



Urban and Peri-Urban Intensive Farming Systems: A Sustainable Approach to Food Security and Livelihoods

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INTRODUCTION

The rapid pace of urbanization, growing populations, reduction in farmlands, changes in climatic conditions, and growing need for fresh and healthy food pose various threats to the sustainability of food production. Urban and peri-urban agriculture has become a vital strategy that helps overcome the above challenges through increased proximity between food producers and consumers. Urban agriculture involves agriculture in the city while peri-urban agriculture is practiced in the intermediate zones around cities where both agricultural and urban activities occur together. Intensive agriculture involves the application of advanced techniques to maximize production and profit through limited space and resources through improved cultivars, efficient use of irrigation and fertilizers, protected cropping, vertical farming, hydroponics, etc. Urban and peri-urban intensive agriculture can serve in providing local food and nutritional security, generating employment opportunities, waste utilization, environmental improvement, and livelihood development. This strategy works well with high-value and perishable crops like leafy vegetables, herbs, micro greens, tomato, cucumber, capsicum, chilli, strawberry, and nursery crops.

Concept and Significance of Urban and Peri-Urban Intensive Farming

Urban and peri-urban intensive farming refers to a production process where the agricultural products are grown or produced within urban settings or their outskirts through efficient management of resources like land, water, labor, etc. The primary goal of this farming system is to ensure that productivity per unit land is increased, along with making sure that the distance between production and consumption is reduced. As compared to traditional agricultural practices, which depend largely on wide expanses of land used for cultivation, urban intensive farming takes advantage of rooftops, balconies, terraces, vacant plots, community lands, greenhouses, containers, vertical structures, among others.



The significance of such farming practices has been rising due to the growing size of the urban population and the demand for fresh produce. Produce that is grown close to the urban market will help reduce the travel time, marketing costs, and post-harvest losses. In addition, farmers can receive higher prices due to the practice of direct marketing. Such farming systems can help the residents obtain fresh produce like vegetables and herbs while creating new avenues for business and employment opportunities. This system of farming can also help in greening the urban areas by utilizing unused land productively.

Intensive Farming Systems

Urban rooftop farming is one of the best systems of urban agriculture where open lands are scarce. The rooftops can be used to cultivate vegetables, herbs, flowers, and fruits using containers, raised beds, grow bags, and light weight substrates. Tomato, chilli, brinjal, coriander, mint, spinach, fenugreek, radish, carrot, lettuce, and strawberry are some examples of crops that can be cultivated on rooftops provided there are favorable conditions. Urban rooftop farming provides

fresh produce as well as reduces building's heat load. Vertical farming is yet another intensive production method that involves planting crops in vertically arranged layers in order to maximize the crop yield in the smallest area possible. This method can be adopted in buildings, greenhouses, warehouses, or indoor facilities that are specifically designed for this purpose. The use of vertical farming is particularly ideal for leafy vegetables, herbs, microgreens, and other crops with a shorter growth period. It is possible to combine vertical farming with hydroponic, aeroponic, and substrate production methods for increased yield. Despite requiring significant investments at the beginning, this production method allows year-round production and environmental regulation.

Hydroponic farming involves growing plants using water solutions instead of soil. Nutrient Film Technique, Deep Water Culture, drip hydroponics, and other types of hydroponic farming can be used to intensively produce leafy vegetables, herbs, tomato, cucumber, and other suitable plants.

Hydroponic systems are quite effective when growing plants where soil quality is poor or unavailable.

However, the precise control of pH, electrical conductivity, nutrient concentration, water, and temperature is needed for successful production.

Aquaponics is an integrated technique where fish rearing along with crop production is done in one system. In this system, nutrients derived from fish waste are transformed into forms that can be used by the plants. The plants and microorganisms along with cleaning of the water facilitate its return back to fish rearing unit. Thus, aquaponics could provide circular use of resources as well as fish as well as vegetables from the same smaller area. Fish health management, water quality maintenance, plant nutrition management etc. are required for sustainable functioning of the system.

Another important technology for intensive urban and peri-urban farming is the use of protected cultivation. Techniques such as greenhouses, polyhouses, shade-net houses, insect proof structures and low tunnels are used for protection of the crops from adverse climatic and pest effects and at the same time providing ideal conditions for production of valuable crops. Various types of crops like capsicum, tomatoes, cucumber, strawberries, leafy vegetables, flowers and nurseries can be produced under protected conditions.

Container and grow-bag farming is especially useful for households, schools, institutions, balconies, terraces, and small urban spaces. Different vegetables and herbs can be cultivated in pots, crates, grow bags, barrels, and other suitable containers. Microgreen production is another promising enterprise because microgreens require very little space and have a short production cycle. Crops such as radish, mustard, broccoli, pea, sunflower, fenugreek, and amaranth can be grown as

microgreens and harvested at an early stage. Their short production period and high value make them attractive for small-scale urban entrepreneurs.

Selection of Crop and Crop Management

The selection of crop is a significant consideration for success in intensive urban agriculture. Selection of crops that have short duration, high market requirement, high market value, high productivity, and fit into limited areas would be preferable. The cultivation of leafy vegetable crops like spinach, lettuce, coriander, fenugreek, amaranth, and kale would be possible due to their low space requirement and quick payback period. Tomato, chilli, capsicum, cucumber, brinjal, radish, and other vegetable crops could be grown depending upon the availability of space and production process. Basil, mint, parsley, coriander, and oregano are some of the herbs which could be cultivated through niche market considerations.

Water management forms one of the most essential aspects of intensive agriculture. Drip irrigation, fertigation, moisture meters, mulches, rain water harvesting, and automatic irrigation systems may be employed in order to increase water efficiency. Hydroponic systems involve the circulation of water and the provision of nutrients in a controlled manner, which helps reduce unnecessary losses of water. Water quality should be monitored since contaminated water may raise the issue of food safety concerns. Wastewater should not be applied to crops directly since it poses a risk of health problems.

Nutrient management also plays an important role in achieving high productivity levels. Soil testing should be conducted in soil based agricultural systems in order to find out the needs of nutrients. Organic manures, compost, vermicompost, and other properly prepared organic amendments may be used in appropriate situations.

Nutrient concentration, pH, and electrical conductivity should be monitored in hydroponic systems. Proper nutrient management is important for plant growth, product quality, and production efficiency.

Recycling of Urban Resources

Urban and peri-urban farming can contribute significantly to circular resource management. Cities generate large quantities of biodegradable organic waste from households, markets, restaurants, and other sources. Properly segregated organic materials can be processed into compost and vermicompost and used as soil amendments. Crop residues and other biodegradable materials can also be converted into useful organic inputs through appropriate treatment. This approach can reduce the quantity of organic waste sent to landfills while returning nutrients to agricultural production.

However, the use of urban waste in agriculture must be undertaken carefully. Waste containing plastics, chemicals, heavy metals, pathogens, or other contaminants should not be used for food production. Compost and other organic amendments should be properly processed before application. Soil and water quality testing is particularly important in urban areas where contamination may occur due to traffic, industries, construction activities, or other sources.

Contribution to Food and Nutritional Security and Livelihoods

Intensive farming practices carried out in the urban and peri-urban areas could play an essential role in improving food security by making fresh vegetables, herbs, fruits and other products available closer to the consumer. Production of nutritious vegetables and leafy greens could play an important role in making fresh produce accessible. However, urban agriculture must be viewed as one part of the overall food chain rather than an

alternative to rural agriculture. The large-scale production of staple crops like cereals and pulses would usually need large extents of agricultural land, whereas urban agriculture is more suited for the production of high-value, perishable, and short-duration crops.

Such farming practices have substantial potential for employment and entrepreneurship. Youth, women, self-help groups, farmer producer organizations and entrepreneurs could set up enterprises based on microgreens, hydroponics vegetables, nursery plants, mushrooms, herbs, protected cultivation, composting, and value-added products. There could be better market prospects for the farmers if the products are marketed directly through farmers' markets, local shops, restaurants, hotels, institutions, subscription vegetable boxes and online.

Environmental and Social Benefits

Urban and peri-urban intensive farming can provide several environmental and social benefits when properly planned and managed. Production close to consumers can reduce the transportation distance for highly perishable commodities and may reduce post-harvest losses. Vegetation on rooftops, terraces, and unused spaces can contribute to urban greenery and potentially reduce localized heat. Crop diversity can provide habitat and food resources for pollinators and beneficial organisms. Efficient irrigation and nutrient management can also reduce resource wastage. Urban farming can provide educational and social benefits by connecting people with food production and natural resources. Schools, colleges, universities, residential communities, and institutions can establish demonstration gardens and training units to promote awareness of sustainable agriculture. Community-based gardens can also strengthen social participation and encourage healthy eating habits.