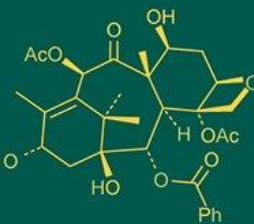


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Integrating backyard poultry with horticulture: A comprehensive review

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Abstract

Integrating backyard poultry with horticulture represents a sustainable and innovative approach to small-scale farming, offering a wide range of benefits, including enhanced soil fertility, natural pest control, diversified income streams, and improved food security. This review examines the synergistic relationship between backyard poultry and horticulture, emphasizing the ecological, economic, and social advantages of this integrated system. It also addresses potential challenges such as disease management, labour demands, and predation, while outlining best practices for successful implementation. By incorporating the latest research and case studies, this article provides a comprehensive guide for farmers, researchers, and policymakers aiming to optimize land use, promote environmental sustainability, and enhance livelihoods. The integration of these two systems not only supports sustainable agriculture but also contributes to climate resilience, biodiversity conservation, and rural development, making it a viable solution for addressing global food security challenges.

Keywords: Integrated farming, backyard poultry, horticulture

Introduction

Backyard poultry farming and horticulture have been integral to rural and peri-urban households for generations, offering food security and supplementary income. While each practice has its own benefits, integrating poultry with horticulture creates a synergistic system that enhances farm productivity, improves soil fertility, and optimizes resource utilization (Reta *et al.*, 2022) ^[28]. This integration aligns with agroecological principles by promoting biodiversity, reducing waste, and improving farm resilience. Poultry manure serves as a nutrient-rich organic fertilizer, providing essential macronutrients such as nitrogen, phosphorus, and potassium, thereby improving soil health and boosting horticultural crop yields (Singh *et al.*, 2021) ^[29]. Furthermore, backyard poultry aids in natural pest control by consuming insects and weed seeds, tender leaves of weeds reducing the need for chemical pesticides (Ahmed *et al.*, 2023) ^[1]. The integration of backyard poultry with horticulture is particularly well-suited for tree-based horticultural systems, including crops like mango, guava, citrus, coconut, oil-palms and moringa, which provide shade and shelter for poultry while benefiting from improved soil fertility (Kumawat *et al.*, 2022) ^[19]. Leafy greens, root vegetables, and leguminous crops can also be incorporated, depending on the stocking density and poultry management practices (Ali *et al.*, 2023) ^[4]. Studies have demonstrated that an optimal stocking density of 300-500 birds per hectare maintains a balance between soil enrichment and preventing overgrazing of crops (Sundaram *et al.*, 2021) ^[31]. Growth performance and egg production in backyard poultry under traditional free-ranging systems versus horticulture integration show variations. Birds raised in integrated systems often exhibit improved health due to access to diverse natural feed resources, while egg production may fluctuate due to increased mobility and scattered laying (Devi *et al.*, 2022) ^[9]. One challenge in such systems is efficient egg collection, as birds may lay eggs in hidden spots within the horticultural field. Precautions such as secure night shelters, thicker fencing, and controlled watering points help mitigate risks from predators like snakes, eagles, and stray cats (Chaudhary *et al.*, 2023) ^[7]. In addition to environmental and productivity benefits, integrating backyard poultry with horticulture increases manpower efficiency. While tree crops require periodic maintenance, poultry demands daily care, thereby enhancing the overall supervision and management of the farm (Reddy *et al.*, 2023)

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[27]. This dual approach ensures better utilization of labor, reducing overall operational costs and improving farm profitability. Despite challenges such as egg collection difficulties and predator threats, the long-term benefits of this integrated farming model make it a promising strategy for sustainable agriculture.

Ecological Benefits

1. Soil Fertility

Poultry manure is a nutrient-rich organic fertilizer, containing high levels of nitrogen, phosphorus, and potassium, essential for plant growth. Poultry excretes nitrogen primarily in the form of uric acid, which decomposes into ammonia through microbial activity, leading to a gradual release of nitrogen into the soil (Girma *et al.*, 2013) [13]. In contrast, ruminant manure contains nitrogen mainly as urea, which is rapidly hydrolyzed to ammonia, increasing the potential for nitrogen loss through volatilization and denitrification (Nahm, 2003) [21]. When applied to horticultural crops, poultry manure improves soil structure, increases organic matter content, and enhances microbial activity (Garg and Bahl, 2008) [12]. Studies have shown that incorporating poultry manure into soil can significantly boost the yield and quality of various horticultural crops (Chastain *et al.*, 2001) [5]. Recent research further supports its effectiveness, demonstrating that the integration of poultry manure with horticulture not only enhances crop productivity but also improves the nutritional quality of produce (Kumar *et al.*, 2021) [18]. Additionally, the use of poultry manure reduces reliance on synthetic fertilizers, minimizing environmental pollution and promoting sustainable farming practices. This makes it a valuable resource for small-scale farmers seeking to optimize soil fertility and crop performance while adhering to eco-friendly agricultural methods.

2. Pest and Weed Control

Poultry, particularly chickens and ducks, play a vital role in controlling pests and weeds in horticultural systems. These birds consume insects, larvae, and weed seeds, reducing the need for chemical pesticides and herbicides (Chatterjee and Sharma, 2018) [6]. A recent study by Mwale *et al.* (2022) [20] highlighted the effectiveness of free-range poultry in managing fall armyworm infestations in maize fields, demonstrating the potential for similar applications in horticulture. This natural pest control method not only protects crops but also contributes to the ecological balance and sustainability of the farming system. By integrating poultry into horticultural settings, farmers can reduce reliance on synthetic chemicals, lower production costs, and promote environmentally friendly agricultural practices.

Biodiversity and Ecological Benefits

Integrating poultry with horticulture provides multiple income streams, enhancing the economic resilience of small-scale farmers, particularly in rural areas. Horticultural crops generate revenue through the sale of fruits, vegetables, and herbs, while poultry farming offers additional income from eggs, meat, and manure (Ahuja and Sen, 2007) [2]. Beyond economic benefits, this integration promotes biodiversity by creating a more dynamic and resilient agroecosystem. Poultry foraging behavior encourages the growth of beneficial insects and microorganisms, while their manure supports soil biodiversity (Smith *et al.*, 2023) [30].

This holistic approach not only boosts farm productivity but also enhances ecosystem health, reduces the environmental footprint of farming activities, and fosters sustainable agricultural practices. By combining these systems, farmers can achieve both economic stability and ecological balance. The present carbon footprints of commercial broiler meat per kilogram of live weight gain in India is 1.15 kg carbon dioxide (Krishna, 2024) [31], of which major factors contributing were feed and electricity. Under integration of backyard poultry with horticultural crops, these two major factors are eliminated, and carbon foot prints are likely fall below 0.3 kg carbon dioxide per kilogram of live weight gain, which come from production of chick, provision of drinking water, vaccination etc.

Economic Benefits

1. Diversified Income

Integrating poultry with horticulture provides multiple income streams, significantly enhancing the economic resilience of small-scale farmers. This diversification not only stabilizes household incomes but also reduces financial risks associated with single-enterprise farming. A recent study by Okello *et al.* (2021) [24] found that farmers practicing integrated systems in East Africa experienced a 30% increase in annual income compared to those relying on single enterprises. By combining these systems, farmers can achieve greater financial stability, improve livelihoods, and build resilience against economic and environmental uncertainties.

2. Cost Reduction

By using poultry manure as a natural fertilizer, farmers can significantly reduce their expenditure on synthetic fertilizers. Additionally, the natural pest control provided by poultry, such as chickens and ducks, lowers the costs associated with purchasing and applying chemical pesticides (Ndiwa *et al.*, 2013) [22]. These cost savings enhance the overall profitability of integrated farming systems. A study by Rahman *et al.* (2022) [26] demonstrated that integrated poultry-horticulture systems reduced input costs by up to 40%, significantly improving the financial outcomes for smallholder farmers. By minimizing reliance on expensive synthetic inputs and leveraging the natural benefits of poultry, farmers can achieve greater economic efficiency while promoting sustainable and environmentally friendly agricultural practices.

Social Benefits

1. Food Security

Backyard poultry farming contributes significantly to household food security by providing a reliable source of animal protein in the form of eggs and meat (Tadelle and Ogle, 2001) [32]. When integrated with horticulture, it ensures a steady supply of fresh fruits and vegetables, promoting dietary diversity and reducing dependence on external food sources (Hossen, 2010) [15]. This combined approach not only enhances nutritional outcomes but also strengthens food security at the household level. A recent study by Kansime *et al.* (2023) [16] found that households practicing integrated poultry-horticulture systems were 50% less likely to experience food insecurity compared to those relying on single-enterprise farming. By fostering self-sufficiency and providing a balanced diet, this integrated

model plays a crucial role in improving food security, particularly in resource-limited settings.

2. Empowerment of Women and Marginalized Groups

Backyard poultry and horticulture are accessible agricultural activities that require relatively low investment and can be managed within the household. This makes them particularly suitable for women and marginalized groups, empowering them with income-generating opportunities and improving their socio-economic status (Ahuja *et al.*, 2008) [3].

Challenges

Disease Management

Integrating poultry with horticulture poses significant challenges in managing diseases that can affect both poultry and plants. Biosecurity measures, such as regular health monitoring, vaccination, and quarantine protocols, are essential to prevent the spread of pathogens and ensure the health of both components of the system (Permin and Hansen, 1998) [25]. Recent research by Thapa *et al.* (2023) [33] emphasizes the importance of farmer education in implementing effective bio-security practices. Without proper disease management, the risk of outbreaks can compromise the productivity and sustainability of the integrated system. Compared to conventional poultry, backyard poultry is less crowded. This has an advantage of slower spreading of any infection, while there is a disadvantage of difficulty in monitoring each bird. The openair ventilation has an advantage of diluting load of pathogens in the air and rapid sterilization through sunlight, while the same factor offers a disadvantage of bringing wild birds and stray birds like crows, parrots, sparrows, cranes etc into the vicinity, which are potential reservoir hosts.

Labor and Management

Successful integration requires careful planning and efficient management. Balancing the labour demands of poultry care and horticultural activities can be particularly challenging for small-scale farmers with limited resources (Dolberg, 2003) [10]. Training and extension services are critical to equipping farmers with the necessary skills and knowledge to manage both systems effectively. Adequate support and education can help farmers optimize their time and resources, ensuring the smooth operation of integrated farming practices.

Predation and Overgrazing

Free-range poultry systems are vulnerable to predation, which can lead to losses in poultry populations. Additionally, overgrazing by poultry can damage horticultural crops, affecting yields and soil health. Implementing strategies such as rotational grazing and protective enclosures can mitigate these risks (King and Bhujel, 2020) [17]. These measures help maintain a balance between poultry foraging and crop protection, ensuring the sustainability of the integrated system. Addressing these challenges is crucial for maximizing the benefits of combining poultry and horticulture.

Best Practices

1. Rotational Grazing

Rotational grazing involves periodically moving poultry to

different areas of the garden or orchard. This practice ensures even distribution of manure, prevents overgrazing, reduces soil compaction, and minimizes nutrient depletion (King and Bhujel, 2020) [17]. By rotating poultry, farmers can maintain soil health and optimize the benefits of poultry integration.

2. Integrated Pest Management (IPM)

Combining poultry with other pest management strategies, such as biological controls and crop rotation, enhances the effectiveness of pest control while minimizing environmental impact (Hill *et al.*, 2006) [14]. IPM approaches should be tailored to the specific needs and conditions of each farm to ensure sustainable and efficient pest management.

3. Health Monitoring and Biosecurity

Regular health monitoring and strict biosecurity measures are essential to prevent disease outbreaks in poultry. Farmers should maintain clean and sanitary housing, ensure proper vaccination, and implement quarantine procedures for new or sick birds (Copland and Alders, 2005) [8]. These practices help safeguard poultry health and reduce the risk of disease transmission.

4. Farmer Training and Extension Services

Providing farmers with access to training and extension services is crucial for the successful adoption of integrated farming systems. Initiatives such as farmer field schools, supported by organizations like FAO and CGIAR, have proven effective in promoting sustainable and integrated farming practices (FAO, 2023) [11]. Continuous education and support empower farmers to implement best practices effectively.

5. Use of Technology in Integrated Systems

Emerging technologies, such as mobile apps for disease monitoring and precision farming tools, can significantly enhance the efficiency and productivity of integrated poultry farming systems (Nguyen *et al.*, 2023) [23]. Leveraging technology enables farmers to make data-driven decisions, improve resource management, and optimize overall farm performance.

Conclusion

Integrating backyard poultry with horticulture offers a sustainable, resilient approach to small-scale farming, providing ecological, economic, and social benefits. By leveraging natural synergies, farmers can enhance productivity, reduce costs, and improve food security. Challenges like disease management and labor demands can be addressed through best practices, farmer training, and technology. As demand for sustainable agriculture grows, integrated systems will play a key role in shaping resilient farming and improving livelihoods. In order to take the maximum benefits of the integration, the governments departments like horticulture, animal husbandry, rural development etc, need to come together and develop a comprehensive policy to encourage introduction of backyard in the existing horticulture tree crops. It should start as demonstration units in every block/ tehsil so that any farmer in a district can be taken for exposure visits with 20 kilometres.

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