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Tree Mulberry-Based Organic Integrated Farming System: A Sustainable Sericulture Model from Madderi Village, Kolar District of Karnataka

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Abstract
Integrated Farming Systems (IFS) are increasingly recognised as sustainable production models that enhance resource-use efficiency, promote nutrient recycling, diversify farm income and strengthen ecological resilience. The present communication documents a tree mulberry (*Morus* spp.) based organic integrated farming system wherein sericulture serves as the principal enterprise integrated with cattle, sheep and poultry rearing, fodder cultivation, rainwater harvesting and on-farm bio-waste recycling. The system establishes a circular resource flow wherein organic residues generated from different farm components are utilised for the preparation of Jeevamrutha and biogas generation.
Tree mulberry cultivation offers several advantages over conventional bush mulberry systems, including improved drought tolerance, perennial biomass production, better light interception and suitability for integration with allied enterprises. Livestock wastes, silkworm litter and crop residues generated within the farm are recycled into organic nutrient sources, thereby reducing dependence on external inputs and improving soil fertility. Rainwater harvesting and biogas production further contribute towards sustainability and resource conservation. The model demonstrates the potential of integrated sericulture systems in enhancing livelihood security, environmental sustainability and low-input silk production under semi-arid conditions.

Keywords: Tree mulberry, Sericulture, Integrated Farming System, Jeevamrutha, Biogas, Organic farming, Resource recycling

Introduction
Sericulture is an important agro-based rural industry that combines the cultivation of mulberry (*Morus* spp.) and the rearing of silkworms (*Bombyx mori* L.) for silk production. Owing to its labour-intensive nature, low capital requirement and capacity to generate regular income throughout the year, sericulture provides livelihood opportunities to millions of rural households in India. Besides its economic significance, sericulture is recognised as an environmentally sustainable enterprise due to its compatibility with organic production systems, efficient utilisation of family labour and potential for integration with livestock and other farm-based activities (Rohela *et al.*, 2020) [1]. The sustainability of sericulture, however, depends largely on the efficient management of natural resources, maintenance of soil fertility and reduction of production costs through effective recycling of farm residues. Mulberry forms the foundation of sericulture and contributes substantially to the productivity and profitability of silk production. In recent years, tree mulberry cultivation has emerged as a promising alternative to conventional bush mulberry systems, particularly under rainfed and water-limited conditions. Tree mulberry exhibits a deep root system, greater drought tolerance, improved soil binding capacity and sustained biomass production, making it suitable for long-term cultivation in diverse agro-climatic regions. Furthermore, the perennial nature of tree mulberry facilitates the integration of allied enterprises such as livestock rearing, fodder cultivation and horticultural crops, thereby creating opportunities for enhanced resource utilisation and diversified income generation. The concept of Integrated Farming Systems (IFS) has gained considerable attention as a means of improving the sustainability and resilience of sericulture-based livelihoods. In an integrated system, the outputs and by-products of one enterprise serve as valuable inputs for another, creating a self-sustaining cycle of resource utilisation.

Sericulture is particularly suited to such integration because mulberry cultivation generates substantial biomass while silkworm rearing produces organic residues including bed refuse, litter and pupal waste. These materials can be effectively recycled within the farm ecosystem, thereby reducing dependence on external inputs and enhancing overall productivity (Rajadurai and Veeraiah, 2025) [3].

Integration of livestock enterprises such as cattle, sheep and poultry with sericulture offers multiple ecological and economic benefits. Livestock provide milk, meat and eggs as additional sources of income while simultaneously generating dung, urine and litter that can be recycled into organic nutrient sources. The incorporation of fodder crops within and around mulberry plantations further strengthens the linkage between sericulture and livestock enterprises by ensuring a sustainable supply of feed resources throughout the year. By integrating sericulture, livestock, poultry, fisheries and other allied enterprises, IFS promotes nutrient recycling, energy conservation and efficient utilisation of available resources. Several studies have reported that diversified farming systems can enhance economic returns while simultaneously improving soil health, biodiversity and ecosystem services (Behera, 2019; Walia and Kaur, 2013) [2, 4]. Organic nutrient management has become increasingly important in sericulture due to growing concerns regarding soil degradation and the excessive use of chemical inputs. Among various organic formulations, Jeevamrutha has gained prominence as a microbial inoculant capable of stimulating beneficial soil microorganisms and improving nutrient availability. Prepared using cow dung, cow urine, jaggery, pulse flour and soil, Jeevamrutha represents an important component of natural farming systems. The availability of livestock resources within an integrated sericulture farm facilitates the regular preparation and application of Jeevamrutha, thereby promoting soil health and sustainable mulberry production. Resource recycling constitutes a central feature of integrated sericulture systems. Livestock wastes, silkworm litter, crop residues and other biodegradable materials generated within the farm can be converted into valuable inputs through biological processes. In addition to Jeevamrutha production, cattle dung and other organic wastes can be utilised for biogas generation, providing a renewable source of energy for household cooking and reducing dependence on conventional fuels. The slurry obtained from biogas plants serves as a nutrient-rich organic manure that can be applied to mulberry, fodder and horticultural crops, thereby strengthening nutrient recycling within the system.

Water availability is another critical factor influencing the productivity of mulberry and the sustainability of sericulture. Increasing climatic variability and erratic rainfall patterns necessitate the adoption of efficient water management strategies. Rainwater harvesting structures such as farm ponds and storage tanks enhance water availability during dry periods and improve the resilience of mulberry-based systems. When integrated with organic nutrient management and livestock enterprises, rainwater harvesting contributes significantly to the long-term sustainability of sericulture-based livelihoods. Although individual components such as sericulture, livestock rearing, organic nutrient management and rainwater harvesting have been extensively studied, scientific documentation of a tree mulberry-centred organic integrated farming system that combines sericulture, cattle, sheep and poultry rearing, fodder cultivation, Jeevamrutha production, biogas generation and water harvesting remains limited. Such systems represent practical examples of circular resource utilisation wherein nutrients and energy are continuously recycled within the farm. Therefore, the present study examines a tree mulberry-based organic integrated farming system with sericulture as the principal enterprise and evaluates its contribution towards resource recycling, environmental sustainability, livelihood diversification and resilient silk production.

Farm Profile and Integrated Farming Practices

Shri Murali, a progressive sericulturist from Madderi Village of Kolar Taluk and District, Karnataka, has developed an innovative tree mulberry based organic integrated farming system under semi-arid conditions characterised by moderate rainfall and seasonal water scarcity. Sericulture forms the principal enterprise of the farming system and is effectively integrated with cattle rearing, sheep rearing, poultry production, fodder cultivation, rainwater harvesting and systematic bio-waste recycling.

The farmer maintained two acres of tree mulberry plantation established with the high-yielding V-1 mulberry variety following a spacing of 10 ft × 10 ft under a tree mulberry cultivation system. The mulberry plants were trained to attain a trunk height of approximately 4 ft (1.2 m) before branching. Exactly five primary branches were retained on each trunk and trained horizontally to the ground to facilitate efficient canopy development and shoot proliferation. Each primary branch was further maintained with five shoot-bearing fists, resulting in a canopy structure wherein a single tree mulberry plant corresponded approximately to twenty-five bushes under conventional bush mulberry cultivation in terms of shoot-bearing potential. Shri. Murali has been exclusively practising bivoltine sericulture for over a decade, reflecting his unwavering commitment to the production of superior quality silk and adoption of scientific sericulture practices. His two acre tree mulberry plantation, established nearly ten years ago, has been meticulously managed to ensure a continuous supply of high quality mulberry foliage throughout the year. The plantation is strategically divided into batches to synchronize leaf production with silkworm rearing schedules, enabling uninterrupted rearing operations and optimal utilisation of available resources. Through systematic planning and efficient crop management, the farmer successfully rears approximately ten bivoltine silkworm crops annually, with each crop comprising around 200 Disease Free Layings (DFLs). Remarkably, he consistently records average cocoon yields of 80–90 kg per 100 DFLs, demonstrating the productive potential of tree mulberry-based organic sericulture under field conditions. The sustained realisation of such productivity over the years is a testament to the effectiveness of the tree mulberry architecture, judicious resource recycling, organic nutrient management and scientific rearing practices adopted on the farm.

Fig 1: Organic tree-mulberry garden

Fig 2: Pruned tree mulberry field – canopy architecture

The wider spacing under the tree mulberry system improved light interception, aeration and accessibility while simultaneously facilitating integration with livestock and other farm activities. Organic management practices were followed throughout the plantation and nutrient requirements were largely met through Jeevamrutha, farmyard manure and recycled organic residues generated within the farm. Mulberry leaves harvested from the plantation were utilised for silkworm rearing throughout the year. Livestock components, including cattle, sheep and poultry generated additional income while simultaneously supplying dung, urine and litter for nutrient recycling. Fodder crops cultivated within the farm ensured year-round feed availability for livestock. Rainwater harvesting structures were developed to capture and store runoff water for utilisation during dry periods. Organic residues generated from mulberry pruning, silkworm litter, livestock wastes and crop residues were systematically recycled within the farming system. A portion of cattle dung and urine was utilised for the preparation of Jeevamrutha, while the remaining biodegradable wastes were used for biogas production. The biogas generated was used for household cooking purposes and the slurry obtained from the biogas unit was applied to mulberry and other crops as organic manure.

Fig 3: Jeevamrutha Preparation Unit

As one of the pioneering adopters of tree mulberry cultivation and integrated sericulture in the region, Shri. Murali has established himself as a progressive farmer and an important source of inspiration for fellow sericulturists. His farm is no less a practical demonstration unit, showcasing how innovative farm design, ecological resource management and technology adoption can work together to support sustainable and profitable bivoltine silk production. The farming model demonstrated an effective example of circular resource utilisation wherein the outputs and wastes of one enterprise served as inputs for another enterprise. The integration of sericulture with livestock, organic nutrient management, rainwater harvesting and renewable energy generation significantly contributed towards reduction in external input dependence, improvement in soil fertility and enhancement of livelihood sustainability under semi-arid conditions.

Integrated Resource Recycling Model

A major strength of the integrated farming system is its efficient integration and recycling of resources among various farm enterprises. The model functions on the principle that the output or waste generated from one component serves as a valuable input for another component within the farm ecosystem. Mulberry leaves harvested from the tree mulberry plantation are utilised for silkworm rearing, while the organic residues generated during silkworm rearing such as bed refuse and litter, are recycled back into the farming system. Livestock enterprises including cattle, sheep and poultry contribute dung, urine and litter, which are effectively utilised for the preparation of Jeevamrutha, compost and biogas generation. The slurry obtained from the biogas unit is further applied to mulberry and fodder crops as an organic nutrient source, thereby improving soil fertility and reducing dependence on external fertilizers. Fodder cultivated within the farm supports the livestock component, while rainwater harvesting structures ensure water availability during dry periods. Such integration establishes a circular nutrient and energy flow within the farm and significantly contributes towards sustainability, waste minimisation and resource-use efficiency in sericulture-based farming.

Farmer's Perspective

According to the farmer, the integration of livestock and allied enterprises with sericulture has considerably reduced cultivation costs and improved efficient utilisation of farm resources. The farmer observed that organic nutrient recycling through Jeevamrutha and biogas slurry improved soil condition and supported sustained mulberry growth. He believes that the combination of tree mulberry cultivation, organic nutrient management, efficient resource recycling and integrated farming has enabled him to maintain high cocoon yields while ensuring the long-term sustainability and profitability of sericulture. The integrated system also ensured regular income generation through livestock and sericulture activities throughout the year while reducing dependency on external agricultural inputs.

Conclusion

The present farming model represents a successful example of a tree mulberry-based organic integrated sericulture system developed under semi-arid conditions of Karnataka. The integration of sericulture with livestock rearing, fodder cultivation, rainwater harvesting, Jeevamrutha preparation and biogas production established an efficient circular resource utilisation system within the farm. The innovative tree mulberry architecture, combined with systematic nutrient recycling and organic management practices, contributed towards improved sustainability, reduced external input dependency and enhanced livelihood security. The model demonstrates substantial potential for replication among sericulture farmers seeking climate-resilient and low-input production systems.

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