

Futuristic Urbanism- Integrating Farming into Urban Landscape for Sustainable Development

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ABSTRACT--- *Unscientific urban expansion and the resulting population growth is phenomenally changing the landscapes of cities and presenting critical challenges. Unplanned urban growth is placing ever increasing demands for better liveable conditions related to housing, transportation, water, food, energy, employment, social infrastructure amenities, etc. As a result, most of the urban areas, transition areas and ru-urban fringe areas are witnessing steady increase in the conversion of farming land leading to degradation of the urban environment while creating food security concerns. Food demands of urban areas are traditionally supported by their hinter lands and surrounding rural areas. Majority of urban area's food equivalences are affected by its multi-cultured social fabric implying that the demand for food is diverse. Against this background, this paper analysis the correlation between urban farming and supporting the food demands in urban areas. Further paper discusses critical challenges and various potential opportunities available for promoting urban farming as a significant tool in encouraging balanced sustenance of urban areas through proactive and innovative methods.*

Keywords — *Urban farming, Food security, Urban expansion, Urban landscape, Sustainable urban development, Futuristic urbanism*

I. INTRODUCTION

Unscientific urban expansion and the resulting population growth (the total urban population is projected to reach 7.5 billion by 2050) is phenomenally changing the landscapes of cities and presenting critical challenges. Taking the cognisant of the situations that prevail in the contemporary cities, it can be visualised that the cities in future will be far more diverse in their socio-cultural and economical domains. Unplanned urban growth is placing ever increasing demands for better liveable conditions related to housing, transportation, water, food, energy, employment, social infrastructure amenities, etc. As a result, most of the urban areas, transition areas and ru-urban fringe areas are witnessing steady increase in the conversion of farming land leading to degradation of the urban environment while creating food security concerns. Food security is associated with the need for stable, accessible and nutritious food services. As a major consequence of food insecurity and subsequently inadequate nourishment is bound to result in chronic public health issues. Inadequate nourishment is not only associated with food insecurity but lack of accessibility to healthy food in neighbourhoods especially those

comprised of diverse mix of urban communities. In view of the increasing price of food owing to the extreme climatic conditions, Food and Agricultural Organization of United Nations (FAO), urban and peri-urban agriculture has been recognized as a farming system primarily contributing to food security and generation of employment while improving the urban ecology to achieve sustainable urban development.

II. FOOD ISSUES IN URBAN AREAS

A. Urbanization and the prevailing adverse conditions

Rapid urbanization process is creating enormous demands for land to accommodate the growth. In the process, huge tracts of fertile farming lands are being developed irrationally leading to food and water crisis severely impacting the urban environment and health of the urban communities. The constant reduction in the arable land is posing threat for the urban bio-diversity. These adverse conditions are further aggravated by the additional demands for energy and water presented by urbanization.

B. Correlation between multi-ethnicity and food demand

Majority of urban area's food equivalences are affected by its multi-cultured social fabric implying that the demand for food is diverse. Cosmopolitan flavor of the cities coupled with the increased income levels and the subsequent unrestricted spending has been transforming food for many urban dwellers into something more than just the sustenance. But in comparison with the other key components of the city building, the profound information and understanding about the food supply-demand system is highly neglected in urban design, planning and policy discourses.

C. Food demand and supply crisis

Increased urbanization, population, migration, high transportation costs, adverse climatic conditions, etc. are potentially impacting the ever-increasing cost of food. Increasing demand and prices of basic food supplies are not only associated with its availability but to the degree of accessibility and right utilization of the available food comprised of affordability, nutrition levels of food as well as food security. Systems of food production and consumption are majorly influenced by the access to quality food and the resulting public health.

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III. URBAN FARMING

A. Cities and farming

A detailed perceptive analysis of the origins of the human settlements reveals the fact that although they were established at strategic locations, they essentially require a fertile land to sustain and meet their food demands. Historically, urban areas have been the epicenters of farming innovations. The settlements grow and thrive as the cosmopolitan metropolis due to the availability of the most fertile lands as well as productive plains. This aspect highlights the correlation between natural and manmade environment in turn stimulating the urbanization. However, unfortunately owing to the adverse changes (socio-economic and environmental) this cohesive correlation is getting disconnected. In the present scenario, cities, across the globe are perceived as solids with built

environment. Hence, urban areas and farming are particularly visualized as conflicting activities.

Food demands of urban areas are traditionally supported by their hinter lands and surrounding rural areas. As the cities grow, the food and the nutritional demands of the increasing population needs to be addressed through proactive and innovative methods. Urban dwellers have limited access and control over the food they consume. Increasing living costs, land prices, transportation costs, labor costs coupled with severe climatic conditions directly influence the quality, quantity and supply of the food. In such scenario, urban farming is not only the most viable solution to address the growing food demands in an ethical way but also to generate related socio-economic and ecological benefits. Following table summarizes the benefits of urban farming in different domains (*Refer Table I*).

Table I. Urban Farming - Benefits Of Urban Forming In Different Domains

Sl.no.	Domains	Remarks
1	Ecological	Protection of hinterland, opportunities for organic farming, effective management of natural resources (open spaces, vacant lands, degraded land areas, water shed areas, wetlands, etc.), reduction in food miles, controlling pollution & degradation of land, etc.
2	Social	Urban farming can be versioned as a form of public space for active involvement in turn enhancing the food security of the community. Endless possibilities for engaging urban dweller's interest in active work, recreation and regenerative activities there by contributing to the physical and mental wellbeing.
3	Economic	Employment & income generation, balanced equation of supply-demand, reduction in food costs as food miles are nominal, etc.

B. Urban farming – Analysis of potential locations

Urban areas do have enormous potential for growing their own food despite of greater densities. Metropolitan areas expand primarily as four distinctive zones; core, wedge, corridor and periphery having dense, mixed use, patchy and ever changing peripheral conditions respectively while influencing the intensity and the type

of land use. Thus farming options differ to a great extent and has a particular character derived from the nature of the zone. The four-zone model can be used to analyze the locations of urban farming along with the scope, despite the exceptions and the fast dissolving boundaries between urban and rural areas (*Refer Table II*).

Table II The four-zone model to locate the urban farming areas and types

Sl. no.	Domains	Character of the area	Urban farming locations and scope
1	Core (center & nodes)	Highest density (Population & built form)	Locations: Redevelopment & vacant plots (for temporary use), public parks, unbuildable areas, water front areas, water bodies, rooftops, balconies, etc. Scope: Small scale plastic greenhouse farming systems including hydroponics for crops with higher value
2	Wedge	High to medium density	Locations: Zones wedged between districts, Wedges between corridors & periphery, steep unbuildable areas (steep slopes, river edge, wetlands), military bases, university campuses, solid waste dumps, cemeteries, etc. Scope: Orchards, fish ponds, milk production, poultry & egg, etc.

3	Corridor	Medium to lower density	<p>Locations: Along main corridors, transportation networks linked to commercial/residential areas, corridor farming with retail outlets, etc.</p> <p>Scope: Interim farming, pollution resistant & low-intensity crops, ornamental horticulture, micro-livestock, grazing, market gardening, vegetables, flowers, etc.</p>
4	Periphery	Low and dispersed density (per-urban fringe areas)	<p>Locations: Efficiently connected fringe areas, Small & medium size farms with favorable landscape features, etc.</p> <p>Scope: Intensive vegetable production, higher value crops, agro-forestry providing firewood, timber, resin, etc.</p>

IV. RESULTS & DISCUSSIONS

Analysis of urban ecological footprint reveals the crucial aspect that every category of material and energy consumption and disposal of generated waste requires the productive / absorptive capacity of a finite area of land and water. Growing competing demands on natural resources have been increasingly challenging long-term sustainability and socio-economic equity.

Supply of food to urban areas is an important component of the ecological footprint of urban areas. Urbanization is interconnected with the locations of food production. Different urban farming systems require different types of urban spaces. These spaces include community lands, public parks, areas allocated for other uses such as area along the streets, areas unfit for building activities such as wetlands, steep terrain, buffer areas of infrastructure facilities, water bodies, flood plains and spaces inside, on and around the buildings (Refer Table III).

Table III Urban Farming- Potential Integrations For Built And Natural Environment

<i>Sl.no.</i>	<i>Type of space</i>	<i>Description</i>
1	Inside, on and around the buildings	<p>Buildings with front, back and side yards Rooftops, vertical surfaces such as (facades, walls, etc.) balconies, patios of buildings in dense cities that do not have the yard space.</p> <p>Advantages: Comparatively secured tenure of the land, no commuting time, availability of vital resources, etc.</p>
2	Community spaces	<p>Community spaces can be promoted as community gardens for farming in a cooperative way in which community gardeners (participants) cultivate in their own plots individually but share common facilities such as supply of resources, operation, maintenance and security.</p> <p>Community farming areas can also act as center of social interaction having institutional, locational and social characteristics.</p>
3	Neighbourhood	Completely and partially built neighborhoods support horticulture without soil and small-scale livestock production. It is also one of the most efficient infrastructures to weave a cohesive community.
4	Urban waste lands	<p>Government and private agencies with the help of NGOs can involve the community in transforming urban wastelands into urban farming plots that are irrigated with waste water meanwhile improving the ecological conditions of the urban areas.</p> <p>They can also have significant positive impacts on the urban area's waste water and drainage system and making productive use of marginal strips of land areas located adjacent to canals, culverts, storm water channels, etc.</p>
5	Steep terrains	Steep terrains present numerous challenges for building activities. hence, present diverse opportunities for urban farming.



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6	Flood plains and streamside areas	Flood plains and streamside present most appropriate sites for urban farming as they have most fertile soil and access to water. Streamside farming includes rivers, creeks, canals, etc. Several urban streams mainly in developing countries are treated as drainage channels or open sewers. Hence, monitoring is required to prevent food contamination from polluted water.
7	Wetlands and water bodies	The extremely sensitive wetlands and water bodies within urbanized areas can be tapped to potentially transform waste water into food for the urban areas. Wetlands are needed to conserve and regenerate ecologically vital resources. Urban farming can be introduced in these areas without much disturbance to the thriving bio-diversity.
8	Community lands	Community lands for farming owned by government, para-government agencies or institutions include areas unsuitable for building activities, areas reserved for future development, open spaces, parks, vacant lands, etc. ranging widely in sizes and locations.
9	Areas along the streets	The long and narrow areas along the streets can be used for urban farming (either mono-cropped or intercropped). Its locational advantages make it easier to move the water/fertilizer supplies and marketing of the produce.
10	Degenerated inner city core areas	Degenerated inner city core areas can be developed as urban farms modelled as large-scale greenhouse facilities to promote and retain business and public activities. They also generate employment for the surrounding neighborhoods.
11	Educational institutions as spaces for community farming	Educational institutions promoted as spaces for community farming with an objective of improving the nutritional conditions in students. They can also be used as platforms for creating awareness regarding farming not only to students but to their families and the community at large while reaping economic benefits by selling the surplus produce.
12	Reserved public and private spaces	Large tracts of reserved public and private open spaces (such as airports, military bases, ports, hospitals, universities, open spaces, recreational areas, etc.) as well as brownfield areas can provide significant space for urban farming. Additionally, they can also gain economic benefits through rents, lease, etc.
13	Industrial zones	Manufacturing facilities in industrial zones can also be farmed with objectives of generating employment, land and water access and food security for the unskilled workers who subsist on the periphery of the manufacturing facility without being employed directly. Advantages: -Promotes productive utilization of the land while discouraging its invasion by squatters. -Industry's treated waste can be converted into inputs for energy and food production. -Multiple positive uses of land such as farming selective produce, guarded forests, beekeeping, breeding tanks for aquatic life, etc.
14	Right-of-way farming	Right-of-way areas such as railroad tracks, canals, electric power transmission/ natural gas and utility service networks can be either rented or leased out for farming for mutual benefits of providing land maintenance, rental income and lands for farmers who do not have space to farm.
15	Women's Community Gardens	Special community gardens with an integral link to gender can be extensions of community kitchens sharing the produce collectively.

A. Duration of use

Urban farming activities are significantly influenced by the duration of the time that a particular space is available for farming as it cascades on several other related aspects

such as types of crops, amount of planning and preparation. certain important spaces are available either permanently or temporarily (Refer Table IV).

Table IV Duration Of Different Spaces Available For Urban Farming

Sl. No.	Duration	Types of spaces
1	Permanent use	Certain areas such as steep terrains, water bodies, flood plains, wetlands and streamside are permanently available for urban farming as they are unsuitable for building activities. They should be used for urban farming along with recreational open space activities.
2	Long term use	Certain urban areas covering large tracts of land are reserved for eventual non-agricultural uses, but in the interim such lands can be used for farming, biological waste processing, ecologically sensitive recreation facilities, etc. enhancing the environmental balance and generation of economy.
3	Short term use	Interim availability of land in tune with the time encourages urban farming. As the city grows and expands its perimeter, several plots are always available for the short-term farming. Temporary sites are often available for urban farming as redevelopment activities in the old city cores and neighborhoods.

It is imperative for government to create long-term plans for managing several unbuilt and unbuildable lands that are permanently available for urban farming. Urban

areas are potential platforms for exploring integration of urban farming with the natural and built environment through various techniques (Refer Table V & VI).

Table V Different Possibilities For Integrating Urban Farming With The Natural Environment

Sl.no.	Urban farming options	Possible settings	Harvests
1	Agroforestry	Peripheral areas, green buffer zones, protected forest areas, natural parks, etc.	Wood, fuel, compost, building materials, etc.
2	Horticulture	Sub-urban areas, open spaces, natural landscapes, derelict land, along the streets, hydroponics, green houses, etc.	All types of green produce, bio-compost, etc.
3	Aquaculture	Wetlands, lakes, reservoirs, drainage basins, sewage lagoons, canals, etc.	All types of green produce, fish, fodder, etc.
4	Livestock	Urban fringe areas, greens along the streets, pens & sheds, open grazing areas, animal farms, etc.	Milk products, meat, hides & skins, manure, etc.
5	Others	Urban forest, container gardening, green houses, roof tops, etc.	Herbs, medicinal plants, flowers, etc.

Table IV Different Techniques For Integrating Urban Farming With The Built Environment

Sl.no.	Title	Description
1	Building Integrated Agriculture (BIA)	BIA is the practice of integrating high-performance hydroponic greenhouse systems into the built forms to make use of the synergies between the building environment and farming like nutrient flows.
2	Vertical farming	Vertical farming conserves bio-diversity, more productivity per unit of area, reduction of heat island & carbon footprint, promotes agro-ecology, facilitates recycling of organic waste and curbs the energy used for providing food.
3	Steep terrain as green buffer zone	Developing steep terrains into green buffer zones stabilizes the slopes, absorbs air pollution and prevents soil erosion while providing food and job security.

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4	Aqua-terra farming systems	Aqua-terra farming systems that combine land and aquatic crops as well as animal life are most appropriate for floodplains. It also helps in preserving biodiversity.
5	Sewage-fed lagoon fisheries	Ecologically sensitive wetlands can be converted into sewage-fed lagoon fisheries to maintain the wetland habitat.
6	Aqua-culture below the city	Conceptually aquaculture is sited below the city. Waste water can be directed downstream to benefit aquatic animal/plant life from its nutrients in turn purifying the water.

B. Urban farming – Analysis of case examples

Several cities in both developed and the developing countries are experimenting with numerous innovative

initiatives and programs to promote holistically sustainable urban farming (Refer Table VII).

Table VII Urban Farming-Analysis Of Case Examples

<i>Sl.no.</i>	<i>Case examples</i>	<i>Project</i>	<i>Analysis</i>
1	Canada	Sharing backyard	This innovative initiative connects owners with parcel of lands with urban farming enthusiasts. Through physical mapping of the locations and online portals, both the parties can connect with each other and farm.
2	Seattle, Washington	Community farming areas as center of social interaction	Community farming areas are promoted as center of social interaction,
3	New York	Sustainable Urban Agriculture Program	Through this program, New York State Energy Research and Development Authority identifies and maps available potential open spaces, vacant lands, community gardens, etc., for urban farming.
4	London	Edible Building	Edible Building, a program by the organization SUSTAIN in London promotes food production in three dimensions of a building- inside, on, walls and roof.
5	Durgapur, West Bengal	Enabling Worker's union for farming	In Durgapur, a planned industrial zone, the plant managers leased land to the worker's union for farming and provided access to water reservoir used to cool the steel. This provision supplemented workers with food and additional income by farming at the job site.
6	Singapore	Agro-technology parks	Singapore has recognized and elevated urban farming as an industrial activity. Agrotechnology parks set up by Department of Primary Production are modelled as industrial parks fitted with parks, hydroponic / aeroponic farms, fish / poultry farms, etc.
7	Hyderabad	Urban farming along Musi river	In this case, people living along Musi river which flows through the city use the river water for urban farming and grow produce although this is not supported by the government.
8	Haiti	CARE- Haiti	Demonstration gardens, mostly on rooftops has been a popular initiative in Haiti to promote urban horticulture in urban, peri-urban, slum areas. It has also extended the program to include community and school gardens.
9	Xochimilco, Mexico City	Chinampas, Floating farms	These floating farms have vegetables, livestock, poultry, trees for fuel and ornamental plants/flowers are produced on land that is punctuated by canals that provide transportation, irrigation, recreation as well as tourism.



10	Ireland	Irish charity CONCERN	CONCERN has been working with local citizens to develop soil conservation and sustainable land-use techniques through a project that includes agroforestry, horticulture (fruit trees) and the construction of non-erodible drains and check dams. The objectives of this initiative are to improve farming practices, reduction in urban soil erosion and practicing ecologically sustainable land-use practices.
11	Delhi	Urban farming along the banks of Yamuna river	Fertile flood plains of Yamuna river along the Yamuna river is used extensively for urban farming.
12	Berlin	Community gardeners	A cooperative initiative in which community gardeners (participants) cultivate in their own plots individually but share common facilities such as supply of resources, operation, maintenance and security.
13	Nagpur	Organic farming on terraces	Slum dwellers of Nagpur city have initiated organic farming on the terraces and narrow vacant plots in an informal way. Along with supporting daily needs, the surplus produce is sold locally.

C. Access to land and tenure

Urban farming continues on land and in water under a variety of legal and extra-legal arrangements through ownership, renting, leasing, etc. (Refer Table VIII).

Table VIII Access to land and tenure

Sl.no.	Type of arrangement	Description	Remarks
1	Farming under permit	Official access to farming on areas such as rights-of-way, port authorities, etc. in return for maintenance of land.	Favorable arrangements for both landowners and farmers if tenancy laws ensure the rights of both.
2	Fiscal rent or lease	This arrangement provides official access to the land and pays rent as a share of income earned through the land.	
3	Usufruct rent or lease	Official access and rent are based on a usufruct basis. Examples include lands around public and private facilities.	
4	Unsanctioned farming	Farming without the owner's consent	Informal /illegals arrangements leading to squatters.
5	Informal agreements	Farming with the owner's consent but without the official agreement.	

D. Land ownership and access for farming in urban areas

Urban areas face the lack of space, land and water bodies to farm. Gaining legal access and secured tenure are the major hurdles to farm the area. Hence, resolving

land ownership and acquiring appropriate official arrangements will unlock potential spaces for urban farming (Refer Table IX).

Table IX Land Ownership and Access For Farming In Urban Areas

Sl.no.	Category	Sub-category	Potential for urban farming	Access
1	Private land	Owned	High	Closed and strongly controlled
		Tenanted (often short term)	Low	Closed and controlled by both the owner & the tenant
		Leases (often long term)	Medium	Closed and controlled by both owner & lessee
2	Establishment land	Large premises	High as excess land can be farmed	Closed and strongly controlled



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		Small premises	Variable as depends on the availability of excess area	Closed and control varies
3	Public land	National/state/city authorities	High as the vacant spaces can be farmed	Often open with variable control
		Community land owned collectively under customary law or donated for use of the public	Medium as Collective/ community farming	Often controlled by property provisions.
		Illegally occupied on private/public/community lands	Low unless the tenure is fairly secured	Variable

E. Differnt framework to support urban farming

Urban planners and managers focus and plan the development in terms of transportation, housing, employment, etc. rather than in terms of farming as it relatively generates low returns on investments. Hence, urban farming suffers from a combination of political restraints, restrictive urban policy, indecision about property rights of land, lack of organization/representation of urban farmers.

Ecological footprint of urban areas can be potentially reduced if the agenda of urban farming is combined into a comprehensive urban policy. It is possible to develop policies to reduce environmental impacts and thereby depletion of natural resources by establishing the ecological footprint of different consumption patterns, infrastructure and certain densities distinctively (Refer Table X).

Table X Differnt frameworks to support urban farming

Sl.no.	Framework	Description
1	Planning framework	Planners need to recognize the importance of urban farming and develop strategies and implementing mechanisms for bringing urban farming in the main stream to secure self-reliance on food to promote sustainable development.
2	Policy framework	Policy and program frameworks to persuade public and private land owners to make sleeping land / free land either make productive or make them available for inserted citizens and farmers to be developed as urban farm land.
3	Community supported agriculture	This scheme brings growing and consumption in a mutually beneficial arrangement.
4	Strong community spirit and social cohesion	Urban farming for self-consumption and occupation are vital sources of food security.
5	Urban farming and food culture	Integration of urban farming and local food culture into nutrition education programs.
6	Producer organizations	Strengthening producer organizations through value-chain development and increased access to finance.
7	Climate change strategies and action plans	Urban area-based climate change strategies and action plans for supporting urban farming through improved market infrastructure, training and extension programs

V. WAY FORWARD

Functioning and the relationships with the environment of urban areas are changing while plugging them into an increasingly global hinterland and thus increasing ecological footprint. Ever expanding ecological footprint of urban areas is stretching far beyond its actual physical boundaries and is stamping out the habitat of several species. Hence, management of land becomes more efficient if the urban farming is considered as permitted land use.

Currently, there is a need to recognize that the urban farming is an appropriate permanent and long-term land use. Urban farming contributes to the socio-economic and environmental sustainability of cities. The contributions of farming in urban areas can be measured in terms of

environmental conservation and food security, rather than purely as returns on investments. The initiatives on energy efficiency, high resource productivity and strong policies for containing the urban sprawl have greater influence in promoting urban farming as a significant tool in encouraging balanced sustenance of urban areas.

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