

Global Innovations in City Gardening for Food and Nutritional Security

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ABSTRACT

Today, the importance of both rural and urban areas in reconstructing food systems is growing. It is necessary to revisit how our food is grown, distributed and eventually ends up on our plates. From a production perspective, agro ecological practices and family farming must be viewed as a way of life whereas availability of safe, nourishing and culturally appropriate food for everyone is vital from a consumption standpoint.

Urban and periurban gardening will make cities sustainable and resilient which is the prime focus of the UN's Sustainable Development Goal 11. With an acknowledged status and duty legally required by the COAG, 1999 FAO worked proactively through its multidisciplinary initiative "Food for the Cities." (Makiko Taguchi and Guido Santini, 2019).

Innovations in City and Peri-urban gardens in different parts of world are ample. Urban farming contributes 30%, 50% and 85% of the vegetables consumed in Kathmandu, Karachi, and Shanghai respectively (FAO, 1996). The strategy for assisting the regional food system through creative vertical facades for seed gathering, green walls and floating greenhouses fits Shanghai's strategy adequately.

Many innovations in marketing of urban farming produce such as organizing farm visits, monthly 'healthy lunches' and guaranteed purchase of vegetables before harvest are seen in the city of Rosario, Buenos Aires.

Keywords: Urban Agriculture, City Gardening, Food Security, Nutritional Security

Introduction

Innovations in Urban Agriculture bring novelty in available plant cultivation systems and technologies. Building-integrated agriculture or Zero-Acreage Farming (or Z-Farming) is taking forms of rooftop agriculture and vertical farming. Rooftop greenhouses (mainly found in North America, Asia and Europe) and Vertical farming systems are often equipped with high end technology and integrate the production of quality fruits and vegetables, with services such as workshops and catering. (Francesco Orsini, 2020). The paper discusses innovative urban farming models of different parts of world for replication in similar geographical conditions.

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Global Cutting edge innovations in city gardening

Smart roofs for smart cities, Rotterdam: DakAkker in Rotterdam is the largest rooftop farm in Europe, is fitted with a 1,000 m² smart roof that works as a sensor with a superior water storage capacity and is downpour-proof. When extreme rain is predicted, the smart control reacts by making extra water storage capacity available 24 hours in advance. The rooftop system also acts as an insulation layer reducing outside temperature by 30-40 degrees Fahrenheit. This smart urban roof grows organic fruits, vegetables, flowers, herbs, chicken and bees to protect biodiversity. Compost is made and used on the roof itself as well as sold as “worm tea” (liquid compost) to shops and consumers.

Consumption links of DakAkker: Bistro ‘Op het Dak’, the restaurant, located on the roof, uses the super fresh harvest of the DakAkker for its menu. The fruits, vegetables, and edible flowers are also delivered to other local restaurants, sold during festivals and in high season directly to visitors every Friday. All produce is delivered within walking or cycling distance, keeping the food chain as short as possible (Bright vibes, 2021).

Trash dump turned to a Agricultural Zone, Shanghai, China

Laogang in Shanghai has an enormous trash dump of about 6.5 sq km, of which 80% is converted into manure which is used in city’s agricultural zone to produce about 55% of the vegetables and 90% of the green-leaf vegetables for city dwellers. (Eden green technologies, 2022)

Urban Plant Factory, Changzhi: World’s most advanced seedling raising machine is located in Yuzhuang, Changzhi City. Tower has LFD spectrum technology, intelligent control of temperature, humidity and carbon dioxide concentration. In a total area is 35,000 square meters, workshops of vegetable seedling cultivation, vegetable production and a Chinese herbal medicine planting were found. The “Plant Factory” can raise more than 600,000 seedlings per batch at one time, and can raise 12 seedlings per year. The products meet the needs of various counties and districts in the city and also reach Shandong, Jiangsu, Zhejiang and other parts of China. (Smart farmer, 2021).

Vertical Indoor Farms of Gotham Greens, USA: The vertical farms are supplying the inhabitants of New York and Chicago with fruits and vegetables (Leafy greens and herbs, including lettuce varieties such as butter, California crunch, romaine, green and red leaf along with basil) grown without soil, pesticides and with an irrigation system based on reusing water. A soilless base is made using coconut coir, rock wool, peat moss or perlite. Water is continuously recycled, filtered and tested. Robotics, artificial intelligence (AI), computer vision, sensors,

monitors, testing systems and controls are installed and farms rely on natural sunlight for photosynthesis. During winter months, when daylight is shorter, supplemental LED lights glow to optimize the total amount of light needed for growth. (Gothamgreens, 2023)

AeroFarms, USA: Newark, USA uses aeroponics to grow 250 types of leafy greens such as arugula, kale and spinach without sun or soil in a fully controlled environment. The technology enables year-round production with less water consumption and high yields per square metre. The rectangular gargantuan growing machine about 20-feet tall has a stack of growing beds with LED lights, each bed is 20-feet long (Malavika Vyawahare, 2016). In Paris, a startup called Agricoool grows strawberries in cooltainers using similar aeroponics technology (Agricoool, 2015).

Swale, the floating Food Forest on Barge: Mary Mattingly, the founder started a food forest on a barge, in New York City, USA utilizing marine common law to make her floating food forest legally and publicly accessible. This moving island, surprises and elevate peoples' senses due to its perennial native fruit trees and shrubs, leafy self-seeding annuals and salt loving grasses (The Barge, 2016).

Sharing Backyards, Canada: Through the initiative's website, those with unused property post their approximate location, and those looking for space to grow food locally can search locations nearby at no cost. Sharing Backyards is set up throughout Canada, the United States, and New Zealand. Support for starting and maintaining the shared backyards is offered by staff (Sandra MacGregor, 2022).

Transforming Shipping Containers to Cropboxes, Abudhabi: Crop box is a controlled environment agriculture system that produces leafy crops year-round. They are also designed to grow vegetables in 40-degree desert of Abudhabi heat by pairing old shipping containers and high-tech hydroponics. In Masdar City - an urban development project in Abu Dhabi - Madar Farms are using hydroponic systems that require much less water than traditional farms, to grow lettuce, herbs and brassicas. Plants are grown in a controlled environment inside the container, with nutrients coming from enriched water, with no pesticides. LED lighting with deep red and blue hues mimics sunlight and cycles on and off to simulate periods of day and night for the plants. The containers, which are 12.2 meters long and 2.4 wide, are stackable, durable and easy to modify (World Economic Forum, 2019).

Japan Food Mileage: Distance between food production and consumption sites is 644kms in USA, 50kms in Canada, 20-100kms in EU whereas it is within a

cycling distance of 0.5 to 1 kms for 71-84% of consumption sites in Tokyo. Due to high prices for lands, only 10-30 sqmts of lands are leased out to urbanites for farming. Urban farm produce is sold in markets called Choku baayi Jyo (Rambabu P, 2023).

Tokyo's Food Garden in Corporate Office: The green space in corporate office building at Pasona, Tokyo, Japan totals over 43,000 sqft uses both hydroponic and soil based farming with 200 species including fruits, vegetables and rice that are harvested and served at the cafeterias within the building. Tomato vines are suspended above conference tables, lemon and passion fruit trees are used as partitions for meeting spaces, salad leaves are grown inside seminar rooms and bean sprouts are grown under benches and a rice paddy and a broccoli field in main lobby. These crops are equipped with HEFL, fluorescent and LED lamps, automatic irrigation system, an intelligent climate control monitors humidity, temperature and breeze. Seasonal flowers and orange trees are planted on the balconies between the double skinned façade (Inside flows, 2022).

Floating Dairy Farm, Rotterdam: The farm currently houses about 35 cows on a two-story floating platform in Rotterdam. Cows are fed food waste from the city and their waste is then used to create fertilizer for nearby fields. The farm is expected to produce about 800 liters of milk daily. It also has a floating chicken farm and a floating vegetable farm (Bright vibes, 2021).

Growing Mushrooms from Coffee grounds in Cities, Rotterdam: Rotterdam is growing oyster mushrooms on coffee grounds and coffee husk in an abandoned swimming pool in the city Centre, and also a Grow kit is developed and sold to people to convert their coffee grounds into food at home. Husk, stored in plastic bags is picked up for free every month. Mushrooms are sold for 10 Euros per kilo to restaurants and catering businesses and 15 Euros per kilo to consumers (RUAF, 2015).

Community Food Forests

L shaped Picasso Food Forest (Parma Italy) covers an area of about 4500 m² and has the shape of two rectangles is hosting more than 185 trees, shrubs and more than 200 plant species and varieties. The barren grassland was transformed into a blooming green area where residents of the Picasso neighborhood meet, connect and forage their food. Melbourne Kensington and Per.ka, Parma, Italy, Sherett, Portland, USA (Melissa Manuel, 2021) are examples of other food forests

FAO efforts in the Poorest Country- Tegucigalpa, Latin America: the case of Honduras

FAO and the district mayor's office launched the "Pilot Project for Strengthening

Urban and Peri-urban Agriculture and Food Security” in Tegucigalpa, one of the poorest countries in the world. 1200 participants were given two-month weekly training on home gardening on low-cost and locally-adapted gardening technologies. Follow-up studies found that almost 90% of the people trained had established gardens and were growing up to 30 different species of plants. Tegucigalpa became a signatory to the Milan Urban Food Policy Pact and is committed to strengthening its food system (Makiko Taguchi and Guido Santini, 2019).

Women led Urban Growers Collective of Chicago

Urban Growers Collective is a Black and women-led, non-profit, urban vegetable farm in Chicago, Illinois. In partnership with After School Matters, Youth Corps teen job training program engages over 180 youth annually, teaching bargaining, leadership skills, communication skills, advertising skills etc. It cultivates eight urban farms on 11 acres of land, on Chicago’s South Side. Produce is available at Fresh Moves Mobile Market, farmers’ markets and in Collective Supported Agriculture program (Urban grower’s collective, 2017).

TERRAE Contract Systems from Self-Production to Self-Employment.

Urban farming enthusiasts were trained in 3 stages empowering them from cultivation to marketing. In the first stage, each participant receive 50 hours of training in agro-ecology and is offered 50 square meters individual plot for 6–12 months and advised for self-consumption not sale. In the second stage, area is increased to 1,000 square meters and are trained in production for local markets they sign a contract with a local restaurant to provide seasonal vegetable boxes for 2–12 months. After one year of self-employed labour practices, the beneficiaries must register in the social security service under 3rd stage. These contracts are signed by the micro-farmer, the DILAS advisor, a local councilor and the holder of the restaurant. (Franco Llobera Serra Marian Simon Rojo, 2014)

Linking children and youth to Urban gardening in Liberia

4,500 students from 290 schools in Liberia received hands-on skills training in growing vegetable gardens and cassava fields on 60 hectares. Liberian youth (aged 16–35) were also linked to domestic and international markets. Seed money is placed into small businesses focused on ancillary services in the agriculture sector. School grounds of C.B. Harris Memorial primary school, Monrovia, Liberia grow half a hectare of okra, peppers, cabbage and other vegetables. Gardeners as young as six years old work with a teacher every day after school, learning the best way to plant seeds and harvest food (Nico Parkinson, 2014). The Askîy project is another example of learning Urban gardens for youth in Saskatchewan, Canada. (CHEP goodfood, 2016).

Tobacco Farmers turned to City Food Producers in Spain

Between 2010 and 2013, the Spanish Ministry of Agriculture and the trade union Comisiones Obreras (CCOO) launched a pilot project called TREDAR for training unemployed people from the tobacco sector in organic agriculture. These newly trained micro-farmers entered into contracts with groups of at least 10 consumers in the capital city of Madrid who would pay 40 Euros per month in return for 20 kg of at least five seasonal vegetables. (Franco Llobera Serra Marian Simon Rojo, 2014)

Saline Desert Farm, Oman

Hortus Aquarius- saline desert farm simulates a semi-natural cultivation method. Seeds are allowed to germinate and grow for one week in fresh water and then for the next 4 weeks, seedlings are grown with salty effluent collected from circular aquaculture system of Aquapolis. After irrigation the effluent from the saline vegetable lagoons is collected in a basin and stored for further re-utilisation. The system secures year round availability of fresh saline vegetables. (Gilbert Curtessi Maarten Feberwee, 2014)

The Farmery, NC, USA

The Farmery is an innovative urban market that combines a retail grocery, a cafe and indoor agricultural systems that offers the customer an educational and stimulating food shopping experience. Here, urban consumers can participate in the harvest of crops and fish. The system uses aquaponics which has three components: a stream like flowing raceway tank, where biofilters convert wastes to nutrients and filter this water through vertical growing panels, where crops are grown. (Benjamin Greene, 2013). La Food Forest (Plettenberg Bay, South Africa) is a similar kind of food forest combined with Café, at La Vista Lodge providing the hotel guests with delicious, locally grown food. (Amos Kapenda, 2019)

Sky Greens, Singapore

In a small country where locally grown vegetables make up only 7% of consumption, imports majority of their food is from China, Indonesia, Europe and the United States. Sky Greens' founded by Jack Ng, is a low-carbon hydraulic water-driven urban vertical farm. The three storeys-high vertical systems produces 5-7 times more per unit area compared to conventional farms. Lettuces and cabbages are grown year-round using less energy and water. The produce is still priced competitively and found at grocery stores in Singapore (Skygreens, 2012).

Indian Innovations

Growing Food on Railway Tracks: Mumbai is a city that has little open space and also is one of the largest slums in the world. Indian Railway has leased its land along railway tracks for cultivation of vegetables and flowers to keep the land clean and useful (Vallabh Ozarkar, 2022). (Samrat Mukherjee and Kate Chaillat, 2013)

Urban Gardens for Cancer Stricken Children: The Earthen Routes initiative -run urban farm located inside the campus of Tata Memorial Centre for Cancer, Navi Mumbai, produces a variety of organic vegetables, with the help of volunteers, is distributed at no cost to the children being treated at the research facility. (Earthen Routes, 2022)

City Farming by Rural Farmers: Urban Mali Network in Bengaluru city employs 54 urban malis, the migrant farmers who set up and maintain gardens of different scales and sizes in the city and earn approximately Rs. 18,000 to 21,000 per month. (Saumitra Shinde, 2022)

Compost from City Waste feeds Fishes and Crops: In Kolkata, Agricultural labourers use aquatic plants and sunlight to treat the waste water and also use strips of land in the low lying area to compost the organic waste from the city. The treated water is used for pisciculture in 3500 hectares and vegetables are grown in 350 acres. 26000 urban poor work in this venture. (Monica Rand Varsha Gupta, 2018)

Digital Initiatives in Urban Farming: City residents in Bengaluru, Hyderabad and Surat can rent 600 sq feet of farmland through Farmizen, a mobile-based platform, to grow organic produce. Users can visit the farm anytime to grow and harvest chemical-free produce. Farmworkers oversee the plots. The app currently has 1,500 subscribers and 40 acres of land under cultivation. (Harshinivakkalanka, 2018)

Metro Farms in South Korea

In the skyscraper-studded metropolis, Seoul, urban farming community is a smart hydroponic farm placed in a Sangdosubway station, on Line 7, Metro Farm and in four more other stations throughout the urban center. Metro Farm is a sleek, glass-encased plant nursery housing rows upon rows of hydroponic growing trays. Under the glow of LED lights and the attention of an automated tech network, 30 varieties of organic edible plants, including microgreens, flowers, and sprouts are grown. It produces around 30 kilograms of fresh vegetables daily. Most of those go directly into the salad bowls and smoothies of the 1,000-odd customers who frequent Farm8's adjacent café. (Metrofarm, 2019)

Thammasat Rooftop on University Farm (TURF), Thailand: 22,000 square meters of “wasted space” on the rooftop at Thammasat University’s campus on the northern outskirts of Bangkok was transformed into the largest organic rooftop farm in Asia. TURF yields up to 20 tons of produce per year, including rice, fruit and indigenous vegetables and herbs. (WLA, 2020)

A vertical Farm tower, Mashambas feeding an entire town in Sub-Saharan Africa.

The tower was designed by Polish architects, farms on the upper floors and the other floors have kindergarten classrooms, a doctor’s office and a docking port for drones. The ground floor would include an open-air market, where farmers could sell their crops. Part of the tower was made of modular pieces, which would allow it to be taken apart and transported somewhere else (World Economic Forum, 2017).

Low Cost Innovations

India: Indian urbanites are making several low cost creative innovations to make their gardens attractive and relaxing. The list consists of mobile vertical towers for balconies, low cost drip, self-watering pots and innovations in making organic inputs, integrating several enterprises like poultry and fish with terrace gardens etc.

Sack Gardens, Kibera, Kenya: AIDS affected 32000 slum populations were allotted small plots and seeds for nursery raising. After the seedling attains 3 weeks of age it is transplanted in a unique sack with a stones spine with a volume of 0.1 to 0.5 m3. One sack holds 30-40 seedlings on top and sides. Households with access to 3-4 sacks can generate 33USD per month and also 2-3 times full meal (Peggy pascal and Eunice, 2009).

“Growing Pillar” (GP) and the “Growing Wall” (GW), Kenya: The vertical growing systems were attributed to saving lives during the period of post-election violence Kenya experienced in 2007-2008, when the community suffered massive food shortages. “Growing Pillar” (GP) is a cylinder (1/2sqmt width x 2 mts height) gives a minimum of nearly five square meters of growing surface, which is ten times greater than the occupied ground area. Growing wall is 50 cm in depth and 1 meter in height while the length may vary. Both utilize simple welded-wire fencing for the structure, fabric for the inner lining and high-quality compost and soil. Like the sack garden, the entire surface can be used to grow food. A vermicomposting component is added to the design. (Randall Coleman, 2009)

Terrace Pigeon Farming Dhaka, Bangladesh: Commercial Pigeon farming is done on terraces under semi scavenging system mainly for squab (tender meat) purpose. Crowned pigeon, Jacobin, Fantail Pouter, Swallow, Bokhara trumpeter and Frill back etc are expensive and fancy pigeons reared for decorative purpose (Ashraful Hoqueetal 2021).

Conclusion

The increased speed of migration into cities poses a barrier to access to healthy, nutrient-dense food for city dwellers. One solution to this challenge is the development and expansion of urban agriculture. Urbanites too have the chance to receive fresh, regional food thanks to city gardening. Nonetheless, consumers' good perceptions and acceptance of urban farming are necessary for urban agriculture to be effectively integrated into cities. Creation and upgrading of urban farmers' inventory and databases, R & D on Urban precision farming, encouragement and incentives to develop innovative crop management techniques and inputs that are both eco-friendly and economically viable are the need of the hour.

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