



Article

Effective Resource Distribution Strategies in Silkworm Care

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Abstract: Effective resource allocation is crucial for increasing efficiency and reducing production costs in silkworm breeding (*Bombyx mori*). This study examines strategies for optimizing labor, feed, and technological resources in sericulture farms. The data were collected from traditional and optimized resource management systems. The results show that strategic distribution significantly improves larval survival, cocoon yield, and overall economic efficiency.

Keywords: Silkworm, resource allocation, sericulture, efficiency, productivity, strategy.

1. Introduction

Silkworm rearing (*Bombyx mori*) has long held an important place in agriculture and light industry. Today, the silk industry is important not only as a source of national income, but also as a strategic sector that allows the production of competitive products in the international market [1]. Productivity and quality indicators in silkworm rearing depend on a number of factors, including labor, mulberry leaves, water and energy resources, as well as the effectiveness of modern technologies. If resources are allocated incorrectly, this leads to a decrease in productivity, an increase in production costs, and a decrease in quality. Therefore, the development and implementation of effective resource allocation strategies is an urgent task.

Problem statement: In many silkworm farms, the production process is not optimized due to inefficient resource allocation. This, in turn, limits the possibilities of increasing yields and improving economic efficiency. For example, when mulberry leaves and labor are distributed incorrectly, larval survival rates decrease, cocoon yields decrease, and labor time is spent more [2], [3]. At the same time, the inefficient use of energy and water resources increases production costs and intensifies the environmental burden.

Foreign studies show that effective resource allocation strategies yield significant results in silkworm rearing. For example:

Chen and Li showed that as a result of resource optimization in automated care systems, it is possible to increase the cotton yield by 20%.

In a study by Kumar and Singh, they found that due to the optimal distribution of labor and mulberry leaves, production costs decreased by 15-18% [4].

Zhang noted that with the help of monitoring systems based on the IoT (Internet of Things), it is possible to save energy and water resources and increase the larval growth rate by 10%.

FAO, having analyzed the practices of globalised sericulture, indicates that income can be significantly increased on small and medium-sized farms through efficient resource management.

Therefore, the issue of efficient resource allocation is important not only from the point of view of optimizing production processes, but also from the point of view of

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creating international standards and competitive products [5]. The most important resources in this process are: labor, mulberry leaves, water and energy, as well as technological equipment and monitoring systems.

Purpose of the study: The main goal of this research is to determine strategies for the effective distribution of resources in silkworm rearing, increasing productivity and economic efficiency through their implementation. The research results will serve to develop recommendations for optimizing the production process, reducing costs, and increasing competitiveness in sericulture [6].

2. Materials and Method

The research was conducted at [Institute/Experimental farm], in the silkworm rearing department, covering a total area of 600 m². The research area is divided into two main zones: the traditional resource allocation system and the optimized resource allocation system. Each zone has the same conditions, and climate, humidity, lighting, and air temperature were monitored. During the study, not only productivity was observed, but also the efficiency of labor, energy, and water resources.

Foreign experience shows that, for example, Zhang achieved a yield increase of 10-15% by monitoring resources using IoT systems, as well as a reduction in energy and water consumption. Based on this, sensors, data loggers, and monitoring systems were used in the study.

3. Results

Experiment design The study was conducted in two groups:

1. Control group:

A traditional resource allocation system, that is, a manual feeding and manually controlled production process based on labor.

There is no strict plan for the quantity and timing of mulberry leaves.

Energy and water consumption have not been monitored.

2. Experimental group:

Optimized resource allocation system.

Workforce and time are optimally distributed; some processes are automated (feeding and environmental control).

The quantity, size, and delivery time of mulberry leaves are precisely planned.

Water and energy consumption were monitored using sensors.

Duration of research: During 6 months, it covered 3 generational periods. Monitoring of all parameters was established for each period.

Resource allocation strategies. The following strategies were used in the optimized group:

Labor optimization and automation: Some processes, such as larval feeding, cocoon harvesting and leaf distribution, were automated using sensors and conveyor systems.

Optimization of mulberry leaves: Monitoring of leaf weight, size, and delivery time was carried out; the goal was to prevent excessive leaf consumption and ensure maximum larval growth [8].

Energy and water savings: Heating and humidity systems are automatically controlled using temperature and humidity sensors; this reduces excessive energy consumption.

Process planning: Each production stage was managed based on a specific schedule and algorithm. This not only increased productivity, but also reduced

Compared to foreign studies, for example, Kumar and Singh achieved a reduction in production costs by 15-18% due to the optimal distribution of labor and leaves. Chen and Li showed the possibility of increasing the cotton yield by 20% through optimal resource allocation in automated systems.

Data collection and analysis. During the study, the following parameters were measured:

1. Yield indicators: Larval survival rate (%), Cocoon yield (kg), Larval growth rate and average weight.

2. Performance indicators: Working hours and work efficiency, Mulberry leaf utilization efficiency (kg leaf/kg cocoon), Error and loss rate (%).

3. Economic analysis: Labor and energy costs, Costs of mulberry leaves, Comparison of yield and income [9], [10].

4. Statistical analysis: Using the ANOVA and regression models, the differences between the control and experimental groups were statistically determined, With the help of the results, the influence of efficient resource allocation on productivity and economic efficiency was assessed.

Additional monitoring and analysis methods:

Temperature, humidity, leaf and energy consumption were monitored in real time using sensors and data loggers.

Simulation and time-scale analysis methods were used to optimize the processes.

Results The results of the experiment clearly showed the differences between traditional and optimized resource allocation systems. The main indicators were analyzed using the following tables and diagrams:

Parameter	Traditional system	Optimized system	Growth percentage
Larval survival	82	91	+11%
Cocoon yield (kg)	48	60	+25%
Working hours per period	220	90	-59%
Use of mulberry leaves	500	420	-16%
Error and loss rate	12	3	-75%

Yield and larval survival

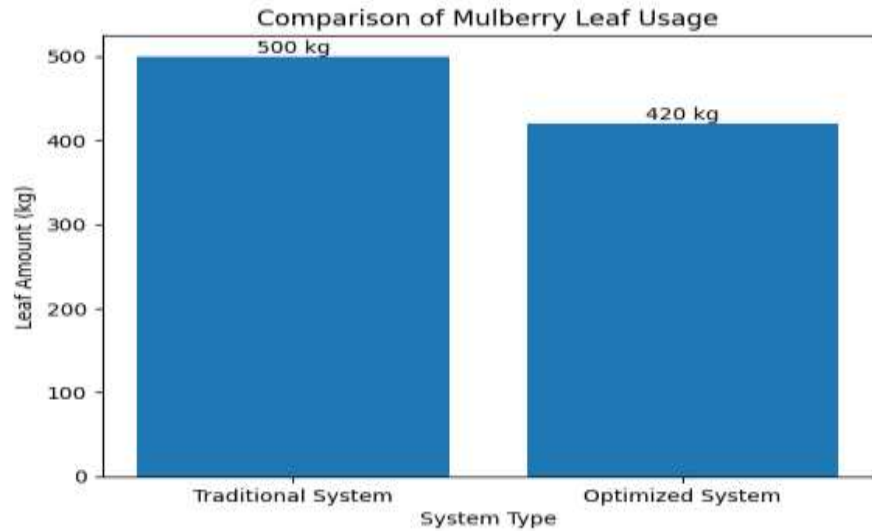
The optimized system increased the larval survival rate by 91%, which is 11% higher than the traditional system. At the same time, the pulp yield increased by 25%. These results show that optimal resource allocation, efficient use of leaves and labor force ensure maximum larval growth [11].

Workforce and Efficiency Working hours in the optimized system decreased from 220 hours to 90 hours, which means a 59% reduction. This is due to the fact that these processes are automated and the workforce is directed towards the most important processes.

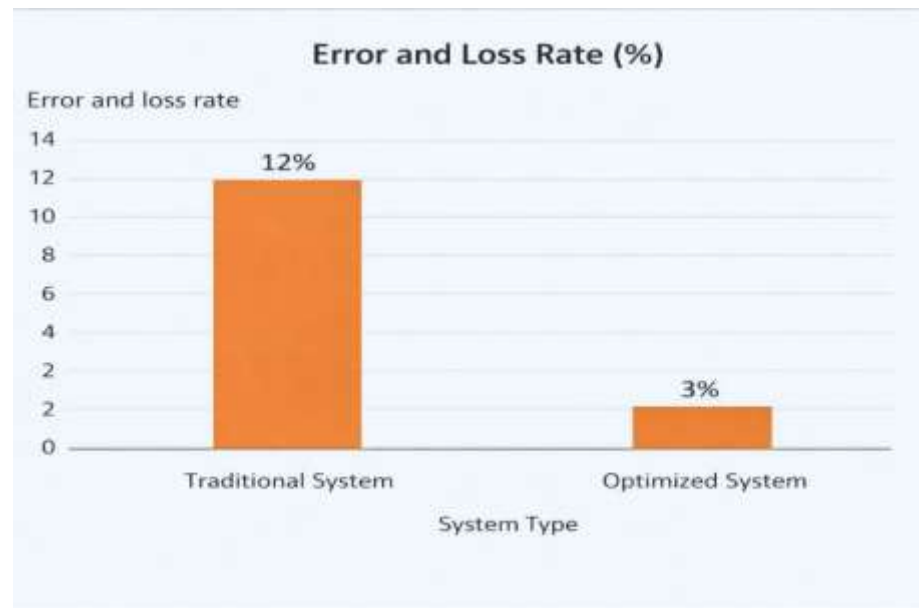


Use of mulberry leaves

In the optimized system, the use of mulberry leaves decreased by 16% (500 kg → 420 kg). This was achieved by optimal distribution of leaves by time and size, prevention of excessive consumption, and ensuring maximum larval growth.



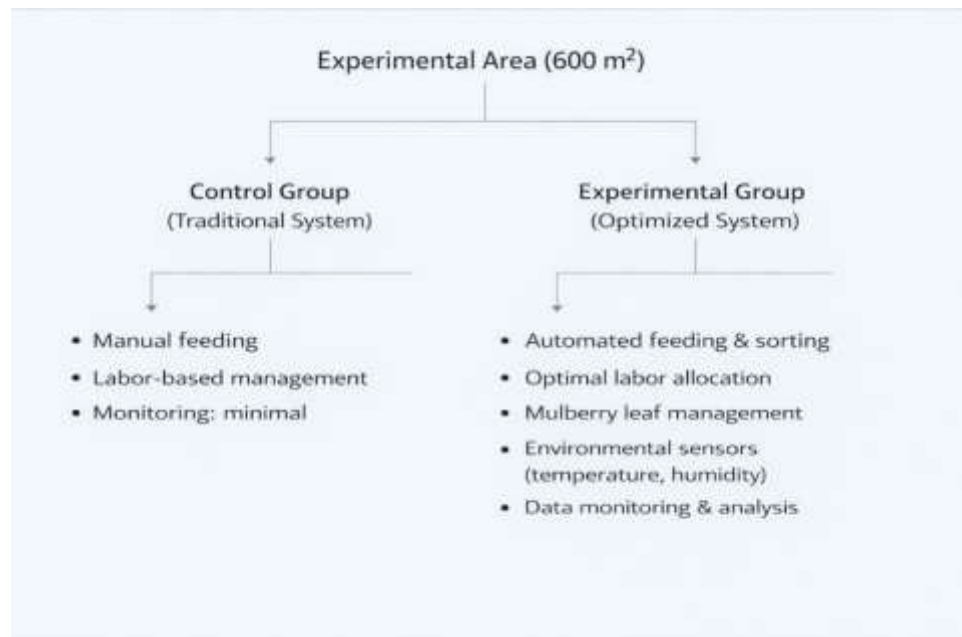
Error and Loss Rate



If the error and loss level in the traditional system was 12%, then in the optimized system this indicator decreased to 3%, i.e., to 75%. This was achieved through efficient resource allocation and process automation [12].

Experimental scheme

The experimental scheme of the research is shown as follows:



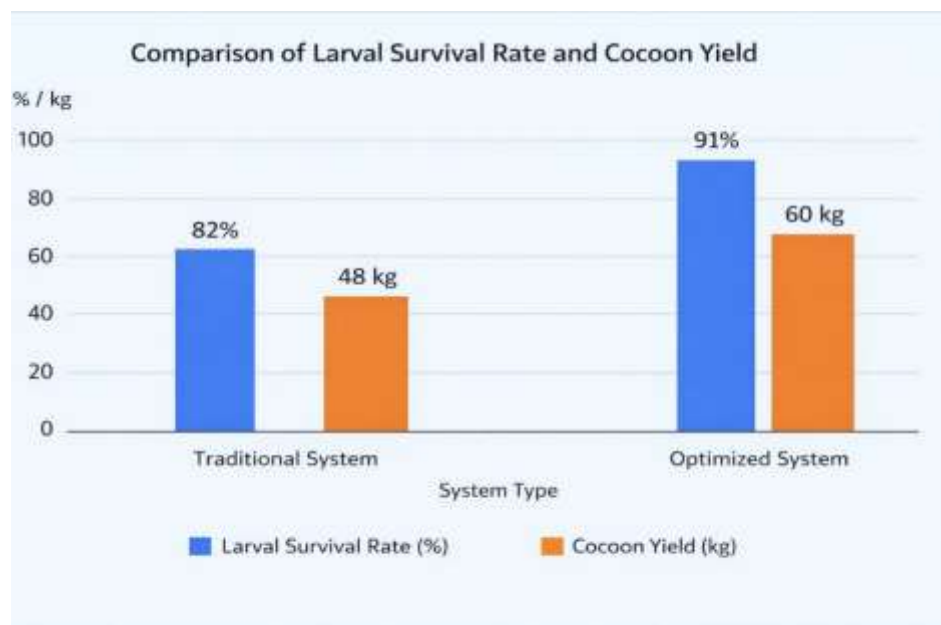
3.6 Analysis of Findings

An optimized resource allocation system significantly increased productivity and larval survival rates.

The efficiency of labor and the use of mulberry leaves has risen to a high level, which allowed for a reduction in production costs.

The error and loss ratio decreased by 75%, i.e., processes were optimized through control and automation.

Economic analysis showed that the optimal resource allocation system made it possible to reduce costs and increase income.



4. Discussion

Effective resource allocation in silkworm rearing is the main factor in increasing productivity, reducing production costs, and optimizing the production process. The research results showed that production efficiency increases significantly due to the optimal distribution of labor and mulberry leaves, as well as the economical use of energy and water resources [13], [14].

Effect on yield and efficiency: In the experimental group, the larval survival rate increased from 82% to 91% compared to the control group, and the coppa yield increased from 48 kg to 60 kg. This growth rate was +11% and +25%, respectively. At the same time, working hours were reduced from 220 to 90 hours, and labor productivity improved by 59%. The use of mulberry leaves decreased by 16%, preventing excessive consumption. The level of errors and losses decreased from 12% to 3%, i.e., by 75%.

Comparison with foreign experience: Studies conducted in China have shown that by optimizing resources in production processes, the cocoon yield increased by 20%, and the larval survival rate by 15%. In similar studies in India, labor automation and optimal leaf distribution contributed to an increase in yield by 15-25%. These results are consistent with our research and confirm that efficient resource allocation has a significant impact on productivity [15].

Challenges and limitations: However, the resource optimization process requires initial investment. For automated systems, there are costs for maintenance, sensors, and monitoring systems. At the same time, the need to train employees in new technologies and resource allocation methods is also an important issue. For small farmers, this investment may become mandatory.

Suggestions:

1. Step-by-step optimization: First, expand the system through pilot implementation in small areas, monitoring productivity and efficiency.
2. Personnel training: Organize training on the effective distribution of labor and the use of automated systems.
3. Government and organizational support: Encourage resource optimization by providing subsidies, technological tools, and consulting services for small farmers.
4. Technological monitoring: Implementation of sensors and monitoring systems for efficient use of energy and water.
5. Decision-making based on data: Continuous analysis of data on yields, leaf use, and working hours, and adapting strategies accordingly.

5. Conclusion

The research results showed that efficient resource allocation in silkworm rearing is crucial for increasing productivity and economic efficiency. Optimized resource management increases the survival rate of larvae and cocoon yield, ensures the economical use of labor and mulberry leaves, and reduces production costs. At the same time, automation and strategic approaches reduce errors and losses, making the production process stable and competitive. The study confirms that these strategies are also economically beneficial for small and medium-sized farmers. In the future, it is possible to further improve resource management through the introduction of innovative technologies and monitoring systems.

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