health of silkworms and the quality of silk production. By providing accurate measurements of air moisture, a hygrometer helps sericulturists maintain the right balance—neither too dry nor too humid. Proper humidity control is essential for silkworm development, disease prevention and optimal silk quality (Savithri *et al.,* 2013) [24]. Regular use of a hygrometer allows for precise adjustments to the rearing environment thus ensuring conditions are ideal for silkworm growth and ultimately enhancing silk yield and quality (Lakshmi, 2015) [16]. Approximate unit cost of hygrometer is Rs. 1500 – 10,000 /-.

2.1.3. Cold storage unit

In sericulture, cold storage units are essential for keeping silkworm eggs viable over long periods. By maintaining a low-temperature environment, these units prevent the premature hatching and spoilage of eggs which is vital for consistent silk production. Cold storage allows sericulturists to manage breeding cycles more effectively thus enabling better planning and synchronization of silkworm rearing activities (Srinivas *et al.,* 2019) [25]. This technology also ensures that high-quality eggs are preserved during off-seasons or low-demand periods which leading to stable silk production and increased economic efficiency. Overall, cold storage units play a key role in maintaining silkworm health and optimizing silk yield (Liu *et al.,* 2021) [17].

2.1.4. Cocoon cutting machine

Presently, selected cocoons are cut manually by hand with the help of the blade and on an average 500 cocoons were processed per hour by a single member which estimated to be 2500-2800 cocoons per day (in a shift of working hours in a day). The cocoon cutting machine can process 5000-7500 cocoons per hour or about 40,000-50,000 cocoons per day (in a shift of 8 working hours) (Kherkatary and Daimari, 2017) [15].

3. Mechanization in silkworm rearing

3.1. Rearing house disinfection

3.1.1. Power sprayer

CSRTI Mysore has created a power-operated sprayer that may be used to sterilize raising houses. Twin piston HTP or an electric pump set with ½ horsepower powers the sprayer. Efficiency: it is suitable for disinfection of rearing house with capacity of 400 or above dfl's (Dandin and Verma, 2002) [6].

3.1.2. Flame gun

It is the greatest tool, affordable and environmentally friendly. Utilizing fire flames and LPG as fuel, this method is utilized to disinfect raising equipment, montages and other items (Jiang and Zhang, 2017) [11]. Approximate unit cost of flame gun is Rs. 1300 - 1800 /-. Efficiency of the machine is ½ kg LPG/hr.

3.1.3. Duster

3.1.3.1. Manual Silkworm Dusting Machine

It has a hopper, a transmission system and a blower. A crank that is turned by hand powers the blower. Chemical powder in the container is raised by a high-velocity air current which then dusts them through an opening. Approximate price of manually operated dusting machine is Rs.2000-2500 /-

3.1.3.2 Battery operated duster

CSRTI Mysore created the battery powered dusting machine to efficiently dust the bed disinfectants. Because it ensures that there is less dust or propelled chemical flying, it lessens the possibility of health risks for the operators. Furthermore, a greater quantity of trays can be handled in a shorter amount of time (Marak *et al.,* 2024) [19]. Approximate unit cost of battery operated duster is Rs.1800/-

3.2. Temperature (°C) & Relative Humidity (%) control machines

3.2.1. Semi-humidifier cum heater

This machine was created by CSRTI Mysore which has the special ability to function as both a humidifier and a warmer depending on what the needs of the rearing chamber. Approximate unit cost of semi-humidifier cum heater is Rs.18,000 – 25,000 /-

3.2.2. Mist sprayer

Mist sprayer at the top of the roof helps us to maintain relative humidity in silkworm rearing room. Approximate unit cost of mist sprayer is Rs.10,000/-.

3.3. Mature silkworm seperator

Picking silkworms by hand is a very labour-intensive task.

Approximate unit cost of mature silkworm separator is Rs.20,000/- (Electric). Efficiency: Electrically operated machine developed by CSRTI, Mysore can separate about 100 dfl's [45,000 worms] in one hour.

3.4. Rotary mountage

The system has been tested in Karnataka, demonstrating its effectiveness in lowering labour costs and enhancing cocoon quality. The method used to mount silkworms is crucial for producing high-quality cocoons. This includes the rotary mounting system developed in Japan, which is detailed here. It features a wooden frame holding 10 cardboard mountings and can be rotated between horizontal and vertical positions. The approximate cost for this rotary mounting system is Rs. 6,500/- and its efficiency ranges from 10 to 20 kilograms of cocoons per unit (Singh *et al.*, 2021) [27].

3.5. Cocoon harvesting machines

Cocoon harvesting is a tedious and time consuming process and involves more labour force to harvest cocoon from the mountages. Tools and machinery for easy harvesting have been developed by CSRTI, Mysore to enable quick and affordable harvesting of cocoons (Anathanarayanan, 2010) [1]. Approximate unit cost: (Rotary mountage harvestor). Hand operated: Rs.800/-; Pedal operated: Rs.7000/-. Approximate unit cost of cocoon harvesting machine is Rs.30,000 – 35,000/-. Efficiency of the machine is 15 kg's /hr (Hand operated) and 50-60 kg's/hr (Pedal operated).

3.6. Tray washing machine

In CRCs, cleaning trays is a tedious and time-consuming task. A motorized equipment was created by CSR&TI, Mysore to provide efficient and quick cleaning (Dewagan, 2018) [7]. Approximate unit cost of tray washing machine is Rs.40,000/-. Efficiency of the machine is 80-85 trays /hr.

3.7. Mountage folding & bundling machine

Upon cocoon harvesting, the foldable plastic mountages must be appropriately folded and packed. With this tool, it may be completed efficiently and precisely (Tripathi and Gurjar, 2021) [28]. Approximate unit cost of mountage folding and bundling machine is Rs.1200/-. Efficiency of the machine is 30 bundles /hr.

Table 1: Impact of mechanization in silkworm rearing

S. No.	Activity	Cost of operation (Rs.)		Reduction in cost of operations (%)
		Manual	Machine	
1.	Disinfection by power sprayers (For 500 dfl's rearing house)	250	100	60
2.	Leaf chopping (Per day for 500 dfl's batch)	500	125	75
3.	Matured silkworm separation (Per 100 dfl's)	600	150	75
4.	Cocoon deflossing	400	50	90
5.	Tray washing	400	100	80

Disinfection done manually usually costs about Rs.250 per unit for a 500 dfl's rearing house but by using a machine, the cost is about Rs.100 per unit. 60% is thought to be the operational cost reduction. For a batch of 500 dfl's, the labour cost for leaf chopping is Rs.500 per unit per day. Using machines will set you back about Rs.125 per unit. The cost has been cut by 75% because of machine use (Table 1). Matured silkworm separation for 100 dfl's cost about Rs.600 per unit when done by hand and Rs.150 per unit when done with machines thereby significantly 75% reduction in operating costs. The estimations in Table 1 were supported by the findings of Dandin and Giridhar (2014) [4].

4. Conclusion

The last two decades have seen mulberry sericulture undergo numerous technological advancements. Nonetheless, there is still much we need to do to lower the cost of producing silk cocoons. The cultivation of silkworms, high-yielding mulberry types, economical silkworm rearing techniques and efficient pest and disease control have increased the profitability and appeal of sericulture to farmers. Moreover, in order to combat the threat of imported silk efforts must be made to lower the cost of manufacturing of Indian silk in addition to improving its quality. The labour required to cultivate mulberries and raise silkworms accounts for a large portion of the cost of producing silk. Approximately 60–65% of the cost of producing silk goes toward labour. In addition, mechanization facilitates timely completion of tasks, less drudgery, an improved working environment and a higher standard of living for farming communities. In certain situations, mechanization may prove to be an essential and vital component in cutting manufacturing costs. Mechanization has been noted to have aided in many nations in halting the young rural population's migration and increasing the amount of land under cultivation.

5. References

1. Ananthanarayanan SK. Silk Reeling. Delhi: Biotech Books; c2010. p. 83-87.
2. Bindroo BB, Kishur MV. R&D Advancements in Indian Sericulture. Proceedings of the Golden Jubilee National Conference Sericulture Innovations: Before and Beyond. Golden Jubilee Publications; c2011.
3. Bindroo BB, Verma S. Sericulture Technologies Developed by CSR&TI Mysore. Mysore: CSR&TI Publications; c2014. p. 10-15.
4. Dandin SB, Giridhar K. Handbook of Sericulture Technologies. Central Silk Board publication; c2014. p. 42.
5. Dandin SB, Verma S. Mechanization in sericulture – Need & scope. Indian Silk. 2002;41(1):9-12.
6. Dandin SB, Verma S. Workshop on mechanization in sericulture. Indian Silk. 2002;40(12):27-28.
7. Dewangan SK. Economics of sericulture—a study of Raigarh District—Chhattisgarh–India. Int J Res Appl Sci Eng Technol. 2018;6(1):573-579.
8. Gowda RVP, Murthy ANN, Muniraju E. Development of design methodology for mechanized harvesting and

pruning of shrubs. Indian J Sci Technol. 2011;4(2):101-106.
9. Gunasheela TJ, Renuka VT, Prathiba SN, Shilpa AP. Implementation of sericulture farm automation using sensor network and GSM technology. Int J Pure Appl Math. 2018;119(14):13-20.
10. Hoque MA, Hasmi MR. Growth and development of sericulture production and mulberry plants cultivation in West Bengal: An overview. Journal. 2017;65(3).
11. Jiang Y, Zhang X. Analysis on the evolution power of agricultural modernization with Chinese characteristics. Rural Econ. 2017;2(1):86-92.
12. Karthick Mani Bharathi B, Susikaran S, Parthiban KT, Murugesh KA, Chozhan K. The economics of commercial mulberry saplings production using mini clonal technology over conventional methods. The Pharma Innovation J. 2022;11(7):1236-1241.
13. Karthick Mani Bharathi B, Susikaran S, Parthiban KT. A comparative biochemical study of mulberry (Morus spp.) mini clones over conventional stem cuttings. Int J Plant Soil Sci. 2024;36(5):975-983.
14. Karthick Mani Bharathi B, Susikaran S, Parthiban KT, Vasanth V, Vijay S. Influence of different transplanting days on yield attributes of mini clones under field conditions for Morus indica (V1). Madras Agric J. 2023;111(1):1-3.
15. Kherkatary A, Daimari P. Growth pattern in raw silk production and employment generation in sericulture in Assam: An economic analysis. Int J Humanities Soc Sci Stud. 2017;6959(2800):164-173.
16. Lakshmi PR. An analysis of silk production in India. Int J Bus Manag. 2015;3(3):151.
17. Liu T, Cui YZ, Hu JJ. Research on allocation efficiency measurement and spatial agglomeration effect of agricultural machinery equipment under high-quality development background. J Chin Agric Mech. 2021;5(1):123-128.
18. Luo B. Small farmers and modern agriculture. Issues Agric Econ. 2020;1:28.
19. Marak M, Singha TA, Saikia D. Mechanization in sericulture: An overview. J Adv Biol Biotechnol. 2024;27(8):820-825.
20. Mohandas TP, Ghosh A, Saraswathi P, Shantala R, Veeraiah TM. Comparative performance of mulberry under different plant density and geometry with manual or mechanized cultivation. Indian J Seric. 2010;49:188-194.
21. Nikhade SR, Gunaki AS. Agricultural mechanization in India. Int J Creative Res Thoughts. 2020;8(5):2594-2605.
22. Parthiban KT, Fernandaz CC, Sudhagar RJ, Sekar I, Kanna SU, Rajendran P. Industrial agroforestry—a sustainable value chain innovation through a consortium approach. Sustainability. 2021;13:7126.
23. Savithri G, Sujathamma P. Scenario of Indian sericulture industry. Int J Res Econ Soc Sci. 2016;6:113-119.
24. Savithri G, Sujathamma P, Neeraja P. Indian sericulture industry for sustainable rural economy. Int J Econ Commerce Res. 2013;3(2):73-78.
25. Srinivas B, Kumari K, Goverdhan H, Niranjan N, Hariprasad SA, Sunil MP. IoT based automated sericulture system. Int J Recent Technol Eng. 2019;8(2).
26. Suraksha Chanotra, Kamlesh Bali. Importance of mechanization in sericulture industry. J Pharmacogn Phytochem. 2019;8(6):912-914.
27. Tanvi Singh, Nigam A, Kapila R. Innovations in silkworm rearing and importance: Recent advances. J Textile Assoc. 2021;8(2):87-90.
28. Tripathi S, Gurjar CP. Impact study of sericulture and production of kosa silk on the economic map of Chhattisgarh: A comprehensive literature survey. Indian J Manag Sci. 2016;6(1):22.
29. Verma S. Modernisation through mechanization in sericulture. Indian Silk. 2011;49:32-35.