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IMPORTANCE OF AGROFORESTRY IN RELATION WITH TASAR SILKWORM CULTIVATION

Haragopal Dutta, Harendra Yadav and Arnab Roy
CSB-Central Tasar Research and Training Institute, Ranchi, Jharkhand, India
*Corresponding author email: haragopalbckv@gmail.com

ABSTRACT

Tasar silkworm (*Antheraea mylitta*) cultivation holds significant economic and ecological importance in many regions, particularly in India. This study explores the vital relationship between agroforestry practices and the cultivation of Tasar silkworms. Agroforestry, the integrated management of trees and agricultural crops or livestock, offers a sustainable approach to enhance Tasar silkworm cultivation while promoting environmental conservation and socioeconomic development. The symbiotic relationship between agroforestry and Tasar silkworm cultivation is multifaceted. Agroforestry systems provide diverse tree species that serve as host plants for Tasar silkworms, ensuring a continuous and reliable supply of feedstock. Moreover, the presence of trees in agroforestry landscapes enhances microclimatic conditions, moderating temperature, and humidity, which are crucial for silkworm growth and cocoon production. Beyond its agricultural advantages, agroforestry promotes biodiversity conservation by providing habitat and refuge for diverse plant and animal species, including those beneficial to Tasar silkworms.

Keywords: Agroforestry, tasar culture, biodiversity

Introduction

Agroforestry emerges as a pivotal and multifunctional approach in the cultivation of tasar silkworm, demonstrating a range of benefits that extend far beyond sericulture. The symbiotic relationship between agroforestry and tasar silkworm cultivation underscores its indispensable role in fostering sustainable agricultural practices.

Fig. 1: Agroforestry model adopted at CSB-CTRTI, Ranchi.

At its core, agroforestry proves to be an effective strategy for tasar silkworm cultivation by providing a conducive environment for the growth and development of the silkworms. The presence of diverse tree species within agroforestry systems not only offers a suitable habitat for tasar silkworms but also contributes to the overall health of the ecosystem (Udawatta *et al*., 2019). Beyond the specific context of tasar silkworms, agroforestry systems exhibit a remarkable capacity to enhance biodiversity, enrich soil fertility, and contribute significantly to climate change mitigation. The integration of trees and shrubs alongside agricultural crops creates a dynamic and resilient ecosystem that supports a wide array of plant and animal species (Wilson & Lovell, 2016). This biodiversity not only strengthens the overall ecological balance but also promotes natural pest control, reducing the reliance on chemical inputs (Figure 1). The positive impact of agroforestry on soil fertility is notable, as the tree roots help prevent soil erosion, enhance water retention, and facilitate nutrient cycling. The continuous interplay between trees and crops in

agroforestry systems creates a mutually beneficial relationship, fostering a fertile and sustainable soil environment. Moreover, the integration of annual crops within agroforestry systems serves as a catalyst for increased agricultural productivity and, consequently, heightened farmers' income.

Tasar silkworm cultivation in diverse agroforests

The cultivation of tasar silkworm stands at the intersection of agroforestry models and innovative farming practices, exemplified by the pivotal role played by diverse models such as arjun, asan, jarul, and sal. These agroforestry systems not only serve as a conducive habitat for the tasar silkworm but also embody a sustainable and multifaceted approach to sericulture.

Fig. 2 : Annual crops intercropped into the arjun plantation.

Among the varied agroforestry practices, intercropping emerges as a particularly effective strategy in tandem with the cultivation of tasar silkworm. By combining trees like arjun, asan, jarul, and sal with agricultural crops, intercropping optimizes land use, fostering a harmonious coexistence that enhances overall productivity (Figure 2). The shade provided by the tree components helps suppress weed proliferation, creating a natural and sustainable weed control mechanism. This not only contributes to environmental conservation but also aligns with the principles of organic and eco-friendly farming practices.

Population dynamics of tasar silkworms in diverse ecosystems

The population dynamics of tasar silkworms, *Antheraea mylitta*, in diverse ecosystems represent a multifaceted and intricate subject shaped by a confluence of various factors. Among these factors, biodiversity plays a pivotal role in determining the health and sustainability of tasar silkworm populations. Ecosystem stability, influenced by the intricate web of interactions between different species, further contributes to the overall dynamics of tasar silkworm populations (Wang *et al*., 2023).

Fig. 3: Pulse crop, medicinal plants, potato etc. planted as intercrop

Tasar silkworms, being non-domesticated in nature, exhibit a susceptibility to a range of diseases, which significantly influences their population dynamics (Figure 3). Microsporidiosis, virosis, bacteriosis, and mycosis are common afflictions that tasar silkworms may succumb to, especially when residing in the wild and feeding on trees.

Local communities and agroforestry for silk economy

Agroforestry stands as a beacon of sustainable land use, embodying a harmonious integration of trees and shrubs with crops and/or livestock. This holistic approach to agriculture goes beyond traditional farming methods, offering a dynamic and multifaceted system that brings about ecological, economic, and social benefits to local communities (Gargano *et al*., 2021). Studies have shown that agroforestry systems can absorb more labor and increase the income of local communities compared to monoculture patterns, fostering cooperation and a sense of mutual care and belonging between companies and local residents (Puspitawati & Susanto, 2022). Furthermore, agroforestry contributes to environmental conservation by enhancing carbon sequestration, biodiversity conservation, soil enrichment, and air and water quality (Jose, 2009). The adoption of agroforestry practices presents opportunities for addressing climate change challenges and supporting green economy initiatives. By optimizing local agroforestry systems, communities can enhance their economic prospects while contributing to carbon stock enhancement and climate change mitigation efforts (Hendri *et al*., 2023). Moreover, agroforestry systems have been recognized for their potential in supporting food security and improving livelihood options for communities (Figure

4), thereby reducing pressure on existing forests and promoting sustainable land use alternatives (Rahman *et al*., 2017). These systems not only provide economic benefits but also offer environmental services such as watershed protection and biodiversity conservation (Wato & Amare, 2020).

Fig. 4: Role of local communities in agroforestry model adoption.

One of the primary advantages of agroforestry lies in its ability to provide a diverse range of ecosystem services.

Resource utilization in agroforestry for tasar silkworm cultivation

Agroforestry, a sustainable land use system that integrates trees and shrubs with crops and/or livestock, represents a holistic approach to agriculture that delivers a spectrum of environmental, social, and economic benefits.

Fig. 5: Space allocation and utilization in agroforestry model

This innovative system goes beyond traditional farming methods, recognizing the interconnectedness of ecological processes and human well-being (Figure 5). Agroforestry systems have been found to be particularly effective in mitigating the impacts of extreme weather events, ensuring a more reliable and stable food supply.

Agroforestry and pest management in tasar silk

Agroforestry emerges as a pivotal strategy in the realm of pest management, particularly in the context of tasar silk production. The intricate relationship between agroforestry systems and pest dynamics plays a crucial role in determining the success and sustainability of tasar silk cultivation. The use of agroforestry systems has demonstrated a tangible influence on pest densities in agricultural landscapes (Castle *et al*., 2022). Research indicates that more diverse and extensively managed agroforests tend to exhibit lower pest densities (Figure 6). The complex structure of agroforestry, combining various tree species with crops and livestock, creates a heterogeneous environment that disrupts the typical habitat and reproductive patterns of pests (Jiang *et al*., 2022). This disruption, often referred to as habitat diversification, acts as a natural deterrent to pest populations, reducing their overall abundance.

Fig. 6 : Sustainable pest-disease management

In the specific context of tasar silk production, the impact of pests on silk production is a significant concern. Pests can inflict considerable damage to tasar silkworms and their host trees, affecting cocoon quality and quantity. The susceptibility of tasar silkworms to pests poses a direct threat to the economic viability of silk production, as the health and productivity of the silkworms directly influence the quality of the silk fibers. Agroforestry, by creating a more complex and biodiverse environment, contributes to the natural regulation of pest populations (Santos *et al.*, 2022). The presence of diverse plant species provides habitats for natural enemies of pests, such as predators and parasitoids, creating a balance in the ecosystem (Ratnadass *et al.*, 2012). This biological control mechanism is a key aspect of agroforestry systems that aids in minimizing the reliance on chemical pesticides, thereby promoting environmentally sustainable pest management practices.

Socioeconomic aspects of agroforestry-based tasar silkworm farming

Agroforestry-based tasar silkworm farming represents a complex and multifaceted system that intertwines ecological, socioeconomic, and cultural dimensions. This intricate fusion of elements creates a unique agricultural paradigm that demands a comprehensive understanding of the interplay between various factors to ensure its sustainability and success.

Fig. 7: Economically viable agroforestry system

The socioeconomic aspects of agroforestry-based tasar silkworm farming are shaped by a multitude of factors, each exerting its influence on the overall viability of this practice (Mukhlis *et al*., 2022). One of the key determinants is income, as tasar silk production contributes significantly to the livelihoods of communities engaged in this industry (Figure 7). The economic aspects of farming, including income generation and market opportunities, play a pivotal role in determining the success and acceptance of agroforestry-based tasar silkworm farming as a sustainable and economically viable land use strategy (Kassie, 2017).

Market competitiveness of agroforestry-based tasar silk

Agroforestry-based tasar silk production stands at the nexus of tradition and innovation, holding the potential to substantially impact market competitiveness. This unique blend of agricultural and sericultural practices integrates trees, shrubs, and silkworm cultivation, creating a system that not only contributes to ecological sustainability but also plays a pivotal role in shaping the economic dynamics of the tasar silk industry.

Fig. 8: Cocoon harvesting and marketing.

This symbiosis between tradition and technology has far-reaching implications for the growth and benefits of stakeholders in the tasar silk industry. The adoption of advanced practices creates a ripple effect, fostering economic development and improving the livelihoods of those engaged in the sector. As artisans and weavers embrace innovative approaches, the market competitiveness of agroforestry-based tasar silk products is bolstered, opening up new opportunities for trade and economic growth (Figure 8). Moreover, a comprehensive study underscores the critical role of trust in influencing social capital, thereby supporting collective action in the development of agroforestry systems. In the context of tasar silk production, trust among stakeholders–farmers, artisans, weavers, and other community members–becomes a cornerstone for the successful implementation of sustainable traditional agroforestry systems. Trust facilitates collaboration, knowledge-sharing, and collective decision-making, creating a supportive environment for the cultivation of tasar silkworms and the subsequent silk production.

Conclusions

The findings of the study highlight the interconnected nature of social, economic, and environmental factors in agroforestry-based tasar silk production. The synergy between technological innovation, traditional craftsmanship, and social capital is key to unlocking the full potential of this industry. By fostering a climate of trust and collaboration, and by embracing advancements in technology, the tasar

silk sector can not only achieve sustainable growth but also position itself as a competitive player in the broader market landscape. This holistic approach ensures that agroforestry-based tasar silk production becomes a model of economic and environmental sustainability, with positive implications for the well-being of communities involved in this age-old tradition.

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References

Castle, S.E., Miller, D.C., Merten, N., Ordonez, P.J. and Baylis, K. (2022). Evidence for the impacts of agroforestry on ecosystem services and human well-being in high-income countries: a systematic map. *Environmental Evidence*, **11(1)**, 1–27.

Gargano, G., Licciardo, F., Verrascina, M. and Zanetti, B. (2021). The Agroecological Approach as a Model for Multifunctional Agriculture and Farming towards the European Green Deal 2030-Some Evidence from the Italian Experience. *Sustainability 2021,* **13(4)**: 2215.

Hendri, Rahmadaniarti, A. and Mahatmandira, G.A. (2023). Optimization agroforestry to address green economy and climate change in Manokwari Regency, West Papua. *IOP Conference Series: Earth and Environmental Science*, **1192(1)**.

Jiang, S., Xiong, K. and Xiao, J. (2022). Structure and Stability of Agroforestry Ecosystems: Insights into the Improvement of Service Supply Capacity of Agroforestry Ecosystems under the Karst Rocky Desertification Control. *Forests*, **13(6)**, 878.

Jose, S. (2009). Agroforestry for ecosystem services and environmental benefits: an overview. *Agroforestry Systems*, **76(1)**, 1–10.

Kassie, G.W. (2017). Agroforestry and farm income diversification: synergy or trade-off? The case of Ethiopia. *Environmental Systems Research*, **6(1)**, 1–14.

Mukhlis, I., Syamsu Rizaludin, M. and Hidayah, I. (2022). Understanding Socio-Economic and Environmental Impacts of Agroforestry on Rural Communities. *Forests,* **13(4)**, 556.

Puspitawati, I.R. and Susanto, A. (2022). Albizia Forest Management System In The Madiun Distric. *International Journal of Science and Environment (IJSE)*, **2(3)**, 104–108.

Rahman, S.A., Jacobsen, J.B., Healey, J.R., Roshetko, J.M. and Sunderland, T. (2017). Finding alternatives to swidden agriculture: does agroforestry improve livelihood options and reduce pressure on existing forest? *Agroforestry Systems*, **91(1)**, 185–199.

Ratnadass, A., Fernandes, P., Avelino, J. and Habib, R. (2012). Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: A review. *Agronomy for Sustainable Development*, **32(1)**, 273–303.

Santos, M., Cajaiba, R.L., Bastos, R., Gonzalez, D., Petrescu Bakış, A.L., Ferreira, D., Leote, P., Barreto da Silva, W., Cabral, J.A., Gonçalves, B. and Mosquera-Losada, M.R. (2022). Why Do Agroforestry Systems Enhance Biodiversity? Evidence From Habitat Amount Hypothesis Predictions. *Frontiers in Ecology and Evolution*, **9**, 630151.

Udawatta, R.P., Rankoth, L.M. and Jose, S. (2019). Agroforestry and Biodiversity. *Sustainability 2019,* **11(10)**, 2879.

Wang, Y., Yang, Y., Li, A. and Wang, L. (2023). Stability of multi-layer ecosystems. *Journal of the Royal Society Interface*, **20(199)**.

Wato, T. and Amare, M. (2020). Opportunities and Challenges of Scaling up Agroforestry Practices in Sub-Saharan Africa: A Review. *Agricultural Reviews*, **41(03)**.

Wilson, M.H. and Lovell, S.T. (2016). Agroforestry-The Next Step in Sustainable and Resilient Agriculture. *Sustainability,* **8(6)**, 574.