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Utilization of Sericulture Waste: A Sustainable Waste-To-Wealth Approach in The Rohilkhand Region Uttar Pradesh, India

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Abstract- Sericulture is an important agro-based rural industry supporting livelihood and rural employment in India. In the Rohilkhand region of Uttar Pradesh, particularly in Pilibhit district (Puranpur, Bisalpur, Barkhera and nearby rearing clusters), mulberry cultivation and silkworm rearing have expanded in recent years. Along with silk production, considerable quantities of by-products such as silkworm litter, frass, defective cocoons, pupae, and reeling residues are generated during the rearing and processing stages. Traditionally these materials are treated as waste, resulting in loss of valuable resources. The present study evaluates the potential of sericulture waste utilization through a waste-to-wealth and zero-waste sericulture approach in the Rohilkhand region up to 2025. The study highlights how rearing waste and reeling residues can be converted into value-added products such as organic manure, livestock feed, and bio-products. The findings indicate that efficient utilization of sericulture by-products can increase farm income by 30–40% while reducing environmental impact in the Ramganga basin. Proper management of sericulture waste can therefore support sustainable sericulture development and strengthen rural livelihoods in Pilibhit and the Rohilkhand region.

Keywords- Sericulture waste, waste-to-wealth, silkworm rearing, Pilibhit, Rohilkhand region, sustainable sericulture Zero-Waste Sericulture, Silkworm Excreta.

I. Introduction

Sericulture, the rearing of silkworms for silk production, is an important agro-based rural activity that contributes significantly to employment generation and rural economic development in India. In 2016, the Central Silk Board (CSB) redefined sericulture as a "bio-resource industry", emphasizing the utilization not only of silk fiber but also of the biological by-products generated during production. Following this policy shift, sericulture development programs expanded across the Rohilkhand region of Uttar Pradesh, particularly in the districts of Pilibhit, Bareilly, Shahjahanpur, and Rampur, where agro-climatic conditions are suitable for mulberry cultivation and silkworm rearing.

By 2025, sericulture activities in Pilibhit district have expanded in areas such as Puranpur, Bisalpur, Barkhera, Amariya, Marori, and nearby rural clusters, where farmers practice mulberry cultivation and silkworm rearing with support from government development programs. Along with silk production, considerable quantities of by-products and residues are generated during mulberry cultivation, silkworm rearing, cocoon production, and silk reeling. These include mulberry plant

residues, silkworm litter, uneaten leaves, silkworm excreta (frass), dead larvae, defective cocoons, pupae, rearing bed refuse, and reeling residues.

Traditionally, many of these materials have been treated as waste. In most rearing villages of Pilibhit, farmers manage these residues through traditional practices such as composting, direct application in agricultural fields as organic manure, or simple disposal near farms. In some cases, silkworm pupae and defective cocoons are used as poultry or livestock feed, while mulberry residues are incorporated into compost pits. However, a large proportion of these biological resources still remains underutilized, resulting in the loss of valuable biomass and possible environmental concerns in the Ramganga river basin of the Rohilkhand region.

In recent years, the concept of "waste-to-wealth" and zero-waste sericulture has gained importance in sustainable agriculture. Sericulture waste contains valuable nutrients, proteins, and bioactive compounds that can be converted into organic fertilizers, vermicompost, livestock feed, handicraft materials, and industrial bio-products such as sericin and fibroin used in biomedical and cosmetic industries.
Therefore, the present study examines the status and potential utilization of sericulture waste in the Rohilkhand region, with special reference to the rearing areas of Pilibhit district up to 2025, and evaluates how improved waste management and value-addition practices can enhance farm income, reduce environmental waste, and promote sustainable rural development.

II. Objectives of the Study

The major objectives of the study are:

1. To identify the different types of waste generated during sericulture activities in the Rohilkhand region.
2. To examine the potential utilization of sericulture by-products for value-added applications.
3. To analyze the economic and environmental benefits of sericulture waste utilization.
4. To suggest strategies for promoting sustainable waste management in sericulture systems of Pilibhit and the Rohilkhand region.

III. Materials and Methodology

Study Area

The present study was conducted in the Rohilkhand region of Uttar Pradesh, particularly focusing on the districts of Pilibhit, Bareilly, and Shahjahanpur, where sericulture activities have expanded significantly after the policy shift of the Central Silk Board. Among these districts, Pilibhit serves as a major cluster for mulberry cultivation and silkworm rearing, while Bareilly functions as a regional hub for silk reeling, weaving, and processing, and Shahjahanpur acts as a secondary cluster for cocoon collection and by-product handling.

Within Pilibhit district, important rearing locations included Puranpur, Bisalpur, Barkhera, Amariya, Marori, and nearby villages, where farmers actively practice

silkworm rearing. These areas generate substantial quantities of sericulture residues such as rearing litter, silkworm excreta, and mulberry plant waste.

Research Design

The research followed a field-based observational and analytical design carried out during 2024–2025. The study aimed to document the types of sericulture waste generated at different production stages and to evaluate their present utilization and potential value-added applications under the waste-to-wealth framework.

Sampling Procedure

A purposive sampling method was adopted to select villages with active sericulture practices. Approximately 40–50 sericulture farmers engaged in mulberry cultivation and silkworm rearing were selected from different rearing clusters of Pilibhit district. In addition, information was collected from reeling units and cocoon traders in Bareilly and Shahjahanpur to understand the generation and handling of post-reeling residues.

Data Collection

Both primary and secondary data were used in the study.

Primary data were obtained through:Field surveys of mulberry plantations and silkworm rearing houses,Direct observation of waste generation and disposal practices,Structured questionnaires and interviews with sericulture farmers,Discussions with extension workers and sericulture department officials.

Secondary data were collected from:,Reports and publications of the Central Silk Board (CSB),Government sericulture development reports,Scientific literature related to sericulture waste utilization.

Identification and Classification of Sericulture Waste

Field observations helped identify major categories of sericulture waste generated during different production stages:

- **Mulberry cultivation waste:** pruned branches, stems, bark, and surplus leaves.
- **Silkworm rearing waste:** silkworm litter (frass), leftover mulberry leaves, molted larval skins, and dead larvae.
- **Cocoon processing waste:** defective cocoons, double cocoons, silk floss, and reeling residues.
- **Protein by-products**: sericin and fibroin generated during silk processing.

Waste Processing and Utilization Methods

Based on field observations and available protocols, several potential value-added utilization methods were identified:

- **Silkworm excreta (frass):** processed for organic compost and extraction of chlorophyll-rich compounds useful in agriculture and pharmaceutical sectors.
- **Rearing bed refuse and litter:** converted into high-quality organic manure through composting and vermicomposting.
- **Discarded pupae:** dried and processed to obtain pupal oil and protein meal for poultry and aquaculture feed.

- **Defective cocoons and silk floss:** utilized for spun silk production and extraction of fibroin for textile and biomedical applications.
- **Degumming effluent:** treated to recover sericin protein for cosmetic and skincare formulations.

Data Analysis

The collected data were analyzed using descriptive statistical techniques and qualitative assessment. Waste generation patterns, current utilization practices, and potential economic benefits were evaluated to determine the feasibility of a zero-waste sericulture system in the Rohilkhand region.

IV. Results and Discussion

Types and Quantity of Sericulture Waste

The field survey revealed that large quantities of waste are generated during sericulture activities in the Rohilkhand region. Among these, silkworm litter and mulberry residues constitute the largest share of organic waste produced during rearing operations. Cocoon processing units generate additional residues such as defective cocoons, pupae, and reeling waste. Waste quantity depend upon DFL rearing,Mulberry feeding quantity,Larval survival rate,Rearing managementCocoon processing method

Table: Assessment of Sericulture Waste Management for Zero-Waste Potential in Rohilkhand Region

S. No.	Type of Sericulture Waste	Average Quantity (per 100 DFL)	Current Utilization Practice	Potential Value-Added Use	Economic Benefit Potential
1	Silkworm litter	70 kg	Mostly discarded or partially used as manure	Vermicompost, organic fertilizer	Medium
2	Mulberry leaf residues	50 kg	Composting in farms	Bio-compost, biogas production	Medium
3	Silkworm larvae (dead/diseased)	12 kg	Usually discarded	Poultry or fish feed after processing	Medium
4	Defective cocoons	28 kg	Sold locally at low price	Spun silk production, handicrafts	High
5	Silkworm pupae	22 kg	Limited use as poultry feed	Protein-rich feed, oil extraction	High
6	Reeling waste (floss, pierced cocoons)	12 kg	Partially reused	Spun silk yarn, textile products	High
7	Bed cleaning residues	6 kg	Farm compost	Organic manure	Low

Current Waste Management Practices

Observations from the study areas indicated that most farmers currently manage sericulture waste through traditional methods, such as composting or direct

application in agricultural fields. Silkworm litter and mulberry residues are often used as organic manure, while some farmers utilize pupae and defective cocoons as poultry or livestock feed. However, systematic value-added utilization of these by-products is still limited. Approximate proportion of waste generated in sericulture farms:Silkworm litter (Frass) – 40%,Mulberry residues – 25%,Defective cocoons – 15% ,Pupae – 10%,Processing residues – 10%

Table 3.1: Types and Estimated Quantity of Sericulture Waste per 100 DFL in Pilibhit District

S. No.	Type of Sericulture Waste	Source/Stage	Estimated Quantity (kg per 100 DFL)	Percentage Share (%)
1	Silkworm litter (excreta + leftover mulberry leaves)	Silkworm rearing	70	35
2	Mulberry leaf residues	Feeding stage	50	25
3	Silkworm larvae waste (dead/diseased)	Rearing stage	12	**6
4	Defective cocoons	Cocoon sorting	28	14
5	Silkworm pupae waste	Reeling and processing	22	11
6	Reeling waste (floss, pierced cocoons)	Silk reeling	12	6
7	Bed cleaning residues	Bed maintenance	6	3
Total	—	—	200 kg per 100 DFL	100%

Source: Field Survey, Pilibhit District (Rohilkhand Region)

Waste-to-Wealth Potential

The study highlights significant opportunities for converting sericulture residues into valuable resources. Silkworm frass can be processed into nutrient-rich organic fertilizer, while discarded pupae can serve as a high-protein feed ingredient. Silk processing by-products such as sericin and fibroin have potential applications in cosmetics, pharmaceuticals, and biomedical engineering.

Economic and Environmental Benefits

Adopting integrated waste management strategies can increase the overall economic return of sericulture farms by 30–40%, while simultaneously reducing environmental pollution caused by unmanaged organic waste. The recovery and reuse of biological by-products also support circular economy practices and improve resource efficiency in rural production systems.

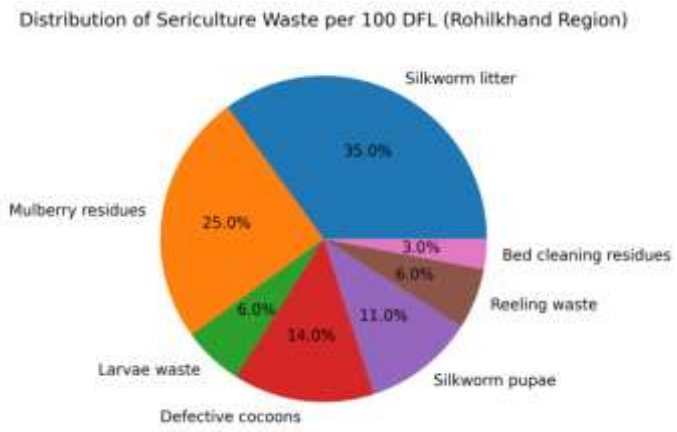

Figure: Distribution of Sericulture Waste Generated per 100 DFL in the Rohilkhand Region

Implications for Sustainable Sericulture

The findings suggest that improved awareness, training, and infrastructure support are essential to promote the complete utilization of sericulture waste in the Rohilkhand region. By adopting the waste-to-wealth approach, farmers can enhance income generation, reduce waste disposal problems, and contribute to sustainable rural development.

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V. Conclusion

The present study demonstrates that sericulture activities in the Rohilkhand region, particularly in Pilibhit district, generate substantial quantities of biological by products during mulberry cultivation, silkworm rearing and cocoon processing. Field observations from major rearing clusters such as Puranpur, Bisalpur, Barkhera, Amariya and Marori revealed that silkworm litter (frass), mulberry leaf residues, defective cocoons, pupae and reeling waste constitute the major components of sericulture waste.

Although farmers currently utilize a portion of these residues through traditional practices such as composting or use as livestock feed, a large share of the biomass remains underutilized. The findings of this study highlight that these materials possess significant potential for value addition under a waste to wealth framework. Silkworm frass and rearing litter can be converted into nutrient rich organic manure and vermicompost; pupae can be processed as protein rich poultry and aquaculture feed;

defective cocoons and reeling waste can be utilized in spun silk and handicraft production; while sericin and fibroin proteins derived from silk processing have promising applications in cosmetic, pharmaceutical and biomedical industries.

The adoption of integrated waste management strategies in sericulture can contribute to improved resource efficiency, environmental sustainability and rural income generation. Proper utilization of sericulture by products may enhance the overall profitability of sericulture farms by approximately 30–40% while reducing organic waste accumulation in the Ramganga basin of the Rohilkhand region.
Therefore, promoting awareness among farmers, strengthening extension services, and encouraging small scale value addition units for sericulture by products are essential for developing a sustainable and zero waste sericulture system in Pilibhit and the wider Rohilkhand region.

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