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GREEN ECONOMICS WITH SPECIAL REFERENCE TO MIXED CROPPING" - A CASE STUDY OF COCONUT CULTIVATION IN D.K. DISTRICT

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ABSTRACT

Green economics seeks to promote sustainable development while integrating environmental, social, and economic goals. Mixed cropping, a practice of growing multiple crops simultaneously on the same land, is a key strategy for enhancing agricultural biodiversity, improving soil health, and increasing farmers' resilience to climate change. This study examines the role of mixed cropping in coconut cultivation in the Dakshina Kannada (D.K.) District of Karnataka, India, a region known for its significant coconut production. Through a review of literature and analysis of recent data, the study explores the economic, environmental, and social benefits of mixed cropping in coconut farming. The findings suggest that mixed cropping in coconut orchards, involving crops like areca nut, banana, and pepper, can provide farmers with diversified income sources, reduce soil erosion, enhance water retention, and improve biodiversity. The paper also highlights the challenges, such as market uncertainties and the need for better policy support, while discussing the potential for scaling up these practices across other coconut-growing regions in India.

1. INTRODUCTION

Green economics is the pursuit of integrating environmental with social and economic goals, with equal consideration for all three in a sustainable manner resulting in green prosperity. This paradigm has been increasingly adopted by the agricultural sector as a sustainable approach to mitigate pressing issues including climate change, biodiversity loss, and resource degradation over the past decades. In this regard, mixed cropping plays a crucial role in achieving sustainability of farming systems. Mixed cropping, which is defined as planting two or more types of crops on the same land, is touted for its potential to increase resilience of agriculture, improve resource use efficiency, and diversify farmer income (Tilman et al., 2017). Intercropping plays an important role, especially in perennial crop systems, such as coconut plantations, they help improve productivity and environmental benefits.

Coconut cultivation is one of the important crops in the agrarian economy in India and one of the major coconut producing districts of the State in Dakshina Kannada (D.K.) District. The area boasts a favorable combination of climate and soil ensuring large coconut groves which are a central part of many farmers' livelihood. On the other hand, monocropping in traditional coconut cultivation brings sustainability challenges from soil degeneracy, (pest) outbreaks, and vulnerability to market fluctuations. Thus, practicing mixed cropping in coconut cultivation is one of the viable solutions for productivity, economic stability and ecological balance (Singh et al., 2020).

Details of mixed cropping practice type in D.K. District found to be of significant importance to the farmer particularly with respect to coconut farming have been presented in this article. In this context, mixed cropping generally refers to the practice of planting compatible crops like areca nut, banana, pepper, or other cash crops along with coconuts. This sustainable farming model not only maximizes use of vertical mask in coconut orchards but also creates multiple livelihoods for the rice coconut farmers. For example, the primary yield comes from coconuts; however, farmers also inter-crop pepper vines and banana plants in an effort to increase income sources and mitigate loss in case of market volatility or catastrophic weather events (Sharma et al., 2018).
On an environmental level, mixed cropping improves the health of the soil as it limits erosion and encourages organic matter to be cycled through different rooting systems. This practice also increases the capacity for water retention, thus reducing the need for chemical fertilizers, which is an environmentally friendly alternative to

conventional agricultural practices (Lal, 2019). As a result, mixed cropping contributes to increased biodiversity at the scale of the agroecosystem (e.g., including a habitat for pollinators and beneficial insects), which can stimulate ecological resilience.

From a social perspective, mixed cropping in coconut farming is an important strategy for improving food security, providing livelihood opportunities, fostering rural development, and improving the quality of life in the rural community. With the production of more crops, farmers feel better able to participate in markets outside their own communities, enhancing diversification of the economy and enabling communities to bounce back more readily after shocks. These outcomes are particularly important for smallholder farmers in D.K. District, as the traditional agricultural practice adopted by them makes them highly vulnerable to external shocks (Chandran et al., 2021).

Yet, despite these benefits, challenges persist. Mixed cropping needs technical know-how and investments, which is not affordable to every farmer. Market uncertainties, like fluctuating prices for intercrops, can play a part in preventing adoption too. Additionally, the policy frameworks in place to encourage sustainable farming practices have not adequately covered mixed cropping systems, leaving farmers without the critical guidance or incentives to transition (Reddy et al., 2020).

This paper aims to fill these gaps and explore the mixed cropping practice in particular in the coconut orchard of D.K. District. By examining existing literature and local practice the paper assesses the economic, environmental and social significance of mixed cropping and identifies possible strategies to scale up practices. The results will help farmers, agricultural policy makers, and researchers for solving the problem of farmers.

2. REVIEW OF LITERATURE

- Ecological and Economic Dimensions of Mixed Cropping: Bhat and Rao (2021) highlight the role of mixed cropping in enhancing agricultural biodiversity and mitigating risks in coconut-based farming systems. Raveendra et al., (2021), argue that mixed cropping increases agricultural productivity and stabilizes farmers' incomes by reducing dependence on a single crop.
- Benefits in Coconut Cultivation: A study by Dissanayaka et al., 2022 shows that integrating crops like banana and areca nut with coconut cultivation in coastal Karnataka boosts soil fertility and pest resistance, contributing to higher yields in the long term. Datta & Tapas, 2020 documented the success of mixed cropping systems in D.K. District, where farmers reported increased yields of coconut as well as supplementary crops, improving overall farm productivity.
- Environmental Impact: Research by Raveendra et al., 2021 emphasizes the positive environmental effects of mixed cropping, such as soil conservation, water conservation, and improved biodiversity. These benefits are particularly valuable in coastal regions, where coconut farming is prone to salinity and soil erosion.
- Challenges and Constraints: Sudhalakshmi et al., 2023 note that while mixed cropping offers multiple benefits, it requires a high level of expertise in managing different crops' needs, and farmers often face difficulties in obtaining reliable market outlets for the diversified produce. Policy frameworks in many regions have not yet adapted to the needs of mixed cropping systems, limiting their scalability (Dissanayaka et al., 2023).
- Policy and Institutional Support: An analysis by Yedida et al., (2020.) calls for better institutional frameworks to provide financial and technical support to farmers adopting sustainable practices like mixed cropping. Policies should encourage research, farmer training, and access to organic inputs.

3. METHODOLOGY

Using a qualitative methodology and a thorough analysis of secondary data, this research investigates the function of mixed cropping in coconut agriculture in Karnataka's Dakshina Kannada District. In order to assess the economic, environmental, and social aspects of mixed cropping systems, the research integrates knowledge from scholarly research, official publications, agricultural data, and market analysis. Key advantages like greater ecosystem diversity, better soil health, and income diversification are identified through thematic analysis, which also tackles issues like policy gaps and market uncertainty. The region's published success stories and case studies offer useful insights into successful implementation. Strategies for expanding mixed cropping methods and incorporating them into more comprehensive environmentally friendly agricultural policy throughout India are suggested by the findings.

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4. ECONOMIC ANALYSIS

Mixed cropping enhances farm income by diversifying revenue sources. Coconut orchards intercropped with areca nuts, bananas, and pepper provide farmers with additional income streams, reducing dependency on a single crop. Studies show that intercropping in perennial systems can lead to up to a 50% increase in net returns per unit area (Singh et al., 2020).

Monocropping, on the other hand, though lower in terms of the upfront investment needed and lower in management complexity, was more susceptible to pests and disease, and fluctuating market demand. On the other hand, mixed cropping systems raise labor and input requirements, but offer greater economic returns, which can be more profitable due to the enhanced efficiency of resource use, as well as the provision of risk-mitigating benefits through crop diversification (Sharma et al., 2018).

Pepper and bananas, crops which have been found to be suitable for intercropping with coconut, are already served by well established local and export markets. Pepper, on the other hand, is subject to price volatility, while bananas afford more stable income. Areca nuts, while important in certain regions, are subject to regulatory and market limitations due to health concerns. Strategic market linkages and cooperatives enhance profitability of farmers owing to the mixed cropping system (Reddy et al., 2020).

5. ENVIRONMENTAL IMPACT

Soil Health

With varied root systems and greater organic matter inputs, mixed cropping facilitates macaroni, which are more efficient and less erosive than singles. One study reveals that intercropped systems raise soil organic carbon levels, reduce soil salinity, and help improve fertility (Lal, 2019).

Water Management

The ability of intercrops to lift water by giving ground, a cover and keeps down evaporation Coconut orchards intercropped with palms and trees consume 15–20% less water than monoculture systems (Chandran et al., 2021).

Biodiversity and Climate Change Mitigation

Landscape genetic diversity improves the agility of agroecosystems through habitat creation for pollinators and predatory insects. Moreover, it lowers laboratory chemical input requirements and their associated greenhouse gas emissions, and thus is a climate-friendly practice (Tilman et al., 2017).

6. SOCIAL AND LIVELIHOOD ASPECTS

Resilience to Shocks

By diversifying income through mixed cropping, farmers are more resilient to economic and climatic shocks. However, it has been reported that intercropped systems minimize income risk by 30–40% in extreme weather events (Sharma et al., 2018).

Contributions to Rural Development

Increasing on-farm job possibilities through the use of mixed crops boosts rural economies. By producing a variety of food crops for domestic use, it additionally enhances food security (Chandran et al., 2021).

Gendered Impacts

Because mixed cropping frequently necessitates more labor for crop management, more women may be involved in agricultural pursuits. Although this change promotes more gender parity in rural economies, it may also result in women having to shoulder greater tasks without corresponding financial gains. (Reddy and others, 2020)

7. CHALLENGES AND LIMITATIONS

Barriers to Adoption

Farmers usually lack training in utilizing the techniques needed for mixed cropping method. Additionally due to the cost of investment in input materials can also reduce the adoption rate among farmers, along with the price fluctuations in intercrops, affecting profitability. Moreover, limited government support for the sustainable farming practices are one among the main problems which hinders scalability (Singh et al., 2020; Reddy et al., 2020).

Practical Constraints
If the system for water and nutrients are not well managed, it can lead to reduced yield. Moreover, scalability becomes difficult mainly due to the labour-intensive management system (Sharma et al., 2018).

8. POLICY RECOMMENDATIONS

Financial Support
The governments must provide the growers with subsidies and interest-free loans to promote the practice of mixed cropping. Even financial support for eco-friendly farming practices could further encourage farmers (Reddy et al., 2020).

Training Programs
Similar training on mixed cropping design, compatibility between crops, and management practices should be provided by agricultural extension services. Successful models could be demonstrated through models such as demonstration farms in D.K. District (Chandran et al., 2021).

Market Development
Institutional measures to stabilize prices of individual intercrops, promotion of cooperatives, and stronger market linkages will lead to better profit for mixed cropping (Singh et al., 2020).

Scaling Successful Models
The successful examples of integrated mixed cropping patterns are to be integrated with the national agricultural policies for scaling up the mixed cropping, particularly in respect of D.K. District. Agroforestry and sustainable intensification methods enforce mixed cropping even on a larger scale (Tilman et al., 2017).

9. CASE STUDY ANALYSIS

Successful Mixed Cropping Systems in D.K. District
One such instance, from the Dakshina Kannada (D.K.) District, is the practice of intercropping coconut with areca nut, pepper and banana. Due to the compatibility of these combinations in terms of resource sharing and market demand, they have proven very effective.

Quantitative Data on Mixed Cropping Benefits

- **Yield and Income Gains**
  In monocropping systems, annual income per acre was increased by 40–50% in farms intercropping coconut with pepper vines and banana. Moreover, the corresponding income through bananas and pepper (depending on market prices) was to the tune of ₹50,000– 75,000 per year (Chandran et al., 2021).Coconuts did not negatively affect Areca nut yields on intercropped farms, but instead helped maintain yields while diversifying income sources.

- **Environmental Improvements**
  Soil organic carbon increased approximately 20% in intercropped systems due to complementary root structures of coconut and pepper (Lal, 2019). Improvement in water retention by 15%, lead to the reduced need for irrigation

- **Biodiversity**
  For example, mixed cropping systems are known to enhance pollinator and beneficial insect abundance which can result in 25% lower pests compared with mono cropping (Tilman et al., 2017).

Comparison Between Monocropping and Mixed Cropping
Monocropping: With stable yet restrictive productivity, monocropping coconut farms in the district yield net returns of ₹30,000–₹40,000 per acre per year. But monoculture systems are extremely vulnerable to fluctuations in price and pests.

Mixed cropping systems, on the other hand, generated total net returns of ₹70,000–90,000 per acre per year, along with being less risky because of income diversification. In addition, compared to single cropping, mixed cropping required 20% more labor input, which may be recovered through better profits (Sharma et al., 2018).

10. DISCUSSION

Green economics emphasizes sustainable practices that balance economic growth with environmental protection and social welfare. Mixed cropping aligns with these principles by fostering ecological balance and promoting long-term agricultural productivity. In D.K. District, coconut cultivation often includes mixed cropping with crops like areca nut, banana, pepper, and vegetables. This practice helps mitigate risks associated with monoculture farming, such as pest outbreaks, market volatility, and climate variability. Diversified cropping systems provide additional income streams for farmers, which can enhance economic stability. For instance, the integration of areca nut and pepper with coconut cultivation leads to multiple harvests per year, increasing overall farm income. Mixed cropping improves soil fertility and reduces the need for chemical fertilizers. The diversity of plant species contributes to better pest control, minimizes soil erosion, and enhances water retention, leading to improved land productivity over time. Mixed cropping systems can contribute to food security and improve livelihoods by providing farmers with a range of products for local consumption and sale. This also helps in retaining traditional agricultural knowledge and practices. Despite its benefits, mixed cropping faces challenges such as the need for specialized knowledge, access to quality seeds, and market linkages for multiple crops. Farmers also experience difficulties in managing crop rotations and ensuring optimal growth conditions for all crops. There is a need for policy interventions to support mixed cropping practices, including subsidies for diversified farming systems, training programs for farmers, and improved infrastructure for market access. The success of mixed cropping in D.K. District provides a model that could be replicated in other coconut-growing regions of India. A nationwide adoption of sustainable practices could significantly contribute to the resilience of Indian agriculture against climate change.

11. CONCLUSION

The study explains the various economic, environmental, and social benefits of mixed cropping among coconut farmers in the Dakshina Kannada District. Integration of crops such as pepper, banana and areca nut among others, resulted in higher crops yields, diversified and enhanced income, and improved soil health and biodiversity. The results emphasize the promise of mixed cropping as a sustainable farm practice compatible with green economy principles.

But accompanying it are obstacles to adoption — market volatility and competition for basic resources — that suggest the necessity of supportive policies. Mixed cropping: Scaling up mixed cropping will require financial incentives for farmers, farmer training, and increasingly efficient market infrastructure. Further studies should focus on identifying optimal crop mixtures and better understanding long-term ecological effects. In conclusion, mixed cropping has the potential to become a model of sustainable agriculture in india providing eco-friendly alternatives against the current widespread farming practices.

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