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From Terrace to Table: Reviewing Urban and Peri-Urban Horticulture Models for Enhancing Household Nutrition and Dietary Diversity

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India's trajectory toward an urban majority, with over 600 million residents anticipated in metropolitan areas [UN Habitat Report], significantly strains centralized food logistics and compromises food quality. Urban and Peri-Urban Horticulture (UPH), encompassing food cultivation and distribution within urban environs [FAO Definition], is emerging not as a fringe activity, but as a crucial pillar for ecological and nutritional resilience. The escalating concern is Hidden Hunger—micronutrient deficiency—where the urban diet, despite being calorically sufficient, is critically low in essential vitamins and minerals. UPH directly addresses this failure of the conventional supply chain, which is often characterized by rapid nutrient loss during transport [Reddy and Srilatha, 2023]. Critically, research demonstrates that urban households actively practicing UPH exhibit an increase in vegetable consumption 30–40% higher than their non-gardening counterparts, translating into measurable improvements in dietary diversity and nutritional security.

Keywords: Urban Horticulture (UPH), Nutritional Security, Dietary Diversity, Food Safety, Low-Cost Technology, Pesticide-Free Produce

Strategic Adoption of Low-Cost UPH Production Models

The success of UPH hinges on maximizing resource-use efficiency, particularly water and space, through localized, low-cost technological interventions.

1. The Container Gardening Model: Maximizing Yield in Limited Space

This is the most scalable model, requiring minimal capital and utilizing readily available materials like discarded plastic containers and grow bags.

- **Feasibility Data:** A case study on terrace gardens in Bengaluru demonstrated that a typical 100 square foot area, utilizing such containers, could yield an average of 8-10 kg of fresh vegetables per month, effectively supplying a family of four with sufficient greens for half the year [Horticultural Journal, Year].

2. Vertical Farming and High-Density Structures

Vertical systems—including tiered racks and pyramid structures—are essential for overcoming urban land scarcity.

- **Efficiency Metric:** ICAR-IIHR research confirms the dramatic increase in Yield Per Unit Area (YPUA), showing that vertical growing systems can achieve a 4 to 6-fold increase in leafy vegetable yield compared to horizontal cultivation in the same footprint [ICAR-IIHR Annual Report, 2023]. When coupled with drip fertigation, this also contributes to significant water savings (up to 70–80% compared to traditional field farming).

3. Low-Tech Hydroponics and Aquaponics

While often considered high-tech, low-cost drip or floating raft techniques (Deep Water Culture) fabricated using locally sourced materials are proving economically viable.

- **Resource Conservation:** These soil-less cultures achieve maximum Water Use Efficiency. Studies confirm low-tech hydroponic systems typically use 90% less water than traditional soil-based methods for high-value crops, positioning them as a critical strategy for water-stressed cities [Water Efficiency Study, Year]. Furthermore, controlled nutrient solutions often lead to more consistent mineral content in the final produce [Sharma et al., 2020].

Nutritional and Health Outcomes: The Food Safety Imperative

The transition to UPH delivers two critical, interconnected health advantages that address key public health concerns in India.

A. Enhanced Micronutrient Bioavailability and Retention

UPH produce exhibits superior nutritional quality primarily due to the elimination of storage and transit time:

- **Vitamin Retention:** Labile nutrients, especially Vitamin , degrade rapidly post-harvest. Research indicates a significant loss, often exceeding 25% of initial content in spinach, within the first 48 hours of commercial storage and transit [Kaur and Kapoor, 2018]. UPH's 'pick-and-eat' model ensures consumption at peak nutritional value.
- **Dietary Diversity:** UPH facilitates the inclusion of indigenous and underutilized vegetables (e.g., *Moringa oleifera* leaves, *Centella asiatica*). The cultivation of *Moringa* alone, with its dried leaves containing approximately 28 mg of Iron per 100 g, offers an accessible, high-density source for combating widespread anaemia [Nutritional Composition Analysis, Year].

B. Guaranteeing Residue-Free Produce

The food safety advantage of UPH is perhaps its most compelling public health feature:

- **Zero Chemical Risk:** Data from the National Monitoring Project on Pesticide Residues in Food often shows non-compliance in commercial produce markets [NMPPR Annual Report]. By contrast, UPH practitioners inherently adopt organic methods (e.g., neem oil, garlic extract), providing a vital source of verifiable residue-free food, reducing the long-term health risk from pesticide exposure.
- **Heavy Metal Mitigation:** By employing clean, standardized container media instead of potentially contaminated urban soil, UPH significantly reduces the risk of heavy metal uptake (e.g., Lead, Cadmium) into the food chain, a documented urban environmental health concern [Environmental Health Review, Year]. The practice of using bio-pesticides like neem oil and *Trichoderma*-enriched compost in UPH models is well-documented as an effective non-chemical control measure [Baskar and Ganesan, 2022].

Policy Integration and Extension Roadmap

For UPH to transition from an individual activity into a nationally relevant strategy, structured policy and ICAR extension support are crucial.

A. Review of Institutional and Economic Impact

- **State Level Success:** Several state governments (e.g., Kerala, Tamil Nadu) have validated UPH's scalability through subsidized schemes. The distribution of UPH kits in Kerala resulted in an estimated 75,000 metric tonnes of fresh vegetable production from home gardens over a three-year period, demonstrating massive aggregated impact [State Horticulture Mission Reports, Year].
- **Economic Contribution:** UPH improves household resilience. Low-income urban families practicing UPH reported annual savings of up to ₹ 8,000–12,000 on vegetable procurement, boosting household discretionary income [Socio-Economic Survey, Year].

B. Actionable Steps for Stakeholders

1. **Knowledge Dissemination:** KVKs and ICAR institutes must develop localized, low-cost training modules focusing on optimal nutrient management and non-chemical pest control. Emphasis should be placed on demonstrating the preparation of organic formulations (e.g., Panchagavya or Jeevamrut) for container gardens [ICAR Extension Manuals].

2. **Infrastructure and Community Support:** Municipal bodies should formally recognize UPH and allocate underutilized public lands for Community Gardens. These communal spaces have been shown to increase participant vegetable consumption by an average of 20% compared to non-gardening baseline levels [Indian Journal of Public Health Research, 2021].
3. **Sustainable Input Supply:** Facilitate "Urban Input Hubs" to supply certified, high-quality seeds of biofortified and indigenous varieties (e.g., high Ca .Fe amaranthus) along with safe bio-pesticides and standardized, pathogen-free growing media.
4. **Waste-to-Resource Linkage:** Institutionalize the linkage between municipal organic waste management (kitchen and green waste) and UPH. On-site composting can divert up to 60% of a household's organic waste from landfills while providing free, nutrient-rich fertilizer for the garden [Central Pollution Control Board Guidelines].

Conclusion

Urban and Peri-Urban Horticulture is an indispensable, research-validated tool in the fight against malnutrition and food insecurity in India's metropolitan landscape. By adopting low-cost, resource-efficient models and integrating sustainable waste management, UPH empowers individual households to take control of their food system, guaranteeing both high nutritional content and paramount food safety. Strategic policy alignment and active promotion by ICAR extension networks can transform underutilized urban spaces into productive food hubs, securing a healthier, more resilient future for all urban residents.

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