Enhancing Fruit Farming with Panchstar Layer - A Natural Farming Technique

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ABSTRACT

Natural farming, a sustainable and eco-friendly agricultural practice, enhances soil health, biodiversity, and ecosystem resilience by avoiding synthetic inputs and relying on organic processes. The Panchstar (Five-Layer) Model, introduced by Padma Shree Subhas Palekar, integrates multiple vegetation layers, mimicking natural forests to maximize resource utilization and improve productivity. The model categorizes plants based on their photosynthetic needs and includes strategic crop combinations for optimal growth. Compared to conventional multi-layer farming, the Panchstar model prioritizes long-term sustainability, carbon sequestration, and biodiversity, although it requires careful planning and investment. This structured approach is particularly effective in drought-prone regions, ensuring continuous yield while promoting environmental conservation.

INTRODUCTION

Natural farming, an eco-friendly and sustainable agricultural practice, is gaining prominence in fruit farming. By avoiding synthetic chemicals and relying on natural processes, this approach enhances soil health, biodiversity, and the overall resilience of agricultural ecosystems. Techniques such as the Panchstar layer—the five-layer model—crop rotation, green manuring, vermiculture, and biofertilizers are integral to this approach. They integrate multiple layers of vegetation, including fruit

trees, shrubs, and cover crops, to create a harmonious and productive environment.

Natural farming emphasizes the use of organic matter like compost and green manure to nourish the soil, and practices such as mulching and intercropping to conserve moisture and control weeds. This method not only boosts fruit yield and quality but also ensures long-term sustainability by maintaining soil fertility and reducing environmental impact.

Padma Shree Subhash Palekar introduced various theories, principles, and approaches that emphasize natural farming techniques. Low-budget farmers adopt methods such as mulching, soil protection measures, and natural insecticides and fertilizers to enhance soil health. Zero Budget Natural Farming (ZBNF) relies on key strategies like crop rotation, green manures, composting, biological pest control, and mechanical cultivation. Its four foundational pillars—Jivamrita, Bijamrita, Acchadana, and Whapasa—play a crucial role in maintaining soil fertility and productivity (Yadav *et al*., 2022).

Panchstar layer model

The five-layer plantation method, developed by Subhash Palekar, is a holistic agroforestry approach that aligns with Zero Budget Natural Farming (ZBNF). It integrates plant species with different sunlight requirements, ensuring complete soil coverage while enhancing soil biodiversity, increasing carbon sequestration, improving water retention, and boosting nutrient availability. This system ensures a continuous income for farmers and supports biodiversity, maintains soil health, regulates temperatures, encourages rainfall, and provides fodder for livestock, making it particularly effective in mitigating drought conditions in semi-arid regions.

Inspired by natural forests, the five-layer model incorporates trees with varying plant canopies to optimize sunlight utilization. It includes specific crop and tree combinations, living fences, and trenches for effective water harvesting (Khadse & Rosset, 2019). The model also follows precise guidelines for row spacing and arrangement, ensuring resource efficiency.

Additionally, vegetation is categorized into three groups based on photosynthesis capacity, reflecting nature's self-sustaining ecosystem:

I. **Highly Photosynthetic Plants**: This category requires strong sunlight, ranging from 8,000 to 12,000 foot-candles. It encompasses large trees like mango, tamarind, and coconut, as well as monocot crops such as sugarcane and maize. These plants achieve optimal photosynthesis between 10:30 a.m. and 3:30 p.m. and are less effective when grown in shaded conditions (Devvrat., 2023).

II. **Mild Photosynthetic Plants**: These plants thrive under medium sunlight intensity, between 5,000 and 7,000 foot-candles. This group includes medium-sized trees, bushes, pulses, oil seeds, vegetables, and flower crops. While they can tolerate reduced sunlight, they may require some shading during the height of summer (Devvrat., 2023).

III. **Photosensitive Plants**: Plants in this group, including spices, ginger, turmeric, and tubers, flourish in partial shade and need between 3,700 and 5,000 foot-candles of sunlight (Devvrat., 2023).

Table 1: Layers in Panchstar farming

Layer 1	Trees suited for elevations between 7000 to 1200 feet, such as coconut, mango, jamun, jackfruit, sapota, wood apple, teak, palm tree, banyan, tamarind, or cashew, should be planted with a minimum spacing of 12 meters.

Layer 2	Medium-sized trees suited for elevations between 5400 to 7000 feet, such as mosambi, dwarf mango, Santra, papaya, lemon, guava, orange, banana, arecanut, and perennial drumstick, should be planted with a minimum spacing of 6 meters
Layer 3	Trees ranging from 3700 to 5400 feet in height, including seethaphal, perennial curry leaves, perennial castor, perennial red gram, betel vine, and black pepper, should be planted with a minimum spacing of 3 meters
Layer 4	Plants measuring 1800 to 3700 feet in height are typically leafy vegetables or spice plants
Layer 5	Plants up to 800 feet in height, such as creepers, bulbs like onion and garlic, and tubers like potato, sweet potato, yam, carrot, and beetroot

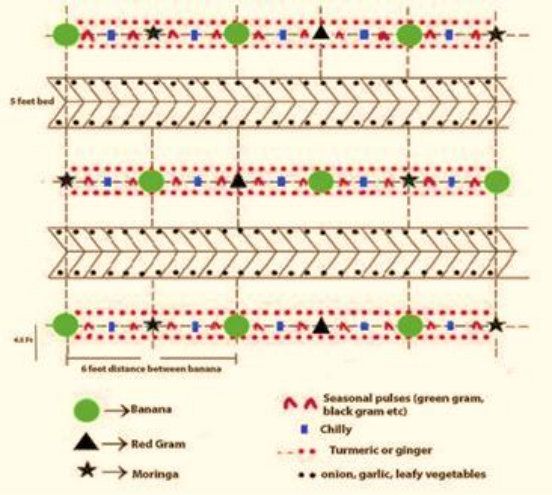

Figure 1: Illustration figure of panchstar model in horticulture (Khadse & Rosset 2019)

Difference between Panchstar farming (Five-layer model) and multi-layer farming model

Feature	Five-Layer Farming Model	Multi-Layer Farming Model
Definition	Integrates five distinct layers of plants, each with specific types.	Cultivates various crops at different vertical levels without a fixed structure.
Structure	Structured with specific layers: tall trees, medium trees, smaller trees, vegetables, and ground cover.	Flexible arrangement of crops with no specified number of layers.
Biodiversity	Promotes biodiversity through structured coexistence of plant species.	Focuses on resource efficiency with diverse crop selection based on needs (Solanki *et al*., 2024).
Benefits	Enhances sustainability, carbon sequestration, and ecosystem resilience.	Maximizes immediate agricultural productivity and adaptability.
Yields	Increases long-term crop yields, reduces pest risks, and supports sustainable livelihoods.	Can increase crop yields by up to 30% with simultaneous harvests (Solanki *et al*., 2024).
Challenges	Requires careful management and significant initial investment.	Demands specialized knowledge, rapid adaptation, and higher management intensity.
Focus	Long-term sustainability and ecosystem health.	Short-term profitability and land use efficiency.

CONCLUSION

The Panchstar farming model exemplifies a structured and sustainable approach to natural farming, balancing ecological health with agricultural productivity. By integrating five distinct plant layers based on their sunlight requirements, it enhances biodiversity, soil fertility, and water conservation. Compared to the more flexible multi-layer farming model, Panchstar farming prioritizes long-term environmental and economic sustainability over immediate yield maximization. While the method demands careful planning and initial investment, its benefits—such as improved resilience to climate change, year-round income, and reduced dependency on synthetic inputs—make it a promising solution for sustainable fruit farming.

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