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Urban Agriculture: Improving Food Security and Environmental Health of Cities

Cities are growing rapidly in developing countries. This process is often accompanied by high levels of poverty and hunger, leading many urban dwellers to engage in farming activities, not only to help satisfy their food needs but for markets as well. Many policy makers are taking action to seize the opportunities offered by urban agriculture. However, cities must do more to meet and keep pace with growing urban populations.

While poverty persists in rural areas, it is increasingly a phenomenon in metropolitan areas as the world continues to urbanise. Since 2008, more than half the world's population, now over 7 billion persons now resides in urban areas. Regionally, over the next 25 years, Asia's urban population will grow by around 70 per cent to more than 2.6 billion people¹. This staggering number and the current trend of increasing urban poverty will place significant pressure on governments already struggling to meet and address a variety of issues linked to such growth.

Amongst global population increases, demand for agricultural goods will rise by 70 per cent with demand for meat doubling by 2050. This will occur without encroaching on new land or tapping into already over-stressed and dwindling water resources. Compounding the stresses on fragile natural resources is the agricultural sector, where greenhouse gas emissions and the effects of more intensive land use are contributing thought to climate change.

In addition to being a significant user of land and consumer of fossil fuels, agriculture contributes directly to greenhouse gas emissions through practices such as rice production, the raising of livestock and transport of agricultural goods from rural to urban areas². According to the Intergovernmental Panel on Climate Change (IPCC), the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture.

¹ ADB (2006), Urbanisation and Sustainability in Asia Case Studies of Good Practice. Edited by Brian Roberts and Trevor Kanaley
<http://www.adb.org/Documents/Books/Urbanisation-Sustainability/urbanisation-sustainability.pdf>

² The Economist November 21st 2009, How to feed the World.

Currently, despite food security gaining more attention following the 2008 financial and food crises across Asia and the Pacific³, the food dimension of poverty in urban areas has yet to be given appropriate consideration in either poverty reduction strategies or international development fora. Policies and resources dealing with urban food security should be given priority as it is linked to overall wellbeing.

Migrating to cities in hope of escaping poverty

Rural to urban migration is a contributing factor in the population growth of cities, but it should be noted that natural population growth and the reclassification of rural into urban areas owing to development also contribute to urban population growth⁴. Of the many reasons persons migrate to cities is in the hope of improving their wellbeing. Arriving poor from the countryside, rural to urban migrants are part of a city's makeup of urban poor, and those born into urban poverty share some aspects similar to rural poverty, such as the expectation of gaining better access to health and education.

The World Bank defines urban poverty as a multidimensional phenomenon, with the urban poor living with many deprivations, including limited access to employment opportunities and income, inadequate and insecure housing and services, violent and unhealthy environments, little or no social protection mechanisms and limited access to adequate health and education opportunities⁵. While anticipation of escaping some of the same deprivations associated with rural livelihoods exists, cities, however, offer an economic ladder that may not be found in rural areas, and that ladder is likely a contributing factor, not only to the on-going rural to urban population shift globally but in the Asia and Pacific region as well.

³ UNESCAP 2009, Theme Study 2009: Sustainable Agriculture and Food Security in Asia and the Pacific.

⁴ UNESCAP 2007, Committee on Poverty Reduction, Fourth session, 12-14 December 2007, Bangkok

URBAN POVERTY AND THE WORKING POOR, p.4

⁵ World Bank What is Urban Poverty,
<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTURBANPOVERTY/0,,contentMDK:20227679~menuPK:473804~pagePK:148956~piPK:216618~theSitePK:341325,00.html>

Given all the perceived benefits of being in a city, a certain safety net found in rural areas not associated in urban areas is better access to food. When the 2008 economic crisis hit China for example, many would-be factory workers, who found themselves missing the opportunity to, "...climb the urban economic ladder" simply went back to the countryside and returned to agricultural pursuits. Subsistence via rural/agricultural pursuits could better put food on the table. The instability created in the urban labor market and its vulnerability to economic shocks directly impact on poverty and rural-urban population flows. Once economic growth picks up again many will make their way back to the cities driven by hope of a better life.

The China example aside, urban poverty is not so much a lack of employment, because almost all urban poor are "working poor" with incomes higher generally than those of the rural poor. The problem also is not an absence of basic services, because such services are highly concentrated in urban areas.

Rather, urban poverty is different from rural poverty in many respects, with the urban poor affected by the highly monetised nature of urban living forcing them to spend far more on accommodation, food, transport and other services than the rural poor. Unlike rural poverty, urban poverty is characterised by the regulatory exclusion of the poor from the benefits of urban development⁶.

Of the increased costs of urban living, access to healthy food is perhaps the most basic of all human needs, and it is the number of hungry city dwellers that appears to be climbing along with the total urban population. Malnutrition is a component of urban poverty with studies showing a link between the growth in underweight children in urban families and the inability of their families to purchase food⁷. Recent findings⁸ indicate that in some countries food insecurity⁹ is more serious among the urban poor than among the rural poor. In India, underweight children constitute 61 per cent of the poorest one fifth of the rural population and 66 per cent of the poorest one fifth of the urban population¹⁰.

⁶ UNESCAP 2007, ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC Committee on Poverty Reduction, Fourth session 12-14 December 2007, Bangkok, *URBAN POVERTY AND THE WORKING POOR* (Item 6 of the provisional agenda) *FACING THE CHALLENGES OF URBANISATION AND URBAN POVERTY IN ASIA AND THE PACIFIC* p8

⁷ Urban Harvest, <http://www.uharvest.org/index.shtml?ape=a-b-653---ES-----~1-&i=EN> Data tend to show malnutrition as more prevalent in rural than in urban areas, but it is an emerging problem in many countries

⁸ UNESCAP, The Millennium Development Goals: Progress in Asia and the Pacific 2007 (United Nations, 2007).

⁹ The World Food Summit, held in Rome in November 1996, defined food security, as access by all people at all times to enough food for an active and healthy life. Food security involves three components: availability, access and utilisation. Availability refers to the total amount of food in supply per person; access refers to the economic ability of individuals to purchase food; utilisation refers to the body's ability to absorb necessary nutrients (See the World Food Summit Plan of Action (WFS 96/REP)).

¹⁰ UNESCAP 2007, ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

As with poverty in general, hunger is different in urban areas compared with rural areas. ESCAP¹¹ notes that urban food security depends on issues related to access and utilisation rather than availability. Given prices and income, the ability of a poor urban household to buy food may be less than that of a poor rural household because the urban poor must buy most of their food. In many cases, the urban poor pay up to 30 per cent more for their food than the rural poor and spend 60 per cent or more of their total expenditures on food¹². Transport costs and post-harvest losses incurred farm-to-market are the main causes of the higher cost of food in urban areas.

Ensuring food security and appropriate nutrition of the urban population, particularly the urban poor, has become a tremendous challenge in many cities in Asia. Cities are becoming the locus for intervention and planning of strategies that aim to eradicate urban hunger and poverty and improve well-being. Urban food insecurity is it not easily addressed by traditional, community-based approaches developed for rural poverty reduction.

Introduction to urban agriculture

Urban agriculture can be defined as the growing of plants and the raising of animals for food and other uses within and around cities and towns, and related activities such as the production and delivery of inputs, processing and marketing of products¹³. In large cities such as Beijing, many urban poor address gaps in their nutritional needs and, thus, their food security via urban agriculture.

As a healthy and nutritional diet requires an appropriate combination of micro- and macronutrients to fulfill the needs of each individual in a household, taking into account age, gender, and health status¹⁴, the main factor largely responsible for preventing the urban poor from achieving a healthy diet is lack of access to fresh foods. Poor households cannot regularly afford to buy perishable foods that contain essential micronutrients, which are especially important for children. However, even non-poor urban dwellers face difficulties in finding adequate amounts of perishable fruits and vegetables¹⁵. If the supply channels from countryside to city are inadequate, perishables will, periodically, be in short supply and, as a result, more costly.

Committee on Poverty Reduction, Fourth session 12-14 December 2007, Bangkok, *URBAN POVERTY AND THE WORKING POOR* (Item 6 of the provisional agenda) *FACING THE CHALLENGES OF URBANISATION AND URBAN POVERTY IN ASIA AND THE PACIFIC* p5

¹¹ Ibid, p. 5

¹² Ibid, p. 5

¹³ FAO (2007), *AGRICULTURAL MANAGEMENT, MARKETING AND FINANCE OCCASIONAL PAPER: Profitability and sustainability of urban and peri-urban agriculture* <ftp://ftp.fao.org/docrep/fao/010/a1471e/a1471e00.pdf>

¹⁴ FAO (2000), *Urban and Periurban Agriculture, Household Food Security and Nutrition*

Discussion paper for FAO-ETC/RUAF electronic conference "Urban and Periurban Agriculture on the Policy Agenda"
August 21 – September 30, 2000. p.1

¹⁵ Ibid, p.1

Urban conditions are more conducive to intensive production of perishable fruits and vegetables as well as small livestock rather than production of staple crops. These high-nutrient foods are needed to relieve undernourishment in poor households and can, thus, contribute importantly to household food security. Production of such food near the populations that need them helps to ensure they reach consumers. In addition, in some Asia-Pacific countries, while urban agricultural production is generally geared towards subsistence, countries such as Bangladesh and Nepal have more than one-third of production sold on markets¹⁶. This additional income serves to offset the increased costs of city living.

Urban agriculture provides a complementary strategy to reduce urban poverty and food insecurity and plays a role in enhancing urban environmental management. Urban agriculture is critical in improving urban food security since the costs of supplying and distributing food to urban areas, based on rural production and imports, continue to increase and do not satisfy the demand, especially of the poorer sectors of the population. Urban agriculture also contributes to local economic development, poverty reduction and social inclusion of the urban poor, especially women. Urban agriculture provides a buffer against both local economic insecurity as well as periods of war and conflict that can disrupt normal food flows¹⁷. Gardeners share food with friends, families, and neighbors as well as members of their community in need, for example, through gardening projects that encourage gardeners to allocate a specific space for urban-produced food donations.

Even in large, congested cities, the urban poor often have a home garden or raise small animals as part of a coping strategy. Food production in cities is a response of the urban poor to inadequate, unreliable and irregular access to food and lack of purchasing power. This urban production, often done by women, older persons and the unemployed, can complement household incomes and improve the quality of urban diets¹⁸. Community and residential gardening, as well as small-scale farming, free up household income for non-garden foods and other needs. Approximately every \$1 invested in a community garden plot yields \$6 worth of vegetables¹⁹.

¹⁶ FAO (2010), Fighting Poverty and Hunger: What Role for Urban Agriculture:

<http://www.unbrussels.org/images/pdf/Policy-brief.pdf>

¹⁷ Health Benefits of Urban Agriculture, Public Health and Food Security., Anne C. Bellows, PhD Rutgers, The State University of New Jersey; Katherine Brown, PhD Southside Community Land Trust; Jac Smit, MCP The Urban Agriculture Network Community Food Security Coalition (CFSC), North American Initiative on Urban Agriculture Committee. <http://www.foodsecurity.org/UAHealthFactsheet.pdf>

¹⁸ R4D 2006, A SYNTHESIS OF URBAN AND PERI-URBAN AGRICULTURAL RESEARCH COMMISSIONED BY THE RNRRS PROGRAMME, Final Report, Sabine Gündel, p.4.

¹⁹ Health Benefits of Urban Agriculture, Public Health and Food Security., Anne C. Bellows, PhD Rutgers, The State University of New Jersey; Katherine Brown, PhD Southside Community Land Trust; Jac Smit, MCP The Urban Agriculture Network Community Food Security Coalition (CFSC), North American Initiative on Urban Agriculture Committee. <http://www.foodsecurity.org/UAHealthFactsheet.pdf>

Growing food, herbs, medicinal plants and raising animals in backyards, along riversides and railways, on office grounds; and plots in peri-urban and urban areas, as well as the processing and commercialisation thereof, provide people with fresh and more nutritional food, savings on food expenditures and income from the sale of production. Nearly 800 million people are employed in urban and peri-urban farming and related enterprises, and this number is likely to expand in the future²⁰.

Types of urban agriculture

When walking in the quieter, low rise apartment neighborhoods in cities such as Beijing, it is readily apparent that urban agriculture plays an important role in food security for many apartment dwellers and urban residents. A common sight around most walk-up apartment buildings is cucumber vines wrapping around string or metal window bars. The cucumber plants utilise what is otherwise unused vertical space and are either rooted at the base of the apartment building or potted. Given that many buildings do not have garden space, plants are often potted (such vegetable cultivation is dubbed “micro-urban agriculture”²¹); or, again in the case of vegetables, produced almost entirely from outdoor window sills in pots or at the foundation of a building that is less than a square metre. Common fruits and vegetables witnessed around Beijing’s walk-up apartment and *hutong* neighborhoods are tomatoes, various herbs, peppers and squash.

Micro-urban agriculture appears to serve as a daily or weekly meal enhancement strategy that fills variety food gaps and is not a primary source of food. Rather, it is a complementary strategy to enhance daily or weekly dietary needs. Often the same windowsills also hold bundles of long onions or stacks of cabbages that the apartment owner has purchased prior to winter and before prices of such items climb during the winter months. Cabbages and onions are meant to last throughout the winter months with the cabbage often pickled. The money urban residents save from such practices is likely used for the purchase of rice, millet, flour and cooking oil. Meat for many poorer residents is considered a luxury reserved for holidays and similar occasions.

For apartment buildings that do have enough open space, vegetable gardens are found with a much greater variety of vegetables. Such gardens in the margins of the urban landscape can be substantive enough to provide weekly food supplies throughout the summer months and into autumn. In addition, studies have found that urban gardens and small farms produce surprising amounts of fruits, vegetables, fish, poultry and meat. In a 130-day

²⁰ Urban Harvest, <http://www.uharvest.org/index.shtml?apc=a-b-653---ES-----1-&i=EN>

²¹ Micro-urban agriculture is a term coined by the author (Eric Roeder) of this brief

temperate growing season, a 10 metre x10 metre plot can provide most of a 4-person household's total yearly vegetable needs, including much of the household's nutritional requirements for vitamins A, C, and B complex and iron²².

Realising the need to increase urban food security, city governments have promoted peri-urban agriculture. Moving toward larger margins of urban space, peri-urban agriculture, or agricultural activities found in areas immediately adjacent to cities (suburban areas), plays a more formal role in urban food security as city governments, such as the city of Beijing, set land aside for agricultural pursuits that also function as green lungs. Beijing increased its land area from 4,822 km² in 1956 to 16,808 km² in 1958, which led to the increased adoption of peri-urban agriculture. This "suburban agriculture" provided more than 70 per cent of non-staple food in Beijing, mainly consisting of vegetables and milk, produced by the city itself in the 1960s and 1970s²³. In Shanghai, technical innovation by urban farmers and institutional changes introduced by the municipal government has resulted in the inner zone of horticultural production – within a radius of 10 kms from the point of sale – supplying 76 per cent of the vegetable needs of the city²⁴. Recently, with relative food security in China, peri-urban agriculture has led to improvements in the quality, as opposed to quantity, of the food available.

Socio-economic benefits of urban agriculture can serve marginalised populations

While access to food is critical to all segments of society, it is the most marginal segments of the urban population, such as older persons and persons with disabilities, that will face the biggest struggle in obtaining sufficient or timely access to food supplies.

Older persons

Home to over 60 per cent of the world's population, the Asian and Pacific region now accounts for 410 million older persons; this number is expected to increase to 733 million in 2025 and to a staggering 1.3 billion by 2050²⁵. Over the next 45 years, Asians aged 60 and older will triple in number, to 1.3 billion, and grow from 10 per cent to 25 per cent of the population because of falling

fertility and rising life expectancy, according to the United Nations Department of Economic and Social Affairs (DESA). DESA estimates that Japan's over-60 population alone will grow from 28 per cent today to 44 per cent by 2050²⁶. Given such numbers, it is essential for governments in the region to start planning for the socio-economic implications of ageing societies, with an understanding of the changing demands and needs of the future elderly population of which their food security is seen as critical to their quality of life.

Thus far, a full conceptualisation of older persons' food insecurity experience has been lacking, leading to limitations in the definition and measurement of food insecurity in older persons²⁷. However, the experience of food insecurity of the elderly is shown to have four components: quantitative, qualitative, psychological and social, with the inability to obtain the right foods for health an element specific to marginalised populations such as older persons²⁸. Common to each of these components were dimensions of severity, time and compromised food choice. Although money is a major cause of food insecurity, older persons sometimes have enough money for food but are not able to access food because of personal transportation or functional limitations, or are not able to use food (i.e., not able to prepare or eat available food) because of functional impairments and health problems.

In cities such as Beijing, it can be noted that many of those engaged in micro-urban agriculture tend to be older persons with the above-sited reasons likely playing all or some part for their participation. Micro-urban agriculture can, therefore, be seen as an informal response to food insecurity in older persons. Larger gardening plots are community-based and more formal as building associations must be involved and, in the case of Beijing, municipal authorities also have some say. In any case, as the elderly population increases, an accurate assessment of the extent of food insecurity becomes more important for programme and policy decisions. Urban agriculture can also serve as a means for older persons and persons with disabilities to gain both reliable access as well as income from urban agricultural activities.

²² Health Benefits of Urban Agriculture, Public Health and Food Security., Anne C. Bellows, PhD Rutgers, The State University of New Jersey; Katherine Brown, PhD Southside Community Land Trust; Jac Smit, MCP The Urban Agriculture Network Community Food Security Coalition (CFSC), North American Initiative on Urban Agriculture Committee. <http://www.foodsecurity.org/UAHealthFactsheet.pdf>

²³ UA Magazine - RUAF: Peri-urban Agriculture Development in China, <http://www.ruaf.org/system/files?file=Periurban%20Agriculture%20Development%20in%20China.pdf>

²⁴ Food & Fertilizer Technology Centre for Asia and the Pacific (FFTC), Urban Harvest: A CGIAR Global Programme on Urban and Peri-Urban Agriculture – Opportunities for Cities, <http://www.agnet.org/library/eb/575/>

²⁵ United Nations 2007, UN News Centre, UN-backed meeting charts course for helping older persons in Asia-Pacific region., <http://www.un.org/apps/news/story.asp?NewsID=24271&Cr=ageing&CrI>

²⁶ Population Division, DESA, United Nations., World Population Ageing 1950-2050 Population Division, DESA, United Nations DEMOGRAPHIC PROFILE OF THE OLDER POPULATION <http://www.un.org/esa/population/publications/worldageing19502050/pdf/90chapter1.pdf>

²⁷ Understanding the Experience of Food Insecurity by Elders Suggests Ways to Improve Its Measurement I Wendy S. Wolfe*,2, Edward A. Frongillo* and Pascale Valois * Division of Nutritional Sciences, Cornell University, Ithaca, NY 14853-6301 and Fonds de la Recherche en Santé du Québec, Montréal, Québec, Canada H3A 3C6 <http://jn.nutrition.org/cgi/content/abstract/133/9/2762>

²⁸ Ibid

Persons with disabilities

In Asia and the Pacific, the population of persons with disabilities may be as many as 400 million, and the number is increasing because of multiple factors, including an ageing population. In China, government statistics say that 6 per cent of the country's population is either mentally or physically disabled. The capital of the country, Beijing, has close to 1 million disabled residents²⁹. Increased access for persons with disabilities in public spaces can be found in many larger cities in the Asia and Pacific region, and, particularly, in Beijing where even most public transit has disability and wheelchair access. But where are they? It is rare to see a person with an evident physical disability on the streets of Beijing. The answer many disabled people are not seen "...going about daily life..." is that despite strides in physical access, societal barriers keep many disabled persons from finding work, attending school or even getting out of their homes.

Persons with disabilities face all forms of discrimination and prejudice as well as all types of barriers. Such barriers, therefore, impede one's access to food. If addressing urban food insecurity for older persons has yet to be fully conceptualised, then food insecurity for persons with disabilities has yet to see any light at all. However, in the area of rural poverty reduction for persons with disabilities, the Food and Agriculture Organisation of the United Nations (UN-FAO) has made efforts to address poverty among the rural disabled population, the poorest of the rural poor, for example, in Thailand.

A commercial horticulture project aimed at income generation for people with disabilities in rural areas of Thailand was developed by FAO to train people with disabilities in mushroom cultivation³⁰. The main objective of the project was for rural, disabled people to reach economic self-reliance as entrepreneurs through income generation initiatives. This was done through a training programme on mushroom production, the promotion of mushroom cultivation and its processing and marketing among groups of rural disabled people. Training included all activities related to mushroom cultivation, from fruiting to drying, processing, packaging and marketing. Entrepreneurial skills were also included in the training programme.

FAO chose mushrooms because they are part of the daily menu in Thailand. Mushrooms can be cultivated on a

small- and larger scale to allow personal consumption, or via commercial enterprise. In addition, people with physical disabilities are fully capable of accomplishing all required tasks necessary in mushroom cultivation, noting that sometimes some modifications in techniques, handling, tools and equipment may be required. Mushrooms grow under the shade and, thus, reduce physical exertion associated with open cultivation, such as with rice and small fruits cultivation, and can also be performed by mentally disabled people since it requires repetitive activities that can easily be learned.

Very little space is needed and an urban setting could just as well serve as a mushroom house. Mushroom houses in the FAO project took into account ventilation, humidity, temperature and light, while buildings and equipment had to be adapted for use and accessibility by people with disabilities. Doors and aisles were designed to be wide enough for easy access by people in wheelchairs, with the height of mushroom racks allowing people in wheelchairs to reach higher levels. The FAO programme allowed trainees to learn how to make simple, inexpensive mushroom houses where grass rice straw, dried leaves and other materials were used efficiently. Recorded outcomes of the FAO project found increased self-esteem and a "can-do spirit", as well as increased economic self-reliance among participants.

In follow-up activities, the FAO also noted that more than 70 per cent of the trainees established their mushroom house successfully and were able to profit³¹. They have regular, supplemental income generated through mushroom cultivation, and the majority of trainees receive regular income with their mushroom farm. It was stated by many trainees that the project has allowed them for the first time to enjoy a regular income.

In short, while the FAO project focused on income generation for rural persons with disabilities, it could very well be looked at and adapted as an urban agriculture programme, with many countries such as China, brimming with agricultural experts in the area of mushroom cultivation, the first in line to adopt this strategy. Such innovation could also be extended to other fruits and vegetable cultivation to increase food security of disabled persons.

As urban agriculture has been embraced and promoted by the international development community as a means for urban dwellers to achieve sustainable livelihoods and socio-economic advancement, it is time to expand such efforts to reach the most marginalised of urban dwellers. Urban agriculture can provide low-income households, who farm in the cities, access to a more consistent source of food and better nutrition as well as allowing many to earn or free up cash for non-food items.

²⁹ China Daily 2008, Paralympic Games helps open more doors by Eric Roeder (China Daily)

Updated: 2008-09-18 07:57 http://www.chinadaily.com.cn/indy/2008-09/18/content_7036577.htm

³⁰ The author (disabled person) of this brief witnessed the programme first hand. - FAO 2000, SDimensions, Mushroom production training for disabled people: a progress report, <http://www.fao.org/sd/ppdirect/PPre0072.htm>

³¹ FAO 2000, SDimensions, Mushroom production training for disabled people: Feasibility, sustainability, replicability, <http://www.fao.org/sd/ppdirect/PPre0072k.htm>

Urban Agriculture and the environment

In addition to the socio-economic advantages of urban agriculture, such practices can be an important component to urban environmental sustainability. Urban agriculture offers opportunities to make a positive impact on urban ecosystems under tremendous strain from high populations and poor infrastructure through the provision of productive, aesthetically pleasing green spaces and the ability to absorb urban organic wastes through composting and productive reuse of urban wastes.

The Resources Centres on Urban Agriculture and Food Security (RUAFA) notes that the most striking feature of urban agriculture, which distinguishes it from rural agriculture, is its integration into the urban economic and ecological system. The RUAFA states that urban agriculture is embedded in and interacting with the urban ecosystem, with such linkages including the use of urban residents as labourers, use of typical urban resources, direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions and being influenced by urban policies and plans³².

Urban agriculture supports a more sustainable production of the food (organic) that uses less harmful pesticides that normally end up as agricultural runoff. Urban and local farmers also eliminate the need for preservatives post-harvest, as their products do not need to travel long distances.

Urban agriculture can also play a role in reducing agriculture's contribution to climate change by reducing both transport time and how food is produced in urban and peri-urban areas. It has been established that the current industrial agriculture system is accountable for high energy costs for the transportation of food, with the average conventional produce item traveling 1,500 miles (2,414 kilometres)³³, using, if shipped by tractor-trailer, one gallon (3.8 litres) of fossil fuel per hundred pounds (45.36 kilos) in countries like the US³⁴. In addition, agriculture and food production has been found to account for nearly one-third of all freight transportation services in some developed countries. In short, the energy used to transport food is decreased when urban agriculture can provide cities with locally grown food.

Growth of cities puts significant pressure on natural resources resulting in a drastic reduction of green open

spaces, depletion of trees, floods, heat-island effects and other natural disasters, further aggravated by the effects of climate change. These challenges can be better handled by giving proper attention to the potentials of urban agriculture, which contributes to urban greening, heat reduction, storage of water and maintaining construction-free flood plains in peri-urban areas.

Urban greening, or promoting a green environment for cities, is seen as a catalyst for sustainable development. For example, in Osaka, Japan, sweet potato was cultured with a lightweight hydroponic³⁵ system on a rooftop as a cooling mechanism for reducing urban heat-island effects during the summer season. Sweet potato was selected as it can grow under stressful conditions and has relatively high abilities for transpiratory³⁶ latent heat loss and photosynthetic carbon fixation compared with other plant species³⁷. The results not only put food on the table but the sweet potato canopy reduced the amount of radiated heat from the building roof-top, thus reducing that building's contribution to the urban heat-island effect.

For water storage and catchment in urban areas, rainwater harvesting can provide a free source of water that is less polluted than other sources of water within a city. Rainwater harvesting includes three components: a watershed area to produce runoff, a storage facility (soil profile, surface reservoirs, or groundwater aquifers) and a target area for beneficial use of the water (domestic or industrial urban agriculture)³⁸. The rainwater harvesting potential of a building is calculated by multiplying the rainfall amount by the catchment area by the runoff coefficient³⁹. The Seoul Metropolitan Government, for example, passed a regulation, which requires the installation of rainwater tanks in new, large buildings with multiple benefits, including sewer waste treatment management preventing sewer flooding, and for use in urban agriculture⁴⁰.

Solid waste has become one of the major headaches confronting developing world cities and its management

³⁵ Hydroponics is a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or mineral wool.

³⁶ The loss of water by evaporation in terrestrial plants, especially through the stomata; accompanied by a corresponding uptake from the roots.

³⁷ *ROOFTOP FARMING WITH SWEET POTATO FOR REDUCING URBAN HEAT ISLAND EFFECTS AND PRODUCING FOOD AND FUEL MATERIALS*, by Yoshiaki Kitaya, Masashi Yamamoto, Hiroaki Hirai and Toshio Shibuya Osaka Prefecture University, Sakai, Osaka, Japan The seventh International Conference on Urban Climate, 29 June - 3 July 2009, Yokohama, Japan.
http://www.ide.titech.ac.jp/~icuc7/extended_abstracts/pdf/404552-1-090521075201-002.pdf

³⁸ Water Productivity in Agriculture: Limits and Opportunities for Improvement (2003) by Authors: Jacob W Kijne, Randolph Barker, This book focuses on both irrigated and rain-fed agriculture. P. 332

³⁹ India Environmental Portal, Rainwater Harvesting Potential for Urban Agriculture in Hyderabad, p.36.,
<http://www.indiaenvironmentportal.org.in/files/Rainwater%20harvesting%20potential.pdf>

⁴⁰ World Plumbing Info (WPI), Executive Board visits Korean rainwater harvesting project Author: Roger Willis 17 February 2009,
<http://www.worldplumbinginfo.com/article/executive-board-visits-korean-rainwater-harvesting-project>

³² Resources Centres on Urban Agriculture and Food Security (2012) (RUAFA) Foundation, Why is Urban Agriculture Important, <http://www.ruaf.org/node/513>

³³ Pirog, R. and A. Benjamin. "Checking the food odometer: Comparing food miles for local versus conventional produce sales to Iowa institutions", Leopold Center for Sustainable Agriculture, 2003.

³⁴ Washington Post, *Eat Locally, Ease Climate Change Globally*, by Anthony Flaccavento, Sunday, March 9, 2008

is a significant consumer of municipal funds. Solid waste is defined as the organic and inorganic waste materials produced by different sources and have lost value in the eye of their owner⁴¹.

In many cities, up to 90 per cent of solid waste is organic. By encouraging and contributing to its composting and reuse in urban agriculture, cities benefit from a low-cost solution to waste management and a productivity boost for local food production. The rapid increase in the volume of waste is one aspect of the environmental crisis, with rapid urbanisation and booming populations leading to generation of massive amounts of solid waste. For example, it has been estimated that India generates as much as 25 million tones per year of urban solid waste of diverse composition, yet per capita waste production in India is considered very small as compared to the per capita production of wastes in industrialised countries⁴².

With composting technology readily available, organic waste can be reused for urban agriculture. Composting up-cycles⁴³ organic kitchen and yard waste and manures into an extremely useful humus-like soil end product permitting the return to the soil vital organic matter, nutrients and, particularly, bacteria, necessary for plant nutrition. Managed aerobic composting arranges environmental conditions so they are optimal for the natural processes to take place. Used in subsistence farming and urban gardening for creating garden-ready soil, composting is becoming increasingly important and better understood as a tool for reducing municipal solid waste⁴⁴ and reducing the amount of green waste going into landfills.

The decomposition of organic material sent to landfills is a principal cause of methane, an important greenhouse gas, making reduction of organic waste in a landfill a key element in the fight against climate change. In both suburban and rural areas, much of the organic waste could be removed from the waste stream by promoting home / urban composting, where consumers compost their yard waste and kitchen scraps on the margins of an apartment complex. In urban areas with apartments lacking individual yard space, there are indoor small scale composting alternatives, such as vermicomposting and bokashi composting.

Vermicompost utilises various species of worms, specifically red wigglers, white worms, and earthworms creating a heterogeneous mixture of decomposing vegetable or food waste, bedding materials and pure

vermicast produced during the course of normal vermiculture operations⁴⁵.

Bokashi composting is a method of intensive composting using either an aerobic or anaerobic inoculation to produce the compost. Once a starter culture is made, it can be re-used, like yogurt culture. Since the popular introduction of effective microorganisms (EM), Bokashi is commonly made with only molasses, water, EM, and wheat bran⁴⁶.

As the above paragraphs demonstrate, more holistic resource management can enhance environmentally sustainable management of the urban landscape. It can also address issues of competition for natural resources (water, soil, land) between agricultural production and other priority urban needs (drinking water, housing, etc.). What were once viewed as constraints to urban agriculture are now seen as additional benefits.

Encouraging urban agriculture in the Asia-Pacific region

With more people now living in cities than in rural areas and with more people migrating to urban areas now and the foreseeable future, urban agriculture has shown to be a viable way to address urban food insecurity. It has also demonstrated the ability to innovate in the face of perceived constraints. As this brief has shown, urban agriculture contributes to increased urban food supply and food security through increased food availability, especially of fresh and perishable foods; employment and income opportunities for the urban poor; and improved household food security of the urban poor, older persons, and other marginalised groups, such as disabled persons, providing them with more independence and increased self-esteem.

Urban agriculture reduces food insecurity if it increases access to food, especially fresh nutrient-rich foods among populations suffering from food insecurity. With the urban poor spending as much as 60-80 per cent of their income on food⁴⁷, the above actions can have a major impact on household well-being. Urban agriculture can

⁴¹ 3RKH Reduce, Reuse, Recycle 3R knowledge Hub by ADB, AIT, UNEP, ESCAP, <http://www.3rkh.net/>

⁴² Vermicomposting: A Better Option for Organic Solid Waste Management, Asha Aalok, A.K. Tripathi and P. Soni, p. 1

⁴³ Up-cycling is the process of converting waste materials or useless products into new materials or products of better quality or a higher environmental value.

⁴⁴ Urban Agriculture Notes, Published by City Farmer, Canada's Office of Urban Agriculture, Composting in Vancouver: 10 Years of Progress, <http://www.cityfarmer.org/CompostPaul.html#compostPaul>

⁴⁵ Vermicomposting: A Better Option for Organic Solid Waste Management, Asha Aalok, A.K. Tripathi and P. Soni, p. 1

⁴⁶ Bokashi process: In home composting applications, kitchen waste is placed into a container, which can be sealed with an air tight lid. These scraps are then inoculated with a Bokashi EM mix. This usually takes the form of a carrier, such as rice hulls, wheat bran or saw dust, that has been inoculated with composting microorganisms. The EM are natural lactic acid bacteria, yeast, and phototrophic bacteria that act as a microbe community within the kitchen scraps, fermenting and accelerating breakdown of the organic matter. The user continues to place alternating layers of food scraps and Bokashi EM until the container is full. Once the bucket is full to capacity, the waste can be buried. Two Bokashi buckets are often employed, in order to create an alternating setup. Waste from the first Bokashi bucket is allowed to continue to ferment for 10–14 days or for any additional length of time. The waste can then be buried. The empty Bokashi bucket is then ready to use when the second one is full. From Bokashi Composting Australia, <http://bokashi.com.au/Bokashi-Instructions.htm#Wiki>

⁴⁷ FAO (2000), SD Dimensions, Urban and Peri-urban Agriculture (UPA) on the policy agenda: Virtual conference and information market. <http://www.fao.org/sd/ppdirect/ppre0073.htm>

⁴¹ 3RKH Reduce, Reuse, Recycle 3R knowledge Hub by ADB, AIT, UNEP, ESCAP, <http://www.3rkh.net/>

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⁴⁷ FAO (2000), SD Dimensions, Urban and Peri-urban Agriculture (UPA) on the policy agenda: Virtual conference and information market. <http://www.fao.org/sd/ppdirect/ppre0073.htm>

enhance quantities of food for urban populations and can supplement income.

Food produced in cities can also play a role in reducing agriculture's contribution to climate change while greening and cooling cities, with such contributions improving the overall well-being of urban residents. Innovations in water catchment can provide potable water for urban agriculture without straining precious city water resources. Such catchment systems can also serve other municipal functions, including managing urban sewer systems. Innovations in composting, as well, can overcome perceived constraints to urban agriculture and now provide cities with viable and affordable policy options.

In the Asia-Pacific region, many municipal governments and communities have taken substantive steps to address urban food insecurity. Through South-South cooperation, such innovations in urban agriculture should be shared to address a future of increasing urban populations where urban infrastructure will continue to be under increasing pressure to meet the needs of city dwellers. Given the socio-economic and environmental benefits of urban agriculture, and with an additional 3 billion people swelling the world's ranks by the year 2050, urban agriculture now needs to be a crucial part of any city's policy agenda.