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Urban Farming - A Sustainable Model for Indian Cities

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ABSTRACT: The population of cities in India continues to expand exponentially. It is predicted that by 2050, 55% of Indians will be living in urban areas. Traditional Agricultural Industry is challenged to keep pace with this as it is estimated that agricultural land capacity can increase by 2% only.
The concept of Urban Farming has gained the serious attention of Planners and Academic communities in India. The combined issues of Population explosion, rapid urbanisation and climate change are posing great threat to the Food Supply. Urban Farming is seen to have potential for cities to have at least some measure of Food Security.
Urbanfarming is a process of using innovative scientific farming techniques to produce high yield and high quality of fresh organic food in very limited urban areas like terraces and balconies, all year -round. It is seen to have many advantages including non- dependence on vagaries of Climate, use of recycled water from Sewage and treated Wet waste as compost, proximity of producers to consumers, reduction of carbon footprints etc.
The Concept of Urban Vertical Farm has been around since the 80's but the Urban Farming Industry is not growing so fast. The main challenges seem to be Economic viability and Sustainability There is still a lack of any comprehensive knowledge and know-how in the public realm regarding practical aspects of Urban Farming. The Economic costs and viability for large scale urban Farming seems prohibitive. Thus, so far, the urban farming industry has not grown much. In this paper, we research into the Sustainability of UF, using the SAFA dimensions of Sustainability as reference. i.e. Environmental, Social, Economic and Institutional dimensions.
In this paper, we study six successfully functioning Urban farms, some are by individuals, some are co-operatives and some are supported by Institutions like government or other institutions and analyse their Sustainability Dimensions. This paper tries to study these operational models of Urban Farms from the aspect of repeating the same model in other regions.

Key words: Urban farming, Sustainability ,health and nutrition, , cost, yield, Solid waste and sewage management, social well-being, Environment, Biodiversity, Economics, land value, Government policies**.**

I. INTRODUCTION

Terrace gardens and farming in urbanized areas are as old as Babylon. But today Urban Greening and Urban Farming has acquired a new significance due to the current trend of rapid urbanization around the world.

In India,the share of urban population was just 30% in 2010, A report by UNDP estimates that this will rise to 40% in 2030 and over 50% by 2045. The urban population in India is set to increase from the current 3.5 billion to more than 6 billion by 2050*Areas under cultivation increase by just a miniscule 2% annually in comparison to the Urban growth.

The combined issues of population explosion, rapid urbanization and climate change are posing a great threat to food supply. The Farmer population has decreased and various factors contribute to the poor yield of existing Farmlands. The youth are taking to non-agricultural vocations and employment in non - agricultural sectors. Thus the Urbanizing communities are confronted with urban growth, changing life-styles and food security problems .

The urban population living and employed in cities has to source their food supply from the market. As much as 70% of their income has to be spent on buying food. Thus they are vulnerable to the fluctuations in the market prices. To support this vulnerable population is a great challenge for urban Governance. In many parts, it is seen that the urban poor are utilizing vacant plots in the city to grow vegetables to enhance their income also.

India, being an agricultural country, urban farming has been a traditional activity at household level which has its origin in household kitchen-waste management. Thus we see great potential for farming lies just below the surface! Urban farmers have access to knowledge, emerging technology, and research in agriculture. Many have carried out highly successful experiments in growing fruits and vegetables under most constrained urban conditions. They have become the torch -bearers and teach by example their methods to grow maximum yield from minimum space available.

Let us study some of the very successful urban farming initiatives by learned persons in our own country with a view let their experiences guide us to determine the key principles involved for success and sustainability of Urban Farming.

In order to get a more holistic understanding of factors involved in sustainability of Urban Farming as a tool for Urban development, we use the basic SAFA model which defines four pillars of sustainability-namely -economic resilience, environmental integrity, social wellbeing and good governance. As we align the issues of UA in India with these four pillars, we can see if they support the adoption of Urban Agriculture on a full scale for Sustainable Urban Development.

II. SUCCESS STORIES IN URBAN FARMING

Urban Farming activities in urban and peri urban residential areas are making significant contributions to sustaining and distribution of knowledge within the community of practice. There are also other benefits from them such as community building, management of green spaces, ecosystem service provision, including improvement of local climate Biodiversity and cultural services .Let us study some of the very successful urban farming initiatives taken up by learned persons in our own cities with a view let their experiences guide us to determine the key principles involved for success and sustainability of Urban Farming.

We have selected two individual Farmers, two voluntary farming communities and two groups of commercial farmers for our study.

A. Case study-1: Green terraces roof-top, Kerala

Vegetable farming by CLUSTERS of farmer land in Kerala remains water logged for most of the year. Hence vegetable prices went high. The Kerala state department of horticulture has taken initiative of promoting roof-top cultivation of vegetables in urban as well as Peri-urban areas.

Vegetable initiatives for urban clusters: they use grow-bags to cultivate cauliflower, tomato, bottle gourd, bitter gourd etc. on terraces and on sticks, poles too. The farmers receive training from the state department who have taught them to grow vegetables on terraces, sticks and poles too. They grow cowpea and cucumber too.

Two Farmer Interest Groups (FIG) having 25 members each in peri-urban areas have registered under the companies act and also under Vegetable and Fruit Promotion Council of Kerala. The VFPCK has set up a market and the urban farmers are able to sell their produce for a good price. The peri-urban farmers are happy with the scheme.

B. Case study-2: Networks of farmers, Kerala

On a busy road, amid high-rise buildings, in convent road of Ernakulam, Kerala, grows the terrace farm (nurtured by 70-year old ARS Vadhyar, a civil engineer). It has 3 coconut trees, 35 banana trees, papaya, guava, chickoo, grapes, pumpkins, ash gourd, snake gourd, bitter gourd, okra, tomato and many many more vegetables. All on just 1500 sq.ft. of terrace. Those who take up terrace farming are not regular farmers, but professionals like engineers, doctors, employees of public and private sectors. Senior citizens, women home makers and even students.

"Each district in Kerala has a minimum of 20,000 roof-top cultivators." says K. Prathapan, Director, State Horticulture Mission. The main reason for this trend is growing health consciousness and fear of consuming contaminated foods.

The social media has played a crucial role in sustaining the organic terrace farming movement. Groups such as Kitchen garden, Krishi bhoomi etc. share knowledge among members. They got together and organised a 3-day exhibition cum training workshop on organic terrace farming. Such initiatives have generated awareness among people also informed about government subsidies, technology transfers and schemes.

C. Case study-3: Garden city Farmers Trust, Bengaluru

This is a committed group of intellectuals leading a highly successful movement in Bengaluru to encourage citizens to take up organic terrace farming. The Trust is managed by a group of nine people. Nearly 10,000 people have already turned farmers in Bengaluru city. The group is now trying to raise the funds for distributing of creepers in city slums, where people are deprived of clean food and air. It hopes to bring back the green standards that the city was known for before the IT sector revolution.

Dr. V. Kadur, founding father explains there is nothing like 100% yield in agriculture. 15-20% is always lost to insects and birds. We have to learn to live with insects and other micro-organisms and go ORGANIC. Otherwise we may be permanently damage the eco-system.

Motto-" Eat what you grow and grow what you eat." They have been motivating citizens to convert all available spaces in and around their dwellings into green, edible patches.

The effort is slowly snow-balling, with many such groups greening vacant plots in the city.

D. Case study-4: Roof Top Revolution in Sakthikulangara, Kerala

S.K., a sea-side local municipal corporation is a village famous for fishing and fishery related activities. The soil there is highly acidic and unfit for cultivation of any kind. Agriculture held no promise.

Now all this is a thing of past. The initiative of Anthony john has transformed this barren area into a hub of a new garden revolution. Each family is encouraged to produce fresh, hygienic organic vegetables.

Anthony john's formula:

Growth medium: treated coir pith, bio-char 95% & local soil 5%.

Plantation of seeds in PVC channels split length-wise in half, kept in stacks.

Irrigation: drip method using a timer automatic

Compost: by converting his own kitchen waste and other bio-waste for which he developed low cost aerobic bio-composting unit.

Ooze(activated compost tea): the liquid which oozes one of the garbage is enriched with bio-fertilizer and friendly microbes and the liquid is sprayed on the plants. Also diluted sea water is used for providing essential nutrients.

He is highly successful in cultivating a variety of vegetables, lettuce, kale, tomato, brinjal and cabbage etc. And now he is a role model for terrace farming all over Kerala too.

E. Case study-5: Urban leaves in Mumbai blossoming on a concrete backdrop

Population in city of Mumbai has increased 12 times over in the past century. In such crowded conditions u/a seems unlikely to be put into practice, since it must compete with real estate developments for access to and use of vacant lands. But dr. doshi's city farming methods are revolutionary. In his terrace of 1200 sq.ft., dr. doshi has grown fruit such as mangos, guavas, figs etc. his method of using sugarcane waste, compost and garden soil in poly bags, tires, drums etc. his policy consumes the entire household waste and makes his household self-sufficient in provision food 5kg. and produced daily for 300days in year.

Urban leaves is a community empowerment programs of vidya vaardhi trust which has come lovely way in developing skins and techniques of urban farming. Preeti patil, has for many years, oversaw the catering for thousands of employees at Mumbai port trust. The massive wet-waste generated was being trucked away until dr. r.t. dodhi inspired her to change the waste into a resource. Putting to use the terrace above the kitchen, preeti has used "amrit mitti" a nutrient rich soil along with pulverised kitchen waste and produced an abundance of fruit, vegetables and greens.

The movement, begun in 2009 has grown tremendously and urban leaves now conducts learning sessions, encourages growth of new similar community of urban farmers. Regularly has sale of organic vegetables in different parts of the city.

"No one can force anyone to be part of this. You can transform people only by example. When people see how much can be achieved even in limited confines of balconies and windows, they realize even they can do it.", says Preeti.

F. Case study-6 Growing vegetables on garbage dumps in East Calcutta

Calcutta, India, has some of the most outstanding waste-into-farming systems in the world. At Calcutta's main garbage dumping site, the municipal corporation leases about 800 hectares of older dump plots with rich compost for intensive farming . Small farmers and cooperatives produce 150 to 300 tons a day of up to 25 varieties of vegetables which fetch high prices in Calcutta. The intensive farming generates employment for about 20,000 youths, men and women.

The site consists of fingers of solid land jutting into a series of lagoons east of the city. The fields are served by unpaved roads. Farmers provide their own security by rotating night-watch duty. The farming system is labour-intensive, including hand-carried irrigation water.

Inorganic materials are removed from the garbage by an informal recycling industry before the waste gets to the dump site. The remaining organic waste is rich in nutrients, and no chemical inputs used. This traditional farming produces safe food and is environmentally sustainable.

Sale of the produce is to middlemen at the farm gate and direct sale at city centre markets. Rent is paid to thika tenants, or landlords, who lease large tracts from the Calcutta Municipal Council. The West Bengal State Department of Agriculture provides monitoring and tests for food safety.

III. SUSTAINABLE DEVELOPMENT MODELS

A. A glance at the definition of Sustainability

"Sustainable development means ensuring dignified living conditions with regard to human rights by creating and maintaining a widest possible range of options for freely defining life plans. The principle of fairness between the present and future generations should be taken into account tin the use of environmental, economic and social resources. Putting sustainability into practice entails comprehensive protection of bio-diversity in terms of eco-systems species and genetic diversity, all of which are vital foundations of life." (Barnwal, 2012).

In other words, we may state that sustainability is a continuous "good Life" that is a combination of High level of Human wellbeing combined with a high level of eco-system wellbeing that supports it.

The human population whilst rushing towards progress in the 20th century had forgotten that in order for Man to survive, we need to maintain the eco system which supports us. In order for man to survive, we need to adapt to nature and not visa-versa.

B. Models of sustainability

Construction of Models help us to understand the concepts of sustainability better.

Three Pillars Basic Model has three vital dimensions which are interdependent and together they make for sustainability- Environmental Dimension, Economic Dimension, Social dimension

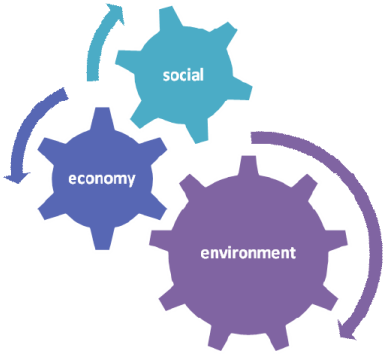

Fig.1 . Three pillar basic model.

An improvement on this model is inclusion of one more dimension- Institutional. It could stand for Government Institution or Private Institution or an Alliance of both. Together, they are said to form the four Pillars of Sustainability.

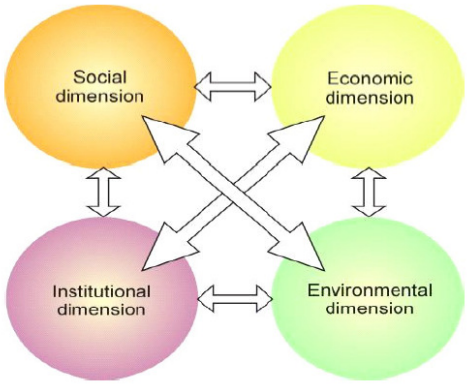

Fig. 2. Dimension of Sustainability.

Thus we see that Urban Farming can be sustainable if it has Environmental Integrity, Economically Resiliant, Promotes Social Wellbeing and is backed with Supportive Governmental Policies.

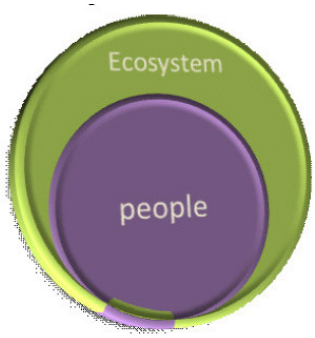

Fig. 3. The Egg of Sustainability.

This Model for Sustainability was designed in 1994 by International Union for Conservation of Nature, The relationship between the Eco-System and People is like one circle within another , like an EGG and its yolk. Just as an egg is good only if the yolk and White both are good.

Social and Economic development can only be sustainable if the Eco-system or Environment offers the necessary resources and raw materials.

Thus the Environmental can be regarded as the Super Co-ordinating System to the other three dimensions- Social, Economic and Institutional.

These later can prosper only if they adapt themselves to the limits of environmental carrying capacity.

In the light of the above Model, we can examine the sustainability of Urban Farming as a tool for sustainable Urban development and draw the following conclusion :

Sustainable Development = Human wellbeing + Eco system Wellbeing

IV. URBAN FARMING- OPPORTUNITIES AND CHALLENGES

An analysis has been made of various sources, including opinions voiced by practicing Urban Farmers to summarise below the main Benefits and Challenges, opportunities and constraints posed for implementing Urban Agriculture in the context of Indian cities.

It is formatted to align with the four pillars of Sustainability.

A. Urban Farming – Opportunities

Urban Farming, although it appears to be simple, impacts a community in various ways. Provides Food security, environmental benefits, biodiversity, even the city form gets modified ,city-dwellers get socially conscious and activated.

Environmental Integrity. Improved Waste management: The most important benefit of UA is its potential to utilize the organic wastes produced by the city. It contributes to natural resource conservations. It can turn waste from a problem in to a resource.

It reduces the public cost of transportation and management of waste. The funds saved can be better utilized for more constructive programs of urban amenities.

As the private sectors gets involved in UA, citizens can create cleaner and better living environment especially in areas not receiving waste management service from Municipal corporations.

Most cities today face acute problems in finding place for dumping waste resulting in air water & land pollution in cities & in bio regions. Examples of Ramsey site bio region Deepor Beel in Guwahati greatly disturbed due to dumping of garbage. Deonar in Mumbai is also a dumping ground, polluted the city when it caught fire.

Waste water and solid waste systems are costly for city administration & yet they do not have capacity to service the entire city centre. Urban farming contributes to this process by a) producing crops for life stock consumption, b) by composting wet waste and c) processing waste water for direct production and for irrigation.

Conservation of resources: UA assists the conservation of bio regions and their resources by reducing the pressure to convert deserts, mountain slopes and rain forests into cropland. Because Urban Agriculture methods are intensive, and yield from UA is estimated to be more than six times that of rural production.UA also uses very little water due to innovative irrigation systems (drip irrigation, aeroponic cultivation).

Replenishing of soil nutrients: Composting of organic wastes puts the nutrients back into the soil. There is no contamination of soil and water bodies. Significant ecological, economic and health benefits thus accrue.

Enhancement of Bio Diversity: By greening the city, UA gives scope for Bio diversity of vegetation, birds, return to their habitat. Many varieties of vegetables which have stopped being produced can be revived.UA beautifies the city, moderates the Microclimate and making it comfortable for living.

Disaster mitigation: This benefit of UA is perhaps least appreciated and least understood, for example, on steep slopes, flood plains, wet lands and other disaster prone areas, trees and orchards and marketable grasses such as vetiver can be planted They are excellent for reducing erosion and vulnerability to disasters.

Economic Resilience. UA can provide income generating activity for people with low skills and little capital as well as for people with little mobility including women with children and aged persons.

Stronger economy base. UA puts unused land to use by paying competitive rent or surface reuse and maintains the land in good condition for the owner.

Cost and energy savings.

In packing, storage, refrigeration, and transportation of food, by diminishing food miles. Pollution and greenhouse gases are reduced. Carbon footprints are reduced.

Added Income generation

Employment generation

Enterprise development

Scope for Marketing Enterprises

Social Wellbeing. Improved food security, nutrition & health for urban poor and marginalized persons.

The locus of poverty is fast shifting from rural to urban areas. The poorest household spends 60-90% on food & face hunger as a result. u/a can contribute significantly to combat hunger & malnutrition.

Self-production and barter increase the food security of the poor by making it possible to obtain food they could not otherwise afford even during financially bad times u/a contributes to the health &wellbeing of a community by reducing hunger, improving nutrition & improving environmental conditions that effect health

cleans and greens the environment reduces pollution & disease causing pathogens in the environment.

Empowers the Urban People, increasing community participation, checking social unrest. It enhances women's control over food cultivation.

By physically farming for food, the younger generation can learn to appreciate the environment, and the life cycle of the vegetables.

Urban farms also are a proven effective educational tool to teach kids about healthy eating and meaningful physical activity

Good Governance. Closing the Ecological Loops: The importation of Food from rural areas and exportation of Wastes to regions outside the city is the norm for City Governances(open loop). But UA closes the loop. In India, urban agriculture is just witnessing the beginning with piecemeal efforts made in a few cities. But in the perspective of growing population and growing food scarcity in the near future, it can be present in every city as a 'resource conserving industry'. It takes away a city's wastes and converts them into resources. It creates a diverse ecology where fruit trees, vegetable plantations and fishes could coexist with built environment– a wholly ecologically sustainable scenario. Surveys suggest that almost 50 percent of vegetables can be composted organic manure to help produce vegetables and fruit trees. Similarly, 50 percent of urban waste water can be biologically treated to be used for irrigation of food products or as a medium for aquaculture.

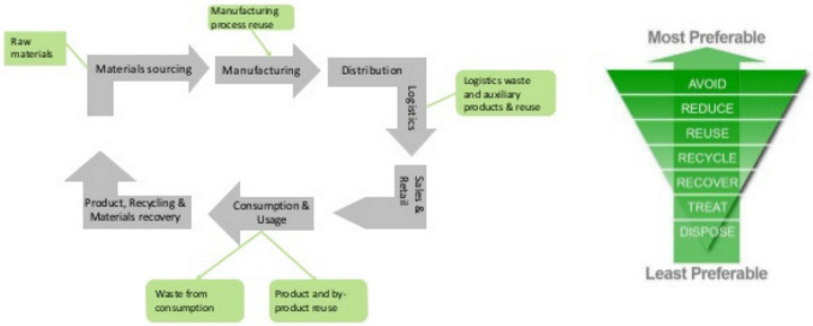

Fig. 5. Key principles of closed loop environment.

B. Urban Farming- Challenges

Little could be found in the academic literature which would condemn UA at large and advocate its ban under any form. But the debate is likely to heat up as UA practice and policy grow in scale and in complexity in the next decades, thus affecting interests in very different and tangible ways.

Environmental dimensions

Although studies have demonstrated improved air quality in urban areas related to the proliferation of urban gardens, it has also been shown that increasing urban pollution (related specifically to a sharp rise in the number of automobiles on the road), has led to an increase in insect pests, which consume plants produced by urban agriculture.

Studies indicate that the nutritional quality of wheat suffers when urban wheat plants are exposed to high nitrogen dioxide and sulphur dioxide concentrations. This problem is particularly acute in the developing world, where outdoor concentrations of sulphur dioxide are high and large percentages of the population rely upon urban agriculture as a primary source of food.

Agricultural activities on land that is contaminated (with such metals as lead) pose potential risks to human health. These risks are associated both with working directly on contaminated land and with consuming food that was grown in contaminated soil.

Because of the undervaluation of UA and stiff competition for land, UA is often pushed back to marginal areas within the city, such as wetlands and hill slopes, where it may harm the fragile ecosystems if not properly guided

Social dimensions

UA is a Highly labour-intensive activity requiring dedicated hours of work

The required Farming inputs are not available in appropriate quantity and time

There is Lack of knowledge of standard practices for organic farming.

The utilization of untreated waste water for urban agricultural irrigation can facilitate the spread of waterborne diseases among the human population.

Economic dimensions

The UA up- and downstream effects on the rest of the urban economy has not been quantified. UA requires inputs and human resources for fencing, crop management, storage, transportation and processing (milling, cooling, drying, cooking, packaging).

Space is at a premium in cities and is accordingly expensive and difficult to secure.

Government policies

Allotment gardens are seen as a relic of a bygone era.

Drastic policy changes and relaxation of gardens protection rules are required.

Claims of former owners of the allotted lands.

Allotment gardens seen as anti to urban development.

Price of the farmlands located close to the city centers compete with real estate.

An important finding is that a majority of the successful Urban Farmers advocate that Urban Farming should remain at small scale only so that market considerations do not over-ride the environmental benefits. e.g. biodiversity in vegetables and fruits.

CONCLUSION

It can be safely concluded from all the above discussions that Urban farming can be taken up as an important tool for Urban development. Urban farming can play a vital role in building more resilient and livable cities.

Economic considerations

People's livelihoods have to be at the center of any discussion about sustainability and making changes.

At a most basic level the need to provide for oneself and one's family is a major driver of behavior. We need to be able to recognize this tension between short-term livelihood decisions and long-term sustainability goals for the city and forge a path that works with people's need to provide for their families, but does so in an environmentally and socially conscious and sustainable way.

Social Considerations

Urban Farming in its nascent stages in Indian cities is characterized by a high degree of professionalism with astructured knowledge transfer and cultivation practice. It clearly represents a projection surface, reflecting the community's environmentally conscious behavior.

Promotion of UA activities in residential areas make a significant contribution to sustaining and distributing knowledge within the community of practice. It is also attributed to other larger benefits, such as community building, management of green spaces and ecosystem service provision, including local climate, biodiversity and cultural services.

Many organizations, for example in Mumbai, Bangaluru and Kerala are disseminating knowledge of results of their own research in Urban Farming suitable for their own area to the communities. This is bringing about a change in mind set and a sensitivity towards the environment, Social wellbeing accrues.

Environmental Considerations

Closing The Loop, Sustainance of the environment and retaining Bio diversity is of utmost importance for a city to remain alive Piling up of garbage, soil erosion, destruction of vegetation, depletion of water bodies, pollution of resources are the killers of cities. Cities have a chance to turn the trends to make their city sustainable. Urban farming is a vital tool for sustainability. Closing the loop is the process where in all waste is converted into resources and utilized in a continuous closed loop.

Waste Management and Sewage management

The three R's of Waste Management, Reduce, Re-Use and Re cycle have to be put into practice at local levels. Compost from wet waste, and recycled water from Sewage can be comprehensively utilized by the city in Urban Farming in a CLOSED LOOP. Complete self-sufficiency in terms of Food production may not be possible and nor ideal, but maximizing the utilization of Waste is of vital importance for the Environment in the City.

ity Planning considerations

Inspite of its seeming simplicity, however, urban agriculture does not just happen.

To foster the development and growth of urban agriculture, the city planners may have to consider implementing techniques that include zoning ordinances, comprehensive plans and, in some cases, state legislation

Land-use

Urban agriculture and food production systems if considered along with land use patterns, a comprehensive consideration of Urban Agriculture and protection of Environment can be made.

- Identification of land for urban agriculture;
- Major water bodies and marshy lands should not be filled up
- Waste lands can be used for tree plantation and urban farming;
- Agricultural land within metropolitan area is to be protected under the provisions of Town and Country Planning Acts;
- Underutilized areas on long banks of rivers or canals can be developed for urban-agro forestry including parks and garden at places;
- Planting fruit trees in the periphery of existing city parks, can generate employment and municipal income for maintaining of parks and other such areas;
- New townships and housing estates should incorporate city farming,

horticulture, etc; from the planning stage itself;

- Derelict land, abandoned brick fields and other areas near industries

should have an ecological restoration program making it part of the

planning condition while granting permission;

- Revitalization of canals will encourage aquaculture and fish production;
- Garbage dumping sites and sewage fields can take the example of east Kolkata, where already people are producing substantial vegetables and fish through pisciculture and farming.

Thus we see that Urban farming can play an important role in building resilient, sustainable, livable cities.

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