AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 06 Issue: 08 August 2025 Article No: 01

Banana Based Multistoried Cropping: A Model for Nutrient Recycling and Income Security

Dhritiman Das and Solanki Bal
Assistant Professor, School of Smart Agriculture, Adamas University, Kolkata (W.B.)

SUMMARY

Banana-based multistoried cropping systems are emerging as an eco-efficient and farmer-friendly approach for enhancing nutrient recycling, improving soil health, and ensuring year-round income security. By vertically integrating crops of varying growth habits, rooting depths, and nutrient needs under the canopy of banana, these systems optimize space and resources. Scientific studies show that such arrangements help build soil fertility through organic residue recycling, reduce pest and weed incidences, and generate higher land use efficiency and profitability compared to monoculture systems. This article outlines the structure, ecological benefits, and economic potential of banana-based multistoried cropping as a resilient agricultural model suited for smallholders in tropical and subtropical regions.

INTRODUCTION

Modern agriculture faces the dual challenge of maintaining productivity while preserving ecological balance. The widespread adoption of monocultures has led to declining soil fertility, increasing dependence on chemical inputs, and heightened vulnerability to market and climate shocks. In this context, multistoried cropping presents a practical, regenerative solution—especially for small and marginal farmers who need to make the most of limited land resources. Banana (*Musa* spp.) is well-suited to such systems due to its canopy-forming nature, high biomass production, and compatibility with a wide range of intercrops (Leonel et al., 2024). When used as the primary crop in multistoried arrangements, banana supports the growth of shade-tolerant species and contributes significantly to soil organic matter through leaf and stem residues, making it a central player in nutrient cycling and income diversification.

Ecological design, productivity, and economic significance of banana-based multistoried cropping systems

Banana's structural features make it an ideal component for vertical cropping systems. Its tall stature and broad leaves provide filtered light and a protective microclimate that favors the growth of intercrops such as turmeric, ginger, sweet potato, elephant foot yam, leafy greens, and even aromatic crops like lemongrass and chives (Rodrigues de Jesus et al., 2023). One of the most significant ecological contributions of banana is its ability to recycle nutrients via biomass return. Pseudostem residues and senescent leaves, when decomposed in situ or composted, serve as a rich source of organic carbon, enhancing microbial activity and improving soil structure (Leonel et al., 2024).

Incorporating legumes such as cowpea, green gram, or *Trifolium repens* not only adds a nitrogen-fixing component to the system but also boosts microbial richness and reduces pathogen load in the rhizosphere (Ren et al., 2023). The presence of these intercrops stimulates beneficial soil biota, which play vital roles in nutrient cycling, especially for nitrogen and phosphorus availability. Furthermore, the integration of aromatic crops such as lemongrass has shown to reduce weed incidence significantly while improving land coverage and water-use efficiency (Rodrigues de Jesus et al., 2023).

From an economic perspective, multistoried cropping based on banana helps ensure a more stable and diversified income. Studies conducted in India and Latin America have demonstrated that farmers can earn significantly more from intercropping systems than from banana monocultures. For example, Sonavane et al. (2022) reported that banana-onion intercropping yielded higher net income and land-use efficiency, especially when intercrops occupied up to 60% of the land area. Similarly, coffee–banana systems in Costa Rica and Uganda demonstrated increased gross returns, reduced weeding costs, and more efficient nutrient use compared to their respective monocultures (Leonel et al., 2024).

These systems are also highly effective in managing pest and disease pressures. Intercrops like millet and *Canavalia ensiformis* have been shown to reduce populations of the banana weevil (*Cosmopolites sordidus*) by modifying soil conditions and deterring egg-laying. Moreover, intercropping is increasingly being investigated as a sustainable method to reduce the incidence of *Fusarium* wilt. A study by Ren et al. (2023)

highlighted that banana intercropped with *Trifolium repens* increased the diversity of soil protists and beneficial fungi that suppressed *Fusarium oxysporum* f.sp. *cubense*, the causative agent of this destructive disease.

Banana-based multistoried systems also contribute to better water conservation and weed suppression. The combined canopy coverage of banana and intercrops reduces light penetration to the soil surface, thereby minimizing weed emergence and lowering evaporation rates. This natural mulching effect has the dual benefit of reducing labor for weeding and cutting irrigation needs—both major cost factors in tropical agriculture (Leonel et al., 2024).

Scientific productivity indices further confirm the superiority of these systems. In banana-bean models, the land equivalent ratio (LER) often exceeds 1.5, indicating 50% more productivity from intercropping than monoculture. High land use efficiency (LUE) and better area-time equivalent ratios (ATER) have been reported for systems that integrate early-maturing vegetables with banana. These findings support the idea that multistoried cropping allows for maximum resource exploitation without degrading the environment (Sonavane et al., 2022).

Despite their benefits, successful implementation of banana-based multistoried cropping requires knowledge about crop compatibility, spacing, pruning, and nutrient management. Farmers need technical guidance on selecting crops that thrive under partial shade and have complementary growth patterns. With proper training and policy support, however, these systems can be widely adopted, particularly in regions prone to climate variability and land fragmentation.

CONCLUSIONS

Banana-based multistoried cropping systems offer a promising route toward sustainable, profitable, and ecologically sound agriculture. These systems make efficient use of vertical and horizontal space, improve soil fertility through nutrient recycling, and enhance biodiversity both above and below ground. Economically, they provide a hedge against market and climate risks by ensuring staggered and diversified harvests. The integration of compatible crops not only improves yields but also adds value through aromatic and medicinal produce. As supported by global research and successful case studies, these systems stand as a replicable and scalable model, particularly for smallholders seeking long-term productivity and resilience. Strengthening extension services and providing institutional support will be key to mainstreaming banana-based multistoried cropping in tropical agricultural landscapes.

REFERENCES

Leonel S, Leonel M, Jesus PRR, Tecchio MA, Silva MdS, Cândido HT, Molha NZ, Ouros LF (2024) Achievements of banana (Musa sp.)-based intercropping systems in improving crop sustainability. Horticulturae 10: 956.

Ren Y, Li C, Zhang J, Chen Y, Wang X, Zhou S (2023) Remodeling the soil protist community improves disease suppression in banana intercropping systems. Frontiers in Microbiology 14: 112233.

Rodrigues de Jesus PR, Leonel S, Tecchio MA, et al. (2023) Banana and lemongrass intercropping for sustainable weed control. Agroforestry Systems 97(1): 45–56.

Sonavane AA, Pawar BD, Mahajan VJ, Salve VM, Waghmare SS (2022) Optimization of banana-onion intercropping for higher profitability. Agricultural Economics Research Review 35(2): 178–185.