



URBAN GReen Education for ENTteRprising Agricultural INnovation

Urban Green Train Modules and Resources (IO2)

Module 3:

Urban Agriculture
types/production systems
and short food chains



With the support of the Erasmus+ programme of the European Union

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MODULE 3 “Urban Agriculture types/production systems and short food chains”

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INTRODUCTION

This module and the related educational resources have been developed within URBAN GREEN TRAIN (URBAN GRGreen Education for ENTteRprising Agricultural INnovation) a project funded by the European Union and the Italian National Agency for the ERASMUS+ Programme. The aim of URBAN GREEN TRAIN ERASMUS+ project (2014-1-IT02-KA200-003689) is to encourage pioneering business oriented initiatives in urban agriculture based on knowledge exchange and mutual cooperation among different actors, as to meet the global demand for urban green innovation.

One of the main outcomes of Urban Green Train is a set of modules and resources (IO2) especially designed to be a useful toolbox for anybody looking to operate, directly or indirectly, in the world of urban agriculture.

The set includes **5 modules suitable for at presence and at distance learning, for a total duration of 150h**. The modules structure and content have been defined on the basis of an accurate analysis of the training needs of relevant key actors in urban agriculture, carried out by project partners in the their respective countries and illustrated in the publication "[URBAN AGRICULTURE INITIATIVES TOWARD A MINDSET CHANGE](#)" (IO1). URBAN GREEN TRAIN modules are the following:

Module 1: Introduction into urban agriculture concept and types

Module 2: Resource use from a challenge perspective

Module 3: Urban agriculture types/production systems and short food chains

Module 4: Networking and governance

Module 5: The world of business and urban demands

The URBAN GREEN TRAIN Modules and Resources (IO2) have been tested within a pilot international course offered from August 2016 to January 2017, both fully online and in a blended modality, to a wide range of participants from different European countries and professional backgrounds, through the e-Learning platform of the University of Bologna. Thanks to the feedbacks of pilot course participants and tutors, the modules and resources have been improved and finalised and made available in the present format to Higher Education Institutions and other private and public adult learning providers with the purpose of offering a complete and structured training pathway tackling all aspects relevant to new ways of doing business in agriculture.

URBAN GREEN TRAIN project is coordinated by the University of Bologna, Alma Mater Studiorum – Department of Agricultural Sciences (www.scienzeagricarie.unibo.it) and developed in cooperation with the following partners:

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- Grow the Planet, Italy www.growtheplanet.com
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MODULE 3 “Urban Agriculture types/production systems and short food chains”

Aims

This module introduces and illustrates the various urban agriculture types found in cities around the world. Various urban agriculture production systems will be discussed in terms of their characteristics, location, functions, technical aspects, development challenges and support needs. Also, urban agriculture input supply, service delivery; processing and marketing systems will be discussed.

Structure

Module 3 contents have been organised as follows:

- **3.1 Overview of Urban Agriculture types**
 - 3.1.1 Micro-farming in and around the house
 - 3.1.2 Rooftop farming (open air, greenhouses)
 - 3.1.3 Community and institutional gardens
 - 3.1.4 Small-scale commercial horticulture
 - 3.1.5 Small-scale commercial livestock keeping
 - 3.1.6 Urban aquaculture/aquaponics
 - 3.1.7 Small-scale specialized production system
 - 3.1.8 Large-scale agro-enterprises
 - 3.1.9 Multifunctional farms
 - 3.1.10 Urban forestry
 - 3.1.11 Vertical farming (wall, in building, soilless or not)

- **3.2 Urban Agriculture integration in agri-business**
 - 3.2.1 Urban Agriculture and Agribusiness
 - 3.2.2 The input supply part of the food value chain
 - 3.2.3 Processing and marketing

- **3.3 Innovation in Urban Agriculture**

Learning objectives

Main learning objectives of Module 3 are the following:

TOPIC TITLE	TIME	LEARNING OBJECTIVES	LEARNING OUTCOMES
3.1 Overview of Urban Agriculture types	15	<p>To introduce different types of urban agriculture that can be found in cities around the world</p> <p>To present a typology of different forms and expressions of urban agriculture</p> <p>To give illustrative examples and best practice cases of different urban agriculture types</p>	<p>Participants are able to:</p> <p>Discuss the need for a typology of urban agriculture systems</p> <p>Differentiate among various urban agriculture production, input-supply, service delivery, processing and marketing systems</p> <p>Recognize and describe the main types and activities of urban agriculture and the multiplicity of functions they play</p> <p>Reflect on the presence of such urban agriculture types in your own city and the relevance of these types for various policy objectives</p>
3.2 UA integration in agri-business	7	<p>To analyse the economic role of agriculture in wider society and relevant trends</p> <p>To describe the links of urban agriculture with different stages of the food value chain</p> <p>To introduce different types of marketing of urban agriculture produce, including short food supply chains</p>	<p>Participants are able to:</p> <p>Identify main linkages between urban agriculture, wider economy and food value chains</p> <p>Analyse links between urban agriculture and food value chains in specific cases</p>
3.3 Innovation in Urban Agriculture	3	<p>To present innovation needs of urban agriculture types and give illustrative examples of these</p> <p>To explore relations between differentiated innovation needs and specific urban agriculture settings in terms of resource use, location, scale, policy and institutional framework, functions, technical aspects, and main development challenges.</p>	<p>Participants are able to:</p> <p>Identify different innovations that address the specific challenges and capture the specific potentials associated with particular urban agriculture types and activities.</p>

MAIN CONTENT AND RESOURCES

3.1 - Overview of Urban Agriculture types

Introduction

This chapter introduces and illustrates the various urban agriculture types found in cities around the world. Various urban agriculture production systems will be discussed in terms of their characteristics, location, functions, technical aspects, development challenges and support needs.

3.1.1 - Micro-farming in and around the house

Introduction

We begin this chapter by studying and discussing the practice of micro-farming in and around the house. This type of urban agriculture occurs in almost every city and has been called the most pervasive land-use system in the world. It is usually practiced on small areas in or on the house (balcony, windowsill, cellar, barn, rooftop, and kitchen) as well as around the house (front and backyard, patio).

Mainly vegetables, herbs, or medicinal plants are grown. Small animals (rabbits, chickens, guinea pigs, pigeons) may be kept in small numbers. Overall investment is low. The reasons why people choose to participate in the activity vary by region and income group. Participating households include low-income as well as medium- and high-income families. These people grow food, herbs, and small animals for either subsistence or leisure or out of environmental awareness and an interest in growing their own food. Minor surpluses may be bartered or shared among friends and neighbours, though occasional selling of produce may occur.

Type of people involved and their main motives

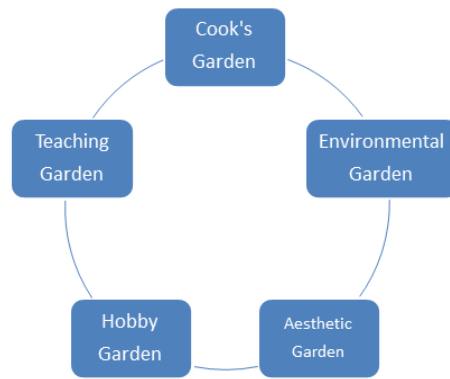
Micro-farming in and around the house (also known as family gardens) is usually a part-time activity. Low-income urban families practice this form of urban agriculture to supplement their food supply, improve their diet or generate a small income. Food composes a substantial part of urban household expenditures (in the Global South poor households spend 60-80% on food, in the Global North this varies between 10-30%) and, in cities, a lack of cash translates more directly into food shortages and malnutrition than in the rural areas. Vulnerable groups in cities often have fewer informal safety nets (kinship and community networks) and their dependence on growing their own food may increase with rising food prices.

Though practiced on a small scale, home production of food by poor urban households can still represent 20-60% of their total food consumption, as indicated by studies for East Jakarta, Indonesia (18%, Purnomohadi, 2000) and Harare, Zimbabwe (60%, Mbiba, 2000). In Cagayan de Oro, the Philippines, urban farming households generally eat more vegetables than non-farming households of the same income level, and also more than households from a higher income level, who generally consume more meat (Potutan et al., 2000). Women are often involved in micro-farming, as food growing in and around the house can be more easily combined with other domestic tasks.

Micro-farming can also be of importance to families affected by different pathologies, especially if appropriate production technologies requiring low labour are used. Adequate nutrition can enhance life expectancy and quality for ill people.

Turning our attention to the Global North, many different reasons explain why people decide to grow. Growing food may be needed for food security reasons. Furthermore, the behaviour is dictated by many factors and is influenced in part by culture and a person's attitude to relationship they wish to have with food.

A recent article by Kortwright and Wakefield (2011) examined the contributions and motivations for growing around the house by focussing on a low- to middle-income area in northwest Toronto, Canada. From their research, they were able to present a typology of different types of home gardens that exist in the area and, by extension, in many other places.



Of course, many households do not fit neatly into these typologies; rather their motivations for growing may overlap. For example, an aesthetic garden may have elements of a cook’s garden with thyme being planted. Which type predominates for any individual will be dictated by their circumstances. A family with young children might opt for a teaching garden to expose their children to the art of growing and learning about food. An individual that finds cooking to be a creative, relaxing part of their day will opt for a cook’s garden, perhaps growing exotic or heirloom vegetables.

Household growing in special situations

How and why people grow at home depends largely on their location and circumstances. Political events and economic shocks will affect people’s behaviour. An example is the resilience that Cuba developed during the “special period” when the Soviet Union stopped supporting Cuba financially in the late 1980s. Urban agriculture was one course of action the government took to combat widespread food insecurity. A recent study by Christine Buchmann (2009) about home gardens in Cuba describes the many functions that gardening around the house fulfilled at the time. The study shows that medicinal plants were the most common use of home gardens, followed by food, decorative, and ritual plants. Moreover, an interesting gender differentiation was noted: men typically grew more food, while women also cultivated medicinal and ornamental plants. In her study of the city of Trinidad, Buchmann coined the concept of a “community-home garden” to accentuate the social merging and reciprocity that occurred in Cuba.

The Gaza Strip provides an example of a place where food insecurity has been alleviated to some extent by urban agriculture. With 97% of the population either living in urban areas or refugee camps, land for growing is a very scarce resource. The United Nations - Food and Agriculture Organization (FAO-UN) conduct a project that brings together aquaculture and vertical growing to raise nutrition standards. Early results show an increase in household food security (FAO, 2012). Since 2014, RUAF is working in Gaza together with OXFAM Italia and local government, civil society, research and private sector stakeholders to assist small-scale urban producers to establish value-adding microenterprises and strengthen market-oriented forms of urban agriculture in Gaza (www.ruaf.org).

How it is practiced

The amount of space in and around where the person lives influences strongly how and what people grow. For people in detached houses, cultivating and planting in the ground is the usual practice. Some divergence around the world is occurring concerning what people are growing. In certain parts of Europe, there is a trend toward more ornamental production. This has been occurring for the past few decades. Growing an edible landscape is still important in former socialist countries (Simon-Roja et al., 2015). In North America, there is a strong movement toward introducing food plants into what previously were overwhelming ornamental spaces. Furthermore, containers can also be used for decorative reasons, or to isolate certain crops from disease or pathogens.

If land is not available, other options exist for growing. Balcony gardening is a popular way to grow vegetables, fruits and herbs. Space can also be utilised efficiently by using vertical and wall growing techniques.

In the Global South some interesting innovations on how to grow in limited space and maximize yield have been developed. In Kenya, sack gardening filled with soil, manure and some rocks is used in areas where space is scarce, such as slums. Intensive growing is possible, for example a sack can grow 30 to 40 kale or spinach plants, or 20 tomato plants (Pascal and Mwendu, 2009).

Many options exist for what people can use to grow plants.



Products and degree of commercialization

The most common crops grown in micro-farming include vegetables, medicinal and kitchen herbs according to family or dietary preferences. Additionally, we can find small-scale animal production of poultry, rabbits, guinea pigs, pigeons, grass-cutters or bees. The production of ornamental plants and flowers is also common, while recycling of household organic wastes through (worm) composting, often complements growing practices.

As indicated earlier, the degree of commercialization in this type of urban agriculture is limited and, generally, only occasional barter of minor surpluses with relatives and neighbours occur. Investment in micro-farming is generally low (use of low-cost production technologies).

Commercial transitioning

Beginning with a few plants on a window sill, some households try to take growing to a more commercial level by converting gardens into family business gardens. The definition of farm business gardens (FBG) describes the situation where production becomes more commercialized. Gardening activity becomes more purposeful, with attention paid to the produce production and marketing.

The table below outlines some of the differences between home gardening and a more entrepreneurial version, highlighting potential health concerns, management skills and economics.

Aspect	Home-gardening	FBG
HEALTH CONCERNS Nutrition value Mental health Landscaping Housekeeping	Yes and general Minimal Usually with flowers Mainly kitchen	Yes and specific Highly focused Land and air-scaping for edible plants Total homestead
MANAGEMENT SKILLS Vertical cultivation Water and soil Waste and shade Entrepreneurship	Not purposively Highly concerned Low or negligible Nil or minimal	Highly focused Highly stressed Prime theme
ECONOMIC SENSITIVITY Income Value addition Business plan Sustainable links	No or minimal sale No or low No concern Low or poor	Planned marketing Highly stressed Mainly stressed Networking

Comparison between home gardens and Farm Business Gardens. Source: Ranasinghe, 2009

Main support needs

Though investment costs are generally low, availability of and access to quality seeds/seedlings, small gardening tools and equipment (e.g. for wastewater use or rainwater harvesting) are important production factors in micro-farming. As the economic return on micro-farming is generally low, provision of micro-credit for investment is not a feasible strategy. Instead, free seeds, compost, tools or equipment may need to be provided to low-income urban households as part of a micro-farming development strategy. As well with climate change resulting in higher temperatures, water conservation is becoming a critical. Self-watering containers can be a very useful addition for gardeners, especially growing on balconies.

Novel ways are being developed on how gardeners can source seeds. A trend in the past decade has been the establishment of seed libraries. These operate like traditional libraries, with seeds being exchanged rather than books and online resources. Often heritage and seeds indigenous to a region are attainable. Garden tool lending libraries also exist in some cities.

Accessing land for cultivation can be a huge problem for some people. In some cities in North America, backyard sharing programmes have proven to be successful. A good example is The Stop Community Food Centre's YIMBY (Yes in My Backyard) programme in Toronto, Canada. The premise behind the programme is simple. Would you like to grow your own food, but do not have space to garden? Do you have a backyard that you would like to put to use? The YIMBY programme links people who want to grow food but do not have access to land, with people willing to share their yards. The programme supports gardeners and landowners to develop clear, effective land sharing agreements and helps build their horticultural skills. This win-win programme promotes growing while making the community more inclusive and welcoming.

Many cities around the world offer some support for backyards gardeners. Mexico City (Mexico) promotes systems for rainwater collection and storage, construction of wells and the establishment of localised water-efficient irrigation systems (e.g. drip irrigation) to stimulate production and to reduce the demand for potable water. The municipality of Cape Town (South Africa) supplies those who wish to start gardening activities with a "start-up kit for survivalist gardeners", consisting of a pickaxe, spade, rake, watering can, seeds and compost. The start-up kit is further supplemented by skills training and extension services.

In 2009, the government of Antigua and Barbuda instituted the National Backyard Gardening Programme, part of a larger scheme to strengthen the country's food production. People growing in backyards register their activity and in return can receive extension service support along with seeds, seedlings, fruit trees and other input for a low cost. The programme has introduced innovative techniques to gardeners as well, such as drip irrigation, vermicomposting, and micro-gardening techniques (FAO, 2014). The impressive results include less money being spent on food and households attaining higher nutritional status. Surveys show that the food grown is shared with food and family, thus resulting in social benefits as well.

Training and exchange of experiences

Urban micro-producers mostly depend on informal social structures (informal network of growers, neighbours or family) to get access to information and training. Extension services do not usually serve the home gardener. Approaches to information sharing are needed to realize the full potential of growing around the home. This could include:

Promotion of grower-to-grower exchange

Producers can learn a lot from their colleagues, who are producing under the same circumstances and have the same production objectives. However, and due to the reason that producers do not know each other, they generally are not able to establish the right contacts or simply lack the means (such as transport): this kind of exchange is not as common as it seems. Organising meetings and bringing together urban producers

to exchange information and visit each other's growing space is a very simple and effective tool that can trigger micro-producers to find solutions for their own problems or apply innovations for improving production practices.

Professional technical extension

With few exceptions, extension services usually are not geared toward people who grow in and around the home. Havana, Cuba, is an exception, with small producer kiosks (*Tiendas de productor*) where farming households can buy small supplies of seeds, tools and get advice on micro-farming and small-scale commercial production technologies. Advice is given on biological pest and disease control for example, or preparation and application of bio-fertilisers. In the European context, technical extension for urban agriculture is (still) poorly developed. Where it exists, it often focuses on community gardening initiatives and less on individual home gardens nor on entrepreneurial urban agriculture initiatives.

Advice on crop choice, food preservation and food preparation

As home consumption and food security figure among the main objectives behind micro-gardening, important questions arise related to crop choice, food preparation and preservation with views on optimal nutritional benefits. Different species of vegetables, herbs and sprouts contribute important vitamins and minerals to the urban diet. The raising of small animals and egg production can be an important source of protein. Root crops can provide part of the necessary carbohydrates a person needs. Deciding on appropriate crop choices (also taking into account climate and growing conditions), crop combinations and use of rainwater or greywater to assure harvest throughout the year are important considerations.

However, after the harvest an important part of the yield can be lost, when good storage and processing techniques are not applied. Fresh produce can be preserved, by applying a variety of low-cost technologies:

- Drying the product using solar heat; many herbs for example can be dried for long term storage.
- Preservation by anaerobic fermentation; in an anaerobic environment (without oxygen) sugars in the vegetable will ferment into lactic acid which will cause the acidity to rise and preserve the product.
- Preservation with vinegar, sugar or salt can also extend the storage time of certain products (e.g. pickles).
- Sterilisation and pasteurisation; vegetables or fruits can be boiled and sterilised, thus also preserving them for a longer time (e.g. jams).

3.1.2 - Rooftop farming (open air, greenhouses)

Introduction

Rooftop farming has become extremely popular in the past decade. Whether practiced at the household level or on industrial, large, commercial scale, many benefits are possible ranging from improved nutrition for families, to economic development and job creation for large operations.

In this sub-chapter, we will examine why people in the Global North and South are turning rooftops into gardening spaces. Urban Green Train case studies that involve rooftops will be highlighted. The discussion concludes with an examination of the technologies used and the main potential, challenges and support needed.

Type of people involved and their main motives

The reasons why people choose to grow food on rooftops are numerous, but it could be argued that it is a response to the lack of the space that is found in most cities. This is not the case in cities with declining populations. Detroit, in U.S., would be an example of this phenomenon. Cities have a great deal of space on rooftops that can be used to provide environmental services, such as installing green roofs to allow for food production and to reduce heating and cooling costs for buildings. In the Global South, rooftops offer a place where food can be grown to improve the food security of the household, with the possibility of surplus being bartered, traded or sold at market.

As part of a project on climate change, RUAF has partnered with the NGO “ENHPO” and the Kathmandu Municipality to demonstrate and promote rooftop agriculture. Aside from making an important difference for household food security, rooftop gardening helps with waste management as well as climate change mitigation.



[Watch the video: Rooftop gardening in Kathmandu - A climate change strategy](#)

- Optimising space for production by intensifying soil-based cropping, developing non-soil based production systems (hydroponics, containers) and/ or switching to above ground, building-borne systems (like rooftop gardening);
- Optimising income-adding value to horticultural production (including processing and direct producer- consumer relationships);
- Optimising multiple urban functions of horticultural value chains (including recreation and landscape management);
- Optimising resource utilisation – improving the spatial connectivity of horticultural activities promoting wastewater re-use in horticultural production; better linking waste management to production, processing and marketing of food hubs.

Rooftop agriculture is usually multifunctional in nature. It provides environmental goods and services, such as reducing storm water runoff, while creating a strong sense of place and recreational opportunities. Recreation and making the city visually pleasing is often at play. Some famous restaurants around the world grow part of their produce on rooftops, taking the ideas of local and fresh to new heights.

Optimising space is part of movement termed ZFarming, which refers to all agriculture that occurs without the use of farm land and open space. Aside from growing on house rooftops, in the last decade there has been a trend of high volume vegetable production being done in greenhouses on top of buildings. Examples of this would be Gotham Greens in New York and Chicago in the U.S. and Lufa Farms of Montreal, Canada. In

Europe, UrbanFarmers AG have introduced greenhouses on top of buildings in Zurich, Switzerland and The Hague, Netherlands.

Aside from profit maximization, these firms claim to be motivated by other factors as well. Energy efficiency is mentioned as a paramount concern by all firms and they strive to produce the best quality of food in the most environmentally friendly manner possible. Lufa Farms lists sustainable actions on their website:

- Growing on no new land;
- Capturing rainwater;
- Recirculating 100% of irrigation water and nutrients;
- Reducing energy use;
- Composting green waste;
- Using biological controls instead of synthetic pesticides, herbicides, and fungicides.

On the other hand, it needs to be noted that an independent comparison of environmental impacts of such high-tech rooftop systems in comparison to other production systems until now has not been made. They also highlight that the food is consumed locally, thereby cutting down on greenhouse gas emission, that are claimed to be responsible to global climate change.

A few Urban Green Train case studies are businesses that work in these areas. In most cases, improving the environment is a major driver.

Poliflor, in Italy, is specialized in living walls and green roofs. The company aims to improve the thermal properties of buildings, increase the aesthetic properties of the space and contribute to capturing pollutants from the environment (www.urbangreentrain.eu).

Horticity, also in Italy, develops horizontal and vertical gardens. Training, research, education and international cooperation form part of their business plan. They are motivated by designing and developing ideas that further urban agriculture while benefitting ecology (www.urbangreentrain.eu).

AMAEVA is a private French company that offers advice, design and installation on green roofs and living walls. The company has distinguished itself and made a major contribution to the industry by creating a training centre. Topics for discussion include sealing, insulation, re-vegetation and the installation and maintenance of green roofs (www.urbangreentrain.eu pdf).

Topager, also in France, is a small company specialized in building and managing urban agriculture projects. They take a scientific approach to their work by integrating agro-ecological principles in their projects. Furthermore, they collaborate with many scientific organizations in order to perfect their craft (www.urbangreentrain.eu pdf).

BiodiverCity is an association of researchers and students of the former Faculty of Agriculture, at the University of Bologna in Italy. The association aims to support and promote biodiversity in its different forms within the urban environment. Growing on rooftops is one of their areas of interest. Students and researchers work jointly on projects that ensure urban space is used in innovative ways. Biological controls are used and plantings encourage beneficial insects and pollination (www.urbangreentrain.eu pdf).

Rooftop gardens are also a way to educate the population about urban agriculture and the food system. In Toronto (Canada), Ryerson University hosts a 1000 m² rooftop garden that has become a centre for production, workshops and a place of research for many university faculties.



Technologies used

In Global South, the level of technology is functional in nature. Growing containers are frequently made from recycled materials. PVC pipes, tires, plastic buckets and plastic bags are some of the materials that can be utilised. Frequently, rooftop gardens in the Global South are an extension of the household so likely the gardener lives close. Food security is a major motive so a diversified set of crops is usually grown. The practice can also be promoted as a social action to improve the environment and to create a recreational space for the household (Orsini et al., 2015).

In parts of the Global South, but especially in the Global North, high tech practices tend to be more prevalent, particularly around water usage. This has become a growth industry with small and medium-sized industries (SMEs) emerging to meet the demand.

Research and experimentation are important as this is a relatively new field. Poliflor, for example, has carried out agronomic and engineering research to discover the best physiological outcomes for plants. They also conduct research on substrate materials to provide both better thermal and sound insulation, while allowing plants to root more efficiently.

Main potentials and challenges

In the Global South, production on rooftop brings nutritional benefits as healthy and clean food is readily available. Cost savings often result. Moreover, some growers will experience the benefit of more time by not having to go to markets to do their shopping. Other social benefits may include a sense of community building as well as creating educational opportunities around the cultivation and preparation of food.

From an environmental perspective, small-scale rooftop growing offers the possibility of better-managed waste streams, as shown in the video featuring rooftop cultivation in Kathmandu. As well, it contributes to greening the city. Especially for large-scale rooftop operations, benefits range from improved input efficiency in the production process and a reduction in greenhouse gases due to the fact of high production occurs where the market is located. Experiences in Amman in Jordan, where urban agriculture is promoted as part of the local climate change action plan, have shown that rooftop gardens also play an important role in counteracting heat island effects by generating fresher microclimates.

Economically, rooftop growing can employ people and present opportunities along the value chain (Sprecht et al., 2014 and 2015). Intensive rooftop production can also meet the consumer demand for fresh and locally produced food. This might be of extreme importance in cities that import much of their vegetables and where there is a high demand for this quality of food. Cities as Hong Kong and Singapore, where land is scarce, are recognising the potential and business opportunities that rooftop growing brings.

One potential challenge involves the regularity issues around rooftop growing in any given city. The idea that agriculture and cities are incompatible is a persistent one in both the Global North and South. In the North, municipal governments that have control over land tools, such as zoning, have been at times slow to acknowledge the upward trajectory that urban agriculture has been riding for the past few decades. At times, planners do not know how to respond to a proposal for a greenhouse on a roof. Cities need to understand that people want to grow in cities. Zoning needs and planning criteria are needed to accommodate for this. This is a highly dynamic area that is increasingly taken up by cities around the world. An interesting example is France, where in March 2015 a national law was approved that rooftops need to be covered by plants or by solar panels, obviously resulting in a strong push for agricultural uses of rooftops. However, also cities like Hamburg in Germany are developing regulations around agricultural uses of rooftops.

Practiced in the Global North, intensive rooftop production is challenged by the fact that the food usually needs to carry a price premium to reflect the fact that the food is fresh and local and to compensate for (still) higher production cost prices. Enterprises such as this will not be accessible to all consumers, especially low-

income people. When it comes to fruit quality, however, foods grown above a sufficiently high rooftop (e.g. the 10th floor rooftop garden of Via Gandusio, Bologna, Italy) may be free from heavy metal pollutants normally encountered on soil-based urban grown vegetables (Vittori Antisari et al., 2015).

Growing on a rooftop, whether in a controlled or uncontrolled environment is very different than growing on the ground. Growers will need a different set of skills to know how to use inputs in the most economic and environmentally sound ways possible. There is likely to be a learning curve for people in the field.

Finally, finding an appropriate rooftop may be a challenge. For commercial operations, the rooftop should be located where it can take advantage of existing infrastructure such as transportation. For all scales of rooftop growing, the building must be structurally sound to take the weight that soil, water and people will bring. In this respect, there is also a technical challenge to develop lighter growing media.

Main support needs

The place to start a discussion of support needs is to examine where the garden or installation will be. Many buildings have the strength to withstand the weight and pressure of a green roof that is designed solely to reduce heating and cooling costs and reduce storm water runoff. These roofs are referred to as extensive green roofs, frequently planted with sedums and similar plants in a thin, light growing medium. Food producing gardens can mean heavier growing medium as well as thicker soil. In these cases, it is imperative to seek advice from architects and engineers to see if the rooftop is able to carry the additional load. Many buildings constructed in the last 50 years were not built to last for the long haul so it may be wiser to look for older buildings that were likely over-designed. A modern tool that can be helpful in identifying appropriate roof space is Google Earth.

In the Global South, the inputs needed to grow on roofs may not always be at hand. Centres where growers could have access to inputs such as soil (growing media), seeds and natural fertilisers would be useful. Advice on how best to grow and what containers could be used would be helpful as well.

In the Global North, the support needs are dictated by how elaborate the system being used is and its main purposes. Indeed, many support needs are the same such as access to inputs, growing knowledge and training.

3.1.3 - Community and institutional gardens

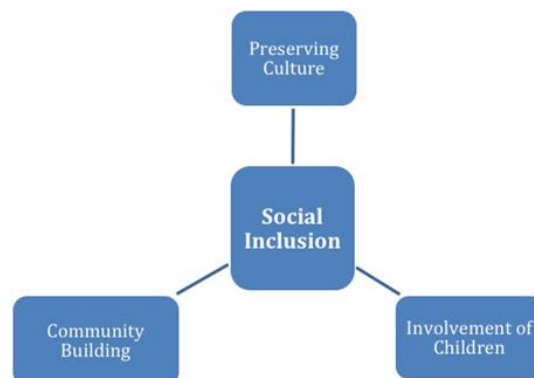
Introduction

Community, school, and other institutional gardens are found around the world. These types of gardens are normally located on public, vacant, open land areas in the city. These can be along railways and roads, under power lines, on the grounds of community centres, churches, and schools and in public parks. Food products such as vegetables, fruits, herbs, and occasionally small livestock are produced for home consumption, leisure, educational purposes, or within the context of community development programmes.

This sub-chapter examines the characteristics of these gardens and the functions they fulfil. The potential of gardens on university campuses is explored. Finally, we look at the main potentials and support needs for this type of urban agriculture.

Type of people involved and their main motivation

Community gardens involve urban poor families, higher-income families and individuals, elderly people and recent migrants, who grow food and non-food products for motives of home-consumption, leisure or outdoor recreation, social interaction or community support. Community gardens have a long history in many parts of the world. In Europe, they began as “Victory Gardens” because of their role in growing food during World Wars I and II. Allotment gardens are a close cousin to community gardens, but differ in the fact that generally, there is no community building component and the rental fees for land tend to be higher. Plots are often larger too.



Source: Adapted from Miedema et al., 2013

Many activities of social interaction and exchange may take place or be organized around a community garden, from simple contact with neighbour gardeners to the sharing of tools, tasks, seeds and plants to the organisation of training courses or harvest festivals. Gardeners may also save and share seeds, including some heirloom varieties. In some European countries, especially Germany and Austria, the concept of ‘Intercultural gardens’ has been successfully developed as a means to promote social integration of ethnic and migrants communities (Schermer, 2015). This is one way to reverse this decline in biodiversity and keep cultural traditions alive. We can summarize and state that preserving culture, community building and involving children in gardening can result in more social inclusion and healthier communities

Another important role played by community gardens is the provision of food and nutrition for low-income people. Irrespective of income levels, many other gardens will allocate part of the harvest to soup kitchens, food banks or social programmes.

Community gardens are usually managed by the gardeners themselves or by a non-profit organisation/association that may rent out individual plots of land on a yearly basis for a small fee. Alternatively, the garden may be collectively tended with no individual plots. The city of Berlin, Germany has

more than 80'000 community gardeners who lease plots on land where buildings were destroyed during World War II. As of 2016, Montreal, Canada has 116 community gardens and 8'200 allotments serving 10'000 residents; a similar number of families are involved in the Rosario, Argentina community gardening programme. The high numbers of people involved in these cities may be partly due to the fact that the municipality actively promotes community gardening and provides advice, education and site identification.

Institutional gardens involve students of primary and secondary schools, clients of hospitals, prisons, factories, etc. Benefits include the growing of nutritious food for the clients of these institutions, ecological education (mainly school gardens) and possibly income generation, physical exercise and therapy (mainly in hospitals and prisons).

School food gardens can improve children's understanding of natural processes such as plant growth and soil formation as well as enhancing their understanding of other cultures. Growing food to complement school meals or snack programmes can improve children's access to healthy, nutritious food that might otherwise not be affordable. The same food can be used to demonstrate healthy food preparation. Studies have shown that children who have some knowledge of food preparation show an increased likelihood of eating the recommended intake of fruit and vegetables. In an age where obesity and inactivity are on the rise, gardening remains a healthy outdoor activity for children and youth. All kinds of curriculum topics can be explored in garden settings, bringing theoretical topics to a very practical level.

A garden in a campus setting offers many possible motivations for students and faculty. A university campus is a mini-city, where the provision of food is, at times, a controversial and political issue. Throughout North America, many campus gardens are often led by students who have a sophisticated awareness of the food system.



Products and degree of commercialization

Community and institutional gardens are devoted primarily to the growing of vegetables, fruits, flowers, and herbs, though at times small animals units can also be found (e.g., in school or prison gardens).

As mentioned before, production is mainly geared to direct consumption (by the gardeners or clients of the institutions) or given away to a variety of social programmes. Occasional sales of surpluses to community members, local shops, and markets occur, and larger institutional gardens may even function as semi-commercial undertakings.

At times, however, there are legal barriers to the commercialization of produce from community gardens. In North America and the United Kingdom, many community gardens are located on city parkland. Regulations prohibit the selling of food grown in these spaces, with the logic being there should be no private gain from using public land. In other countries, food hygiene regulations may be the reasons why produce from community gardens cannot be commercialized. Even where it is outlawed, anecdotal evidence suggest that selling and bartering does occur.

Scale and location

Community and institutional gardens are generally limited in size between 500 m² to several hectares. Community gardening mainly takes place on open public spaces in the city, ideally located within walking distance of the homes of the participants or adjacent to popular neighbourhoods. This may include parks,

lands that are temporarily excluded from residential development, vacant lots, and land near railways and under electricity lines. Land tenure is either informal or in agreement with the owner (via temporal or permanent user-right agreements). Demands for other recreational land uses and nature/green spaces will have to be weighed against the benefits of community gardens.

Technologies applied and resource needs

In many cases, only low-cost investments are made in community and institutional gardens. Often, there is some sort of water or irrigation system in place. Other investments might include fencing, storage or tool sheds, and a meeting place. At times, often with outside support and mainly in institutional gardens, more technical and intensive production methods are used (e.g., under-tunnel cultivation, drip and sprinkler irrigation). To maximize the learning potential, it might be desirable to add a greenhouse to a school garden, where seedlings can be produced and some winter crops can be grown. This provides an opportunity for the students to be exposed to agriculture year round.

Often, ecological production methods are promoted in community gardens. In Montreal, Canada, the municipal community garden programme has a clear focus on ecological gardening methods, with only environmentally friendly methods being allowed to control pests, plant diseases, and weeds. Other cities have similar rules.

Composting of garden and other organic wastes is almost always done onsite. It is done at different scales and by a variety of institutions, from households to community garden groups to municipalities. Compost is either added to the soil or mixed with the soil and used in raised-bed gardening. The use of compost increases soil fertility (thus reducing the need for chemical fertilisers), while also improving the water retention capacity of the soil. (For more information on composting in community gardens, [click here](#)).

Advices and a forum for sharing experiences and knowledge regarding growing methods, water management, and season extension will be of interest to community gardeners. In addition, sharing experiences around food preservation and preparation with a view to increasing nutritional outcomes for gardeners might be important components of community garden support programmes.

Main potentials

Community gardens are an important way for improving nutrition and food security of low-income urban residents. Apart from supplementing the household diet with nutritious and fresh produce, significant saving on grocery bills may occur. Similarly, yields from institutional gardens can be quite significant. At Pennington County Jail in Grand Rapids (U.S.), inmates produced over 13'000 kg of food in 2015, with much of it being donated to local non-profits and food banks.

Community gardens are also important for the role they play in community building. This can refer to programmes centred on community organisation, developing capacity and social inclusion for certain vulnerable groups, such as women, recent immigrants and youth. Recently, community gardening projects have been seen to help newcomers integrate into city life, provide people with a basic livelihood, encourage feelings of belonging and purpose, and building community. A garden can also serve as a vehicle for community revitalization, cleaning up of derelict areas while contributing to city greening. They are also important in offering low-cost recreation and leisure opportunities. Community gardens form good training ground for developing the skills of future small-scale horticultural farmers.

School gardens offer an important opportunity for ecological and nutritional education. In these non-traditional learning environments, youth become familiar with good and healthy food, especially the fruits and vegetables critical to improving nutrition, reducing obesity and chronic diseases. Are precisely these foods that are missing from those children's usual diets. School garden programmes teach a skill and a

lifetime hobby that provides exercise, mental stimulation and social interactions. Children receive practical education in biological and environmental sciences, math, geography, and social studies. School gardens help to improve the diets of students (school meals) and of their families (through replication of the learnings at home). School gardens in Tananarive, Madagascar for example contribute an important share of the fresh produce offered in the school canteens.

Other institutional gardens, like hospital gardens may lead to an improvement of nutrition of patients. Hospital and prison gardens also offer therapeutic benefits. Rikers Island in Flushing Bay, New York City is the home of a jail that houses up to 20'000 inmates at any given time (Jiler, 2006). The GreenHouse is a gardening/greenhouse project with the goals of helping teach inmates horticultural skills, with the hope of reducing the rate of recidivism. An extensive curriculum has been developed including topics such as soil science, botany, Integrated Pest Management (IPM) and garden design. The food grown is largely destined for organisations that feed the hungry in New York City. This training helps train some former inmates for jobs in the horticultural profession.

Main support needs for community gardens

Overall, four main support needs to enhance the development of community gardens can be identified:

- Support to access of land and to enhancing security of use (license, lease, fence);
- Assistance in group development, leadership and establishing external linkages;
- Provision of training, water, compost, quality seeds and small tools;
- Assistance in establishment of savings systems.

Securing land tenure

Depending where you are, securing land tenure can be difficult and at times impossible. Infrastructure that could help people access land is often lacking. Contrary to common belief, some highly urbanized areas have a surprisingly high number of vacant spaces that could be used for agriculture on a temporary or permanent basis. Many cities such as Cienfuegos (Cuba), Piura (Peru), Dar Es Salaam (Tanzania) and Rosario (Argentina) have created inventories of available land using GIS techniques, which is made available to the public. Cities like Havana (Cuba) and Lima (Peru) have formulated city ordinances that regulate the use of vacant municipal land by organized groups of urban farmers. In the Netherlands also, cities like Amsterdam and Utrecht make visible on their municipal website where land for urban agriculture uses is available (see example for Utrecht [here](#)).

Even when vacant municipal land is earmarked for future uses (residential or industrial areas, hospitals, or schools) or located in areas that are not fit for construction (flood zones, buffer zones, land under power lines), they may be given on a temporary basis to organisations and groups of urban poor for gardening purposes via temporal leases. In Cape Town (South Africa), underutilised lands around public facilities or road verges are leased out to groups of low-income households. However, often those in need of land or interested are not aware of such opportunities and information campaigns are an important accompanying measure.

Some cities have taken a more active role in establishing community gardens. Both Chicago and Seattle (USA) allow the city to use tax-delinquent and surplus land for community gardening. Many cities operate community gardens on parkland. Such gardens often combine food production with other active and passive forms of recreation. For example, heritage apples and other edible landscaping might be planted that have both aesthetic, educational and food value.

Group development, leadership, and external linkages

The rate of turnover of participants in community gardens varies greatly. At times it may be high, which could indicate problems in how the garden is being operated. For popular community gardens, people may wait for years to get a plot. Frequently, community gardens bring together people from a variety of backgrounds and cultures. Assistance in building leadership and group relations may be necessary. Rules for social

organisation around the garden, norms of behaviour, and trust among various members are ingredients for successful community garden programmes.

Strong community garden organisations are characterized by good leadership, the promotion of a flexible and participatory structure of organisation and management, and the active involvement of its members.

Establishment of external linkages with other groups and organisations might also be important, such as with neighbourhood groups that can help keep an eye on the garden, church or social groups that can inform members of the possibility of joining the garden, and other interest groups and municipal departments that can offer support and secure land tenure of the garden.

Provision of training, compost, quality seeds, and small tools

Although gardening at some level is simple, producing high yields and consistent quality is a challenge. Increasing the skill level and productivity of gardeners requires training and information. Training on ecological production techniques might be of specific interest. Consistently, training may be needed on the proper management of compost facilities. Cities could explore the possibility of engaging the services of a horticultural adviser to support community gardeners (as is done in Montreal and Rosario). This person can give technical advice, assist with garden design and liaise with landowners.

Municipalities can play an important role in enhancing access to water and production inputs for growers. Access to a year round supply of low cost water is of crucial importance, as well as access to organic materials (e.g. compost) and other sources of nutrients (e.g. wastewater).

The city of Bulawayo, Zimbabwe, provides treated wastewater to poor urban farmers in community gardens, while the cities of Gaza, Palestinian Authority, and Tafila, Jordan, promote the collection and reuse of grey household water in home and community gardens. The municipality of Cape Town, South Africa, supplies community garden groups with a basic infrastructure (fencing, tool sheds, and a tank and hoses for irrigation), composted organic waste, and some free water.

Cities also can develop agreements with non-profits to jointly acquire and manage land: the city provides infrastructure and support (such as water, leases, signage, insurance, and liability), while non-profit partners manage the gardens and related programmes.

Assistance in establishment of saving schemes

In Europe, community gardeners are often organised in a gardeners' associations. They pay small yearly fees for renting a plot of land and for contributing to other expenses. In the Global South however, many community gardens are dependent on outside support for their survival. To assure the autonomy of the garden, over-dependence on outside support needs to be avoided. In this way, when the external support falls away (for example after a change of government or at the end of a project) the garden organisation will not be seriously destabilized.

Community gardeners might decide to set up a group saving scheme to cover costs for garden maintenance, communal buying of inputs and for new investments in complementary micro-enterprises (e.g. selling from a cart, food preparation and vending).

Main support needs institutional gardens

Specific challenges and support needs for institutional and school gardens include:

- Training of institutional garden managers
- Training of school teachers and provision of practical training curricula
- Assistance in the design and establishment of the gardens
- Management of school gardens in summertime

Training of institutional garden managers and school teachers

Institutional managers and school teachers often do not have an agricultural background or experience in gardening. They may need to receive training from specialists. Apart from technical production skills, further training in people management or administrative skills may be needed to help them effectively manage their garden.

School teachers will also need help in developing curricula and training modules for their students in different grades. Such curricula should not only include subjects related to plant growth and care, but also explore the opportunities of applying mathematics, biology, science, cooking and other subjects in and around gardening practices. Many good resources are available for teachers online, for example [Life Lab](#).

Assistance in the design and establishment of the gardens

Important aspects to consider in designing and establishing the gardens include issues of safety and access, while at the same time assuring an aesthetic design. Raised beds may be needed to allow elderly or hospital patients to garden more easily; sharp edges and prickly plants should be avoided.

A sensory garden is an appropriate design option for therapeutic (hospital) gardens. The types of plants and elements featured here would include those that are pleasant to watch, smell, touch and listen. School gardens can be designed to maximize these elements.

Management of school gardens in summertime

Often, the main problem in setting up a school garden is the issue of how to take care of the garden throughout the summer holiday months, when plant and weed growth is at its highest, as is the need for caring for the garden (e.g. watering, harvesting). Schools may already be underfunded and lack human resources. The teachers motivated are often already involved in other extracurricular activities. Other teachers might not want to take on this additional task without further incentives.

Two interesting solutions to this are currently being experimented in Ghana and Sierra Leone. In the first case, a community/training garden is combined with the school garden. This assures presence and involvement of community members and trainer gardeners/farmers in management of the garden. School children are allowed to do some gardening tasks under supervision of their teachers in clear agreement with the community gardeners/farmers who carry the main responsibility for the garden. It will also be important to reach a clear agreement on who has access to the garden and at what times, and when and how benefits from the harvested produce will be shared. It is wise to formalise these agreements and agree on how possible conflicts will be solved.

In Freetown, Sierra Leone, youth master gardeners were trained to become involved in managing school gardens. They receive training in gardening, nutrition and working with children. The youth, in turn, will help teach school children the importance of nutrition and hygiene, while training them to set up and manage their micro-gardens allotted to them on school grounds. The youth will also take care of garden management in summer periods. Youth master gardeners are selected from established local institutions, such as schools of agriculture, vocational training centres or youth associations. In this way, capacities of youth leaders to promote food security, nutrition and health and to deliver services to children are strengthened. The project, also implemented in several other countries, is financed by the city council and the FAO.

3.1.4 - Small-scale commercial horticulture

Introduction

Small-scale commercial horticulture practised in and around cities is the focus of this sub-chapter. This is probably the most common type of urban agriculture found around the world because of the high demand for fresh vegetables and fruits. Urban and peri-urban horticulture production may have a comparative advantage to rural horticulture because of its proximity to urban markets. Growers in and around cities typically have access to better infrastructure, institutions providing technical advice, market information, and, possibly, financial support. They grow mainly for the market, and their main objective is income generation.

Cultivation practices vary. In areas with a longer horticulture tradition, there is a tendency for higher-input use and more capital-intensive production methods, such as greenhouse growing.

The types of people involved in small-scale horticulture in the Global North and South will be explored, along with scale, location and technologies used. We conclude by looking at the potential of this activity as well as its main support needs.

Type of people involved and their main motive

Small-scale commercial-horticulture producers in the Global South include both traditional, small-scale peri-urban farmers and urban poor households (e.g., unemployed youth, female-headed households, migrants) who have access to land either through informal channels or through anti-poverty or social inclusion projects run by local organisations (governmental and non-governmental). In a study of southern African cities, Crush et al. (2010) suggested that commercial producers, fall into the following categories:

- Low-income people who produce some food because they need it to survive;
- Those who cultivate in order to attain income and raise their living standards;
- Small-scale entrepreneurs who are high-income and have access to land and input.

A case study on Lomé, Togo, illustrates the capacity of market-oriented urban agriculture systems to absorb workers from other urban activities, where urban demand justifies it. From the late 1980s to the early 1990s, employment in Lomé's vegetable market multiplied (from 620 growers in 1987 to 3'000 in 1994) in response to population growth, reduced food imports, and rising local unemployment. Only 6% of growers had previous agricultural experience, and the great majority of them, both men and women, were now occupied full time in vegetable growing (Mougeot, 2005). Various studies show that new categories of small urban agriculture entrepreneurs (e.g., youth, migrants) can emerge if financing programmes are made available.

Horticulture production provides good returns regularly to various actors in the value chain either as a main or secondary source of income. Wages and income from market-oriented urban agriculture are often favourably compared to those of unskilled construction workers or mid-level civil servants (e.g., Tanzania and Cuba). This is especially the case when urban agriculture products are in high demand or enjoy a comparative advantage over rural production, as is the case with perishable products such as eggs, dairy, mushrooms, medicinal herbs, flowers, and ornamental plants. The following table presents some monthly income statistics for market gardeners in selected African cities. In most cases, the income generated is greater than the national average.

City	Typical monthly net income per farm (USD\$)
Abidjan	\$120
Accra	\$66
Ibadan	\$27
Libreville	\$650
Lubumbashi	\$166
Lusaka	\$33
Maputo	\$120
Yaoundé	\$70

Monthly net income from mixed vegetables farming for selected African cities. Source: FAO, 2012

In the Global North, it is difficult to generalize about the people involved and their motivations. However there is a noticeable trend in millennial (the generation born between 1980s and 2000) becoming interested in urban agriculture. For example in the state of Maine, USA, farmers under 35 years of age is up 40%. Much of this activity occurs in cities ([Farmville to table](#)). For many, the desire to be a small-scale commercial horticulture producer is in line with their values – wishing to provide good, healthy, local and sustainably grown food to the community. Anecdotally, many of the new urban farmers are university educated and were raised in cities. Urban Green Train case study Le Jardin de l’avenir in France is a good example of this new wave. Part of their value proposition is direct relations with customers, who have faith in the quality of the food they purchase.



Watch the video [Meet your Urban Farmer - Curtis Stone of Green City Acres](#)

Products and degree of commercialization

Main crops produced in small-scale commercial horticulture include fresh vegetables (lettuce, spinach, tomatoes, onions, peppers, cabbage, beans, pumpkins, etc.) and other crops (like maize or potatoes, berries/fruits, and plant seedlings). Generally, the types of crops cultivated vary according to the area and are influenced by culture, tradition, natural conditions and market demand. For example in the Global South, traditional (mainly female) vegetable producers may prefer short-cycle crops with regular cuttings (twice a month) to ensure regular income and food availability for home consumption. They cannot afford to cultivate longer-cycle crops like carrots, which take several months of growth before they can be harvested. Often peri-urban farmers can afford to grow both short-cycle vegetables (to ensure quicker returns on inputs and salaries) and long-cycle vegetables (to maximize benefit and investment in infrastructure), depending on management capacities and farm size.

Produce is mainly grown for the market, though it may also contribute to family home consumption. Dealing with a market and customers puts demands on producers in terms of quantity and quality of production. Investments in improved production technologies and marketing may be needed. Access to credit and capital may be crucial.

Urban horticultural areas may supply the urban market more regularly than the rural areas. In Nouakchott, Mauritania, urban and peri-urban growers supply the urban market for nine months of the year, while the rural areas provide vegetables to the city for only three months — as farmers have better access to water

and transport in urban areas. Around Beirut, Lebanon, leafy vegetables and strawberries are grown throughout the year.

In the Global North, a great deal of this produce ends up being sold at farmers' markets, in CSAs (Community Support Agriculture), box schemes and similar direct marketing schemes. The variety of crops grown can be staggering, as many producers try to find a niche by growing unusual vegetables or fruits. As well, heirloom varieties and types that link to a city or region's culinary past also may figure into the decision of what to grow. Urban Green Train case study De Moestuyn Maarschalkerweerd in the Netherlands for example grows 50 kinds of vegetable and fruits, including traditional varieties.

Scale and location

Small-scale commercial horticulture is mainly practiced in peri-urban areas and vacant, open spaces within the city (private, public, or semi-public). Areas generally cover between 500 m² to several hectares.

In the Global South, a steady flow of income is a main objective for growers. In the dry season, vegetables may be grown along rivers and (sometimes polluted) streams or with water from dugout wells, shallow groundwater, or pipe-borne water. In the rainy season, farmers often move to areas not prone to flooding. This was observed in Brazzaville and Bangui, where farmers on sloping land move to higher ground when waters rise. In Bissau, female farmers have access only to plots along the river. They have to stop growing vegetables in the rainy season, which has a serious impact on their income (Moustier and Danso, 2006). Everywhere, access to suitable land remains a key issue in urban horticulture production. Higher land prices closer to the city core have to be weighed against the growing costs of transport and refrigeration that increase with distance from the city.

Access to land by urban or peri-urban producers is often difficult and poses a major constraint to their activities. As they are usually not landowners, they are obliged to rent from others or squat on public land in order to have a plot to cultivate. This uncertainty of land tenure has a strong influence on land use strategies and maintenance. Producers may select fast-growing plants (such as leafy vegetables) rather than perennials (such as berries or trees) if they are squatting. They may also be forced to farm on degraded land, which further limits the range of crops that can be grown. The safety of the food may also become an issue.

Insecurity of land tenure may also inhibit investment in sustainable production technologies. As a result, farmers may choose inputs with strong and quick effects, such as chemical fertilisers and pesticides, rather than improving the soil using long-acting natural fertilisers and compost.

Technologies applied and resource needs

Horticultural crops are cultivated in open fields or under cover (e.g. greenhouses), in small gardens or larger fields. Sources of irrigation water include treated or untreated wastewater, local rivers and various rain harvest systems. Producers may use traditional or more high-tech and innovative production practices. In areas with a tradition of horticulture, there is a tendency to employ more capital intensive production methods, including higher input use and agrochemicals. Production of speciality or niche products is common among these growers. In the Global North, organic methods dominate the market in response to consumer demand. As well, some cities prohibit chemical pesticides.

Some relatively new production techniques are being used more frequently in urban areas. These include horticultural production on built-up land using various types of substrates. Organoponic production uses a mixture of soil and compost as the growing medium, while hydroponic production uses water. Other farmers have specialised in the growing of organic or conventional vegetables year round.

Urban and peri-urban cultivation systems differ from rural systems by their proximity to cities and by the constraints of space, which often lead to greater intensification of production. However, in such a competitive environment, a focus on profitability may also lead to improper management such as the intensive use of water, land and chemical inputs, and thereby can pose threats to humans and the environment.

Health and environmental risks originate not only from improper agricultural input usage, but also from cultivation in contaminated areas or irrigating with polluted water. Proper wastewater treatment and integrated pest management techniques should be employed to ensure a safe food supply.

The control of disease is a fundamental aspect of urban horticulture production. Prevention is always better and more cost effective than control. Important prevention measures are:

- Plant variety - some varieties are more resistant against plagues or diseases than others.
- Crop rotation - the same crop should preferably not be grown on the same part of land every year.
- Clean seed - using clean seed material is an important prevention measure.

Instead of or in combination with chemical pesticides, bio-pesticides can be applied in programmes of integrated pest management. Plants such as pyrethrum, rotenone, barbasco, nettle, tobacco or neem can be used. The leaves, berries or roots of these plants can be dissolved or macerated in water and sprayed on the crop. Similarly, repellents made out of concentrates of garlic, pepper, ginger are often used in community gardens as an ecological pesticide. Another effective technique that can be used is companion planting. Natural remedies frequently are highly effective and may cost less than using synthetic solutions.

Principle resources needed for small-scale commercial horticulture are land, water, labour, and inputs like (bio) fertilisers and pesticides. (See module 1, chapter 1.1.6).

Main potentials

Policymakers around the world are showing an increased interest in urban horticulture, although their major focus is still on the temporary use of peri-urban lands.

Peri-urban horticulture is being encouraged because it improves food security and nutritional status of both producer households and the urban population. It is especially important in countries with poor transport and food storage infrastructures. In Hanoi (Vietnam), 80% of vegetables come from Province of Hanoi. In Brazzaville (Congo), 65% of the marketed vegetables comes from local gardens and farms, while in Bissau, Dar Es Salaam (Tanzania) and Antananarivo (Madagascar) 90% of leafy vegetables are provided by peri-urban horticulture (Tixier and de Bon, 2006).

These data show that urban and peri-urban horticulture is already a large contributor in supplying fresh produce to city markets and is expected to remain so in the near future.

Policymakers also encourage small-scale horticulture because it provides jobs and incomes to urban poor households and small farming families and thus contributes to local economic development. Urban agriculture systems based on crops that add high value and that are less risky to grow on small parcels of land, such as leafy vegetables with short cropping cycles that enable regular cash generation, is a typical income-generation strategy. In peri-urban Hanoi, alongside commerce, agriculture provides more than half of the incomes in a municipality such as Trung Trac. In Cagayan de Oro, Philippines, 40 of 100 farmers surveyed indicated vegetable production as their main source of livelihood (Moustier and Danso, 2006).

Urban horticulture also contributes to maintaining open space and green areas in and around cities. These areas serve other functions such as promoting social interaction, and recreation. Urban Green Train case study Uit je Eigen Stad in the Netherlands for example conducts tours, tastings and workshops and has an on-site restaurant. In Europe and North America Community Supported Agriculture (CSAs) systems may be found. These are small-scale commercial horticulture farms, consisting of one or more producers and the subscribed consumers, who support the farm and the agricultural practices. The consumers (or shareholders) of a CSA farm are involved in the farm in multiple ways which may include funding, decision making, labour, risk sharing, knowledge and empowerment. The products of the farm are sold directly to the CSA members, who either come to farm to harvest their share of produce or pick up their food box.

Main support needs

Four main support needs to enhance development of small-scale commercial horticulture can be identified:

- Technical assistance to producers (e.g. business management, soil and water conservation, ecological growing, safe use of wastewater);
- Assistance for farmers' organisations, quality control, certification, transport and marketing;
- Enhancing medium-term land security;
- Enhancing access to credit.

Horticulture in urban areas will continue to be adapted to specific circumstances, as determined by opportunities and constraints. Specific techniques will be developed, including combinations of practices from traditional horticulture and more modern, innovative practices. The most exciting changes are perhaps occurring with the rapid development of aquaponics and vertical farming. These will be discussed in detail in chapters 3.1.6 and 3.1.11.

The application of bio-intensive gardening and permaculture practices entail intensification and diversification of production through the application of ecological principles. Permaculture (<http://www.neverendingfood.org/b-what-is-permaculture/>) is particularly relevant in the context of urban horticulture because it is a flexible option that suits city conditions due to the local recycling of energy and resources. The variety of production limits the risk and gives financial security. It is well suited to the developing countries because external inputs (chemical fertilisers, pesticides) are limited or absent.

Improvement of the fertility of the soils is always an important subject area. Due to compaction, overuse, and farming on marginal land, fertility in urban farming systems is often a problem. Incorporation of organic materials, especially by applying composted urban organic wastes, should be a further focus of technical innovation.

Enhanced access to low-cost seed and planting material is of major importance for poor urban producers. This can be addressed through the promotion of local seed networks and seed libraries.

Introduction of high yielding varieties could result in increased production. They are often used in combination with a more intensive use of agro-chemicals, which may lead to higher risks of soil and water contamination by nitrate leaching. These seeds may also require more water resources.

Reduction of health and environmental risks by facilitating the conversion to practices based on Integrated Pest Management (IPM), agroecology or organic farming practices are technical innovations that find favour with consumers.

3.1.5 - Small-scale commercial livestock keeping

Introduction

Though often more restricted and controversial than urban horticulture, the keeping of livestock in and around cities is a phenomenon as old as cities themselves. In the Global South, livestock keeping in cities is practised for many diverse reasons. Income generation and the improvement of household food security are the main motivations for stock keepers. Cultural and religious reasons also figure into the equation.

In the Global North, livestock keeping within cities is legally banned or restricted in many places, with some exceptions, especially keeping chickens. Currently, the practice is undergoing resurgence, as more people question the current global food system. Livestock keeping is a way in which people can reassert their claims of food sovereignty.

This sub-chapter examines urban livestock production systems in the Global North and South, focusing on what is occurring and examines the potentials and challenges. We conclude with a discussion of the main support needs for urban livestock keeping.

Type of people involved and their main motives – Global South

In the Global South, small-scale livestock keeping is widespread. Some examples include Bamako (Mali) where the participation rate is around 20'000 people. In Dar Es Salaam (Tanzania) 75% of urban farmers keep livestock, while 80% of urban farmers in Dhaka (Bangladesh) are involved. In all these cities, urban and peri-urban commercial livestock farmers are comprised of a variety of groups, including traditional small-scale farming households specialising in livestock production, urban poor that undertake some livestock activities on available vacant open land in the city, as well as urban middle class households (e.g. teachers, government officials, policemen) with larger plots that engage in livestock as a secondary source of income.

Their main motivations for involvement in small-scale livestock include:

- To supplement food security at the household level;
- To have access to fresh food;
- To gain a supplementary income;
- Traditional and religious motivations.

Supplement food security at the household level

Where access to income is a constraint, small-scale livestock production can make a significant difference with respect to nutrient intake. Rather than being a lifestyle choice, it should be seen as a survival strategy. Meat and milk, that otherwise would be unaffordable, becomes accessible as it is produced at home or on land owned or rented by the farmer. Small-scale livestock can also be seen as part of the solution to other problems, such as handling urban waste. Chickens and other stock can use household and restaurant waste products as feed.

Increased access to fresh foods

Access to fresh food is another important reason why small-scale livestock is practiced in cities. Lack of proper infrastructure with respect to transportation and refrigeration makes dairy production in peri-urban areas a reasonable choice. In and around Addis Ababa, Ethiopia, the dairy industry is practiced on differing scales to meet the demands of urban consumers. In Hubli-Dharwad, India, a group of people (*goulies*) have a long history of being water buffalo keepers, for the main purpose of milk production. It is the group's niche in a very dynamic, crowded economy. The desire for fresh milk traditionally has been a major demand of consumers.

Gaining supplementary income

Due to requirements for space and capital investment, many urban producers keep smaller herds/flocks or only smaller animals (guinea pig, rabbit, guinea fowl, poultry). Yet they still make a good income. For example,

in Addis Ababa (Ethiopia), above-normal profits are earned with very low capital input by even the smallest-scale backyard owners of inner city dairy units, large part of which are managed by women (Tegege, 2004). In Quito (Ecuador) small animal husbandry is an important component of urban agriculture, on the one hand laying hens for egg production and broilers for meat production, but another species of choice is the guinea pig. These small rodents have been part of Ecuador's culinary tradition for more than a millennium, and breeders do not have to compete with large industrial producers as they would if they raised chickens. The municipal urban agriculture program, AGRUPAR, provides training on the care, breeding, and processing of the animals to more than 90 small guinea pig farms within the city limits.

Studies of larger-scale commercial urban livestock keeping in Nairobi also show generation of significant incomes. Urban pig and poultry farming are profitable ventures and guarantee a quick return on capital. Mireri (2002) calculated that the economically minimum viable poultry farm requires 300 birds with farmers getting a return on their investments within 18 months. A pig farmer with 5 breeding mothers can earn a net profit of US\$ 2'667 per year.

Traditional and religious motivations

This refers to certain areas where urban farmers keep livestock for reasons of tradition. Pig raising in the peri-urban area of Montevideo, Uruguay, in connection with the collection of organic and inorganic waste is an example of this. In some parts of the world, livestock is raised for religious and traditional reasons. Urban Green Train case study Königshausen in Germany keeps sheep (six to 15 ewes) and bulls (150). The livestock is kept for the Muslim sacrificial feast of *Kurban bayrami*. (www.urbangreentrain.eu).

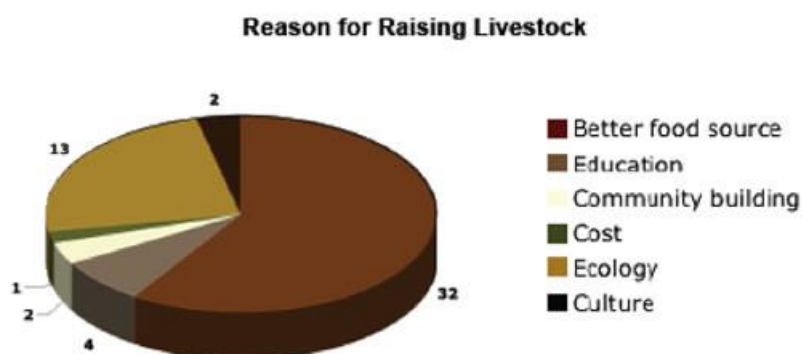
Type of people involved and their main motives – Global North

In the Global North, the motivations for people practising urban livestock keeping are quite different from those of the Global South. Livestock production in cities in North America was outlawed in the late 19th and 20th century. It collided with the image that many people felt a city should project. Rising living standards and changes in the livestock industry made urban livestock production in cities unnecessary. As well, the 20th century development of large supermarkets also helped to make the practice fall from favour.

In the last decades of the 20th century, the restrictions on livestock keeping in cities were reinforced in view of fears for possible health risks propagated by livestock (zoonosis). This was especially a response to food safety crises and food scares, such as outbreaks of Foot and Mouth Disease, avian influenza and Q-fever.

Over the last 20 years or so, there has been a strong movement against the current globalized food system. People have lost touch with where their food comes from and how it is produced.

Pallana and McClintock (2011) studied urban livestock keeping in Oakland, California. A low income city with significant poverty, Oakland is an important centre for urban agriculture and community food security programmes, so the results should be taken as an indicator of what could happen elsewhere. Reflecting on the difficult economic circumstances of the city, it is not surprising to see that 89% of the population keep livestock to improve their nutritional outcomes.



Source: Pallana and McClintock, 2011

The pie chart above shows a breakdown of the major reasons why people raise livestock: better food source (32), cost (1), education (2), community building (2), and ecology (13).

The article delves into the most controversial aspect of keeping chickens – slaughtering them for meat. This household skill would have been common at one point, but is largely lost. Now, butchers and community groups hold workshops instructing livestock keepers on how to slaughter in a healthy manner.

Different livestock production systems

The types of animals kept in urban livestock systems range from dairy cattle and buffalo, rabbits, goats and guinea pigs, to backyard poultry, pigeons, industrially kept layers and broilers, and pigs of native and exotic breeds. The choice for certain livestock systems may be culturally defined.

Livestock keepers produce meat and eggs, milk, butter and cheese. Young stock can also be raised for sale, further breeding or fattening. An important by-product of urban livestock keeping is the manure produced, that can be either used in urban crop production, for biogas production or for cooking and heating purposes. Produce is often sold directly to consumers.

Livestock production is practised both on small as well as larger scale. Small-scale production tends to focus on raising smaller animals or, raising a few units of larger livestock (1-10 dairy cows, 5-10 pigs or goats). They can be found in areas of the city with larger housing plots, in barns, on vacant open spaces in the city.

Small-scale livestock production is generally semi-intensive, with low external inputs and low cost housing units. Producers may collect grass or tree foliage, buy their animal fodder (e.g. Napier grass, fodder legumes, Paragrass) from peri-urban areas or collect waste residues from restaurants, markets, agro-industries, breweries or grain mills and urban households for the preparation of animal feed.

Poultry farming

Poultry production can be divided into traditional backyard, semi-commercial, commercial and industrial poultry systems. Poultry includes chickens, ducks, turkeys, pigeons, etc.

Chickens are kept for many reasons, including for consumption, gifts and ceremonial activities. A major purpose of chicken keeping is to supplement household revenues in terms of food and cash. When daily wages are low, the sale of even only a few eggs can be a very substantial contribution to the family income. Urban households with relatively high incomes also keep chickens, especially laying hens, because they believe that eggs produced at home are of higher quality than those found at the market. The demand that people have for village-raised chickens (more flavour, tougher meat) is reflected in a higher price for these animals.

Young broiler chicks are usually bought when they are one day old and fattened over a period of six to eight weeks. Support with vaccination schemes, input supply and marketing can be particularly helpful for producers. Feed can account for up to 70% of total production costs, so it is important that it be produced and used efficiently. It is worth investing in good feeders that keep losses from spoilage down to a minimum. Layers for egg production are kept in an intensive way and the investments are longer-term than they are for broilers. Housing for layers is more important and, if the animals are enclosed, a balanced ration is indispensable in preventing nutritional stress. Lighting is sometimes used to provide the longer daylight hours that are necessary to induce egg production.

Pigeon keeping is very popular in the Mediterranean region; for instance, in the Nile delta, dovecotes are common in both rural and urban areas. Pigeons can contribute substantially to household diets and income. They do not compete with other animals for space and feed; if fed by their owners, the birds tend to remain in the neighbourhood, but they are able to find feed within a radius of 15 km, thereby making use of the different vegetation cycles of local plants. In low-input systems, feeding is necessary only during the short period when the animals are getting accustomed to their new home. Pigeons adapt easily to urban conditions and are a common sight as they scavenge in town squares and markets.

Pig farming

Pig farming is common in the urban areas of many countries of the Global South, other than those in which the Islamic or Jewish religion is prominent. Pig keeping adapts well to the family level where the role of women is very important, both in collecting household waste and in looking after the animals. Pig production implies a significant reuse of household waste as feed, but the waste of commercial enterprises (bakeries and vegetable and fruit markets) and industrial activities (breweries and abattoirs) is also useful. Pig farming allows households to generate supplementary income in peri-urban squatter settlements in, for instance, Montevideo, Uruguay and Port-au-Prince, Haiti. In these areas, the activity is generally linked to the widespread practice of collecting, sorting and selling household waste to the local recycling industry.

Most pig breeders are small producers who have one or two sows and raise their animals from birth to fattening prior to slaughtering. Usually they sell suckling pigs (either slaughtered or alive) to intermediaries and slaughterhouses or directly to consumers.

Typical problems associated with pig keeping are caused by fears that pigs spread disease, that young piglets in particular will be involved in car accidents and that pigs cause noise and public nuisance. Ways to cope with these issues include providing housing, reducing the number of pigs so that they can survive and grow on local waste and keeping them in a hygienic way.

Rabbits

Keeping rabbits in urban areas is common in many countries, including Indonesia, Mexico, Ghana and Egypt. In some cases, rabbits provide an essential source of high quality food (protein) for the family; in other cases, they provide income or "pet" value for children. In towns where urban rabbit keeping is common, the animals are kept in cages on rooftops, in gardens and even in empty rooms. The people who live in towns are generally wealthier and can sometimes afford to buy metal cages, although these are not strictly necessary; any simple wooden or bamboo cage may do, as long as strict hygiene is maintained.

Guinea pigs

The keeping of guinea pigs is somewhat similar to that of rabbits. It can be done in urban and rural areas and guinea pigs alleviate food deficiencies in places where other kinds of animal production are difficult. They eat any kind of grass or leaves, and a small daily quantity of fresh feed per animal is sufficient. Guinea pigs need very little space; a fenced area of about 1 m² is sufficient for eight to ten does and one buck. Whatever material, from a cardboard box to bricks, can be used.

Management is very simple because there is no need to interfere in mating or nest preparation. After a gestation period of approximately nine weeks, an average of 2.5 animals per litter is born. New born are able to feed by themselves immediately and can be weaned after two weeks. Each doe can produce about eight to ten animals per year, which means about 100 offspring from a group of ten does, corresponding to nearly 1 kg live weight per week. Disease incidence and mortality are very low but, at the first suspicion of sickness, as with rabbits, the animals must be slaughtered and can be eaten if they are large enough.

Dairy, sheep and goat keeping

Keeping of larger livestock like cattle, sheep and goats in urban areas is generally more complex than in the case with the livestock systems we have discussed so far. Peri-urban areas are more appropriate. Feeding, breeding and reproduction are issues that require special attention.

Feeding of large herbivorous species (sheep, goats, cattle, buffalo), may be a challenge because a large proportion of their ration has to be fibre in order to ensure a good functioning of the digestive system. Roughage such as straws and grasses contain a lot of fibre, but, in urban conditions, these feeds are generally expensive and hard to find. They are less commonly produced inside cities, and the costs of transport (from rural areas) and storage of bulky fodders are high. However, urban production systems using expensive roughage can be profitable in particular circumstances.

In cities in the Global South, goat, cattle or buffalo husbandry is almost always related to dairy production. If there is a demand for fresh milk, feeding milk-producing cows and their calves with industrial by-products and expensive roughage is economically feasible. Even large commercial production units are remunerative. In India, the high demand for fresh buffalo milk leads to large commercial units of up to 500 lactating buffaloes inside cities. Fodder is bought from specialized grass producers and cutters living on the city

outskirts, who often irrigate (treat) the grass they produce with sewage water. Dairy farmers are prepared to pay high prices for these feeds and grass is becoming a cash crop for local smallholders. Semi-zero grazing systems develop when grazing opportunities increase, e.g. on roadsides. Zero-grazing systems seem to be labour-intensive but, as units are small, the cutting and carrying of feed in urban conditions is less time consuming than herding.

In countries with a high proportion of Muslims (such as those of North and West Africa), uncastrated male sheep are slaughtered at such religious festivals as Ramadan and Eid. Animals that are raised elsewhere are brought to the city to gain a lot of weight in a short time. In Mali, the main feed ingredient for these animals is cereal straw complemented with industrial by-products such as oilseed, groundnut and cotton cake and cereal bran. Feed may be expensive, because the market prices of these animals are high.

Concentrate feeding is mainly used in intensive and specialized poultry, pig and dairy units in peri-urban areas. The concentrates are often imported or made from local grain and oilseed milling by-products. Locally produced commercial feeds are often too expensive to serve as full ration feeds. As a result, poultry, pig and dairy farmers in some regions tend to use concentrates as supplements to rations based on waste products, thereby focusing on economic issues rather than nutrient-use efficiency.

Cow or buffalo operations tend to obtain young stock from informal markets in the countryside, which are often hundreds of kilometres away. Breeding policies for such animals should not be directed at urban farms but at the source of cattle supply.

Main potentials and challenges

How and where urban livestock is practiced is important in determining benefits and problems. Societal and government acceptance of the practice plays an important role as well as traditional and religious aspects.

Main potentials

We can identify broadly the positive benefits of having urban livestock:

- Improved access to protein and a better diet;
- Providing a supplementary or major source of income for participants;
- Responsibly practiced, environmental benefits can be plentiful;
- Potential to close nutrient cycles at local level and provide animal-based fertilizer for crop production;
- Keeping traditions alive, social and religious benefits.

Main challenges

The nuisance factor can be a real or imagined problem for urban livestock. All livestock will create a nuisance if not properly managed, but generally, the larger the animal, the larger the potential problem. Odours and noise from animals do not fit into everyone's idea of what a city should be. Re-allocation of animals would be one way of solving problems related to animal excreta. However, an urban gardening or biogas production programme could be a better solution by converting the excreta into a valuable resource rather than waste, thus maintaining a "vibrancy" and social activity rather than killing local initiative. In addition, the community action resulting from such a programme could also be used to start up other activities.

The spread of disease is a real, but at times over-exaggerated issue. Serious illnesses related to animal keeping and consumption of meat exists. Zoonoses are diseases that affect both humans and animals. They are more likely to spread when hygienic conditions are poor - for example, commercial forms of livestock keeping in urban areas are particularly favourable to the multiplication of rodents because these systems require the storage of animal foodstuffs. Rats are a carrier of hanta virus, an important human disease in Asia. In Africa and Latin America, a human tapeworm makes use of scavenging pigs to complete its lifecycle. Pigs feeding on human excrement containing tapeworm eggs become infected by cysticerci (the larval stage), while humans who have eaten insufficiently heated pork meat become hosts to the adult tapeworm. The disease becomes a serious problem when other humans, such as playing children, are infected with tapeworm eggs from human excrements. In many developing countries, meat is slaughtered in conditions at

times less than hygienic. The housing of animals, maintenance of hygiene and proper storage of animal feeds are typical responses to these problems.

Many of the problems that are associated with livestock keeping have solutions. The following table reports on dialogue between livestock keepers and administrators in Kampala, Uganda that helped to better define perceived problems and possible coping strategies:

Perceived problems	Coping strategies
Farm level <ul style="list-style-type: none"> • Animal health and welfare problems caused by high densities • Low output per animal, provides only a small part of the total food requirements 	<ul style="list-style-type: none"> • Redesign of housing, awareness building, improved management, ventilation and food • Awareness raising at municipal administration level on multiple perceptions of urban livestock systems, e.g. animals as cash generators for poor sections of the population or as efficient recyclers of waste
Community level <ul style="list-style-type: none"> • Smell, dust and noise • Conflict in neighbourhood • Damage to ornamental plants 	<ul style="list-style-type: none"> • Use of drains, straw, bedding, sheds, tree hedges • Make/modify legislation; involve local people, look for solutions rather than for rigid legislation • Erect fences and/or tether animals; hang plants out of reach
City level <ul style="list-style-type: none"> • Public health problems (diseases such as parasites) • Pollution (from manure effluent and wastes from slaughterhouses, etc.) • Overgrazing of urban grounds • Competition for space • Stray animals/ traffic problems 	<ul style="list-style-type: none"> • Good health service, improved hygiene, improved packaging/treatment and awareness raising • Biogas; smaller-scale enterprise; dung cakes; integration with vegetables • Importing feed from rural areas and/or reduction or change of local herds • Efficient housing; reduction of numbers; introduction of smaller animals • Traffic rules, limited speed of cars, animals kept off main roads; reduced number of through roads • Do not over-promote large industrial urban livestock systems and/or restrict import of feed out of villages

Source: Urban Harvest (n.d.)



Main support needs

Main support needs for urban livestock keeping include technical training and assistance to livestock keepers, especially regarding prevention and reduction of health risks, improved waste management and improved husbandry practices. Enhancing access to forage and other feed sources, especially waste or industrial by-products, and their efficient use in livestock nutrition, are important issues for technical innovation. Enhancing access to young stock, the use of indigenous breeds and improving the inter-relationships between urban crop and livestock production are other aspects to be considered.

In Port-au-Prince, Haiti, several government and non-governmental organisations are involved in improving pig production. Indigenous Creole pigs that are well-adapted to local conditions (feed, management) and popular with consumers, were re-introduced. Other activities include:

- Improving feed availability by using such local resources;
- Improving the marketing of fresh meat and processed products;
- Improving access to vaccines and medicines.

There is also a need for information on best practices to raise livestock in a safe manner. The increased risk of transferring diseases from animals to humans in urban areas needs to be reduced by working with producers on managing animal diseases and wastes, preventing scavenging, and maintaining adequate slaughtering procedures, among other issues. Education is also required on best practices to prepare the food so that it is not 'dangerous' to consume the meat.

The need to invest in more safe and sustainable production systems require as a first step official government support and sanction for the practice. The potential of livestock in urban areas is slowly starting to be appreciated by some governments. However, policy development is not keeping pace with changes in the field. For example in many parts of North America and Europe, small-scale abattoirs that could service small-scale livestock keepers have disappeared as regulatory changes have favoured the big players of the industrial food system.

As a starting point, policy makers need to be made aware of the positive impacts that this form of urban agriculture can make. When that is secured, innovative projects and programmes can be developed that will make livestock-raising in cities safer, more productive and a social benefit for any given city.

3.1.6 - Urban aquaculture/aquaponics

Introduction

Urban aquaculture and aquaponics have received renewed attention in the last few decades. Aquaculture has been identified as a major economic opportunity due to the diminishing supplies of wild caught species in the oceans and the inability of this natural supply of seafood to meet the increasing demands of public consumers for healthy, nutritious, and tasty products. Aquaponics has acquired a great deal of attention and could prove to be an elegant way to produce fish and vegetables in a combined way.

Type of people involved and their main motives

Aquaponics

The concept of aquaponics differs significantly from the types of aquaculture that we will be examining next. Aquaponics refers to the co-activities of aquaculture (raising fish) and hydroponics (the soilless growing of plants) that grows fish and plants together in one integrated system. The fishes waste provides an organic food source for the growing plants and the plants provide a natural filter for the water the fishes live in. The third participants are the microbes (nitrifying bacteria) and composting red worms that thrive in the growing media. They do the job of converting the ammonia from the fish waste first into nitrites, then into nitrates and the solids into vermicompost that are food for the plants (www.theaquaponicsource.com).



An international survey was conducted in 2014 to gauge production and profitability of commercial aquaponics observations (Love et al., 2014). The survey points to the fact that the industry is in its early stages, but with great potential:

- Most operations occur in controlled environments;
- Average age of aquaponics farmers is 47, with males constituting 77%;
- The median year they began production was 2010;
- 41% of respondents used a greenhouse with another location to grow plants and raise fish; greenhouses solely were used by 31%;
- Supplemental lighting was used by 43%;
- In the U.S. the average size was 0.01 ha (0.03 acres);
- Two species of aquatic animals was raised by 30%: Tilapia was the most popular variety (69%), ornamental fish (43%) and catfish (25%) were the next most popular;
- Most popular raised plants are basil (81%), salad greens (76%), tomatoes and lettuce (68%), kale (56%) and bok choy (51%);
- No marketing channel pre-dominated: fishes were sold at farmers markets, farm stands and by CSAs. Indirect marketing included grocery stores, restaurants, institutions and wholesalers.

Aquaculture

Thousands of migrant and low to middle class income families in Southeast Asia and to a lesser extent Africa and Latin America are generating their livelihoods in aquatic production systems, while feeding an even larger number of urban inhabitants and recycling a large part of the city's waste. Their main motive is to supplement income, while using part of the produce for home consumption. Small-scale commercial vegetable and fish producers in Bangkok, Thailand for example have average earnings of US\$ 4'000-8'000 per year, while households in Phnom Penh, Cambodia growing water spinach generate between US\$ 200-500 per year in additional income (PAPUSSA, 2006).

Farmers with sufficient resources, businessmen, and urban investors who hire farm labour are involved in high-intensive aquaculture as either their main business or as part of a diversification strategy. As menu

choices in Europe and North America's fast-expanding food service and niche retail markets increasingly feature various seafood and exotic fish options, aquaculture has become a new income-earning strategy for many of its farmers. In North America, aquaculture systems, which are relatively low cost, are beginning to be found in unusual places, such as at the household level. A recent article from the [Toronto Star](#) describes the aquaponics system in someone's home. This is an extreme example of self-provisioning, but for a low cost, it can be done.

Products and degree of commercialization

Aquaponics

For home-based aquaponics, there will likely be no commercialization involved. The motivations are for personal use. The cost of small systems is low so they would not need to recoup through investment by selling fish or vegetables. For commercial operators, both the fish and plants are produced for sale to customers. Depending on the size of the enterprise, sales may be local or for export.

Many different types of fish do well in aquaponics systems. The choice of fish is influenced heavily by consumer demand. The most common species are tilapia, perch and catfish. Other common types raised are carp, barramundi, trout, salmon, Murray cod, and largemouth bass (Sommerville et al., 2014). Fish chosen are not restricted to varieties to eat. In some parts of the world Koi and other ornamental fish are grown.

Aquaponics systems are especially well-suited to growing a wide range of vegetables. Production time can be quite rapid for the smaller greens. Typical varieties of plants grown include basil, mixed salad greens, basil and other herbs, Swiss chard, cucumbers, eggplants, peppers, tomatoes, cabbage, broccoli, parsley and cauliflower (Sommerville et al., 2014). Greens are especially sought after by customers, especially by restaurants. The quality is high, the product is local and with proper planting cycles, harvesting can happen year round.

Aquaculture

We can distinguish five types of aquaculture systems:

- Growing of fish, shrimp, or shellfish for food consumption;
- Growing of aquatic plants for food consumption or animal fodder;
- Production of fish seed or fingerlings for sale;
- Growing of ornamental fish and plants for aquariums or artificial ponds;
- Integrated systems

Aquatic fish and shellfish

The most popular types of fish include tilapia, catfish, and different breeds of carp because of their high adaptability (to low-quality water, which is of especial importance when wastewater is used), high productivity, and easy hatching. Other intensive urban aquaculture systems have been used to produce high-value fish such as eel, sea bass, mussels, and shrimp.

Aquatic plants

Common aquatic plants grown for human consumption include water spinach, water mimosa, water dropwort, water chestnut, and watercress. Most production occurs in flooded fields, some of which were converted from rice production to generate a higher income. Water spinach is also cultivated floating on canals and lakes.

Aquatic plants also serve as an excellent source of high-protein fodder. Around Ho Chi Minh City, Vietnam, many farmers in Binh Chanh District have combined water mimosa cultivation with fish production in separate ponds; mimosas provide a daily income, and the fish consume the duckweed that grows alongside the mimosa.

The operating costs for aquatic vegetable production may be lower than for fish culture, with fewer risks from environmental disturbances and higher potential returns. However, aquatic vegetable production in many areas is threatened by land-use change and the environmental, animal, and public health impacts of applying large quantities of agrochemicals during.

Fish seed and fingerlings

For proper fish culture, good quality fish seed or fingerlings is required. Some farmers specialize in the production of fingerlings, which are sold to other growers for further fattening. Sometimes fingerlings are not hatched but are caught in the wild.

Ornamental species

Aside from food production, examples of urban aquaculture from Europe, North America, and other regions demonstrate that the practice is used to produce ornamental species, to create tourist attractions, and to incorporate as part of social development and educational schemes. In developing countries, intensive urban aquaculture systems do exist by, for example, producing for regional and export markets — a practice that is being encouraged by the local government around Ho Chi Minh City in response to growing pressure on land resources.

Integrated systems

Aquatic production can be integrated with chicken, duck, or pig production. The manure produced by the animals is applied to the pond and eaten by the fish or used for plant growth. Mature aquatic plants, in turn, can be fed to the animals.

Other integrated systems comprise of combined rice-fish production in wetland areas. In Tananarive, Madagascar, rice production is combined with the production of watercress and fish.

Aquaculture can also be integrated with horticulture production. Aquatic plants can be composted and the compost used to improve soil fertility for urban horticulture. Horticulture residues (leaves, peelings) can be fed to fish living in nearby ponds.

Scale and locations

Hydroponics

Small hydroponic systems take up little space and can be incorporated into a house. We also see rather small units being installed in restaurants and offices. For larger scale systems, many choices exist when it comes to location. Peri-urban areas where land prices are lower are a popular choice. As well, former buildings that were used for industry or manufacturing are being repurposed for aquaponics.

Aquaculture

Generally, these operations occur in peri-urban areas. We see the aquaculture happening in open-water bodies, lakes, channels, streams, or reservoirs, as well as in tanks that can be placed either outside or inside buildings and greenhouses. A [recent example from South Africa](#) features a fish farm located in a shipping container. With many urban centres located in coastal areas, it is also important to note that urban aquaculture, although probably dominated by freshwater production, may also include production in brackish water and marine environments.

Urban aquaculture comprises a large variety of aquaculture systems, varying from small to larger scale systems. One way to differentiate among aquaculture systems is to distinguish between extensive, semi-intensive, and intensive production systems.

Extensive aquaculture consists of growing water plants and stocking fish in either natural or artificial reservoirs and/or urban water bodies. Such extensive systems hardly require any external feeding sources, although some fertilisation with manure and organic farm by-products or household wastes may occur. A serious constraint to aquaculture in public water bodies, however, is the multiple uses by various groups, often with conflicting interests.

Higher densities of stocked fish and a more intensive use of external feeding sources characterize semi-intensive systems. Unlike aquaculture in reservoirs, urban rivers, and lakes, pond-based aquaculture offers farmers greater control over management and permits better surveillance, enabling producers to guard against theft, predation, and contamination.

Intensively managed aquaculture operations in urban areas are being developed by entrepreneurs in several countries. Although less land may be required per unit of production for intensive as compared to extensive or semi-intensive pond units, investment costs associated with establishing these systems are comparatively high. The advantage of intensively managed farms is that operators can exert greater control over the operation of the system, better regulating factors such as water quality, feed delivery, and stock management. Intensive cultivation systems in the production of fishes such as tilapia or perch, generally take place in land-based tanks. However, because of the high capital and operating costs of intensive systems, often it is only feasible to produce high-value products, such as eel or shrimp, destined for specialist or export markets.



Prototype of container farm tested by Efficient City Farming (ECF) with aquaculture in container and hydroponics in greenhouse. BY ECF Farmsystems Berlin

Technologies applied and resource needs for aquaculture

We have seen that urban aquaculture encompasses a broad array of activities, varying from large-scale extensively managed open-pond fisheries and plant production to intensive and high-tech production of freshwater and marine fish in tanks. An example of the latter include bioponic systems, combining fish production with hydroponic techniques, by replacing the mineral nutrients conventionally used in hydroponic plant production, with natural inputs of nutrients contained in fish effluent wastes. This is an innovative system of food production that combines aquaculture with hydroponic vegetable growing techniques. The system is relatively simple and, depending on the scale, may not be too expensive.

Conventionally, extensive aquaculture is characterised by the dependence of stock on natural food. However, in most urban and peri-urban settings, it can be assumed that natural production in water bodies, where extensive aquaculture is practised, is enhanced indirectly through nutrient-rich runoff and drainage water. Semi-intensive production routinely involves fertiliser applications to enhance natural food production and/or the provision of low protein supplementary feed. In urban settings, agricultural and food processing by-products, brewery, hotel and restaurant wastes and direct wastewater applications are typically used. Producing in wastewater fed systems of insufficient water quality may however threaten both levels of production (contamination may significantly reduce production levels) as well as human health. Intensively managed systems, whether in rural or urban settings, depend on externally sourced inputs of high protein feed (up to 20%). In urban areas, entrepreneurs have seized upon opportunities to utilise by-products and (animal) waste resources to culture high protein feeds such as worms and fly larvae to supply aquaculture producers. In Thailand, by-products from chicken processing plants are used to feed catfish grown in urban aquaculture systems stocked at high densities, providing a framework for the interaction between livestock and fish production in peri-urban conditions, as opposed to rural environments. Using animal waste resources however brings with it the risk of contamination and pollution, while depending on externally supplied high-protein feed incurs high capital costs and inherent financial risks.

Main potentials

Food security, employment and income generation constitute important and tangible benefits of urban aquaculture, in particular, for people from poorer communities. However, wider benefits afforded to society include waste reuse leading to improved public and environmental health protection and non-renewable resource recovery.

Farmers engaged in urban aquaculture have a number of advantages over rural producers, most notably their proximity to markets. They or intermediaries are able to deliver fresh products in a timely fashion to consumers. Consumers may prefer to buy live or locally produced fish as a guarantee of freshness, and for urban aquaculture producers it is possible to supply live fish to the market at little extra cost.

In Hanoi, Vietnam 10 to 20% of freshwater fish consumed comes from peri-urban production, while the considerable daily demand for aquatic vegetables is met almost entirely by production grown in peri-urban areas.

In the northern part of Bangkok, Thailand hybrid catfish farms produce more than 70% of the country's total production of catfish (around 80'000 tonnes). It was recently estimated that in Kolkata, India, urban ponds account for over 18'000 tonnes of fish per year that is sold in urban markets, which serve predominantly poor communities (PAPUSSA, 2006).

Aquaculture as a potential economic sector

(Peri-) urban aquaculture not only contributes to food production, but can also become an important income source for producers and vendors. As much as 80 - 100 tonnes of aquatic plants are sold every day in Talat Thai, one of Bangkok's (Thailand) two main wholesale markets, with a daily sales of US\$ 44'000 and annual sales of US\$ 15.3 million (PAPUSSA, 2006).

Urban aquaculture can also provide employment for large numbers of people. Jobs are created directly as a result of stocking, harvesting, maintenance and management, and indirectly for activities such as producing and supplying seed and feed, making nets and boats and transporting and marketing harvested products. Estimates suggest that urban aquaculture around Kolkata, India provided direct employment for 8'000 people, while employment in associated sectors servicing the farms was estimated at over 20'000 people.

Aquaculture contribution to greener cities and resource recovery

Next to its potential impacts on food production, job creation and economic development, aquatic production systems treat wastewater effectively, while reusing both nutrients and water and, in so doing, contribute to greener cities. Conventional treatment of urban wastewater is often not an option for fast growing cities in the Global South and, provided public health issues are addressed, aquaculture systems can be both cost effective and a practical low-cost treatment alternative. Depending on their design and operation, urban and peri-urban fishponds receiving wastewater inputs are likely to facilitate a range of physical, chemical, bio-chemical and biological contaminant removal processes similar to those observed in wetlands and lagoons. Ensuring that the maximum possible benefit is derived from recycling appropriated water resources and nutrients contained in both solid and liquid waste, pressure on the remaining renewable freshwater resource and non-renewable mineral resources will be reduced.

Support needs

Investments and supports are required to further develop and increase the sustainability of urban aquaculture production systems, while regulating potential health and environmental risks. Governments should recognize the role urban aquaculture could play in local economic development, promote and secure access to land and safe water resources and integrate aquaculture in urban development and planning. Producers need to be assisted in adopting better production and management practices, while vendors and markets should assure food hygiene, both adhering to commonly agreed upon food safety parameters.

Security of land and water sources

Access to land and sources of water that are reliable in terms of quality and seasonal availability and quality are needed for aquaculture systems. Aquatic production systems should be acknowledged as a legitimate land/water use and integrated into urban development and land use planning. Multifunctional land use and zoning, combining urban aquaculture with open and green space management, recreation, and flood control should be promoted, while securing aquatic producers longer-term tenure of land and promoting safe use of wastewater. The terms of access to land can also restrict the long-term sustainability of the aquatic production systems. In Hanoi, Vietnam many fish farmers can obtain at most a 5-year lease for land rented from the commune or acquired by auction. In Phnom Penh, Cambodia women renting plots in Boeung Cheung Ek Lake can be forced to move their plots after a warning period of only two weeks. Depending on the local situation, legal instruments that guarantee land tenure for 10-15 years should be put in place. Securing longer term access has the advantage of allowing producers to maintain and modernize their systems, encouraging them to use more resource-conserving farming technologies, or grow higher value crops and fish.

The future for growing aquatic plants and fish using urban wastewater will depend on planners being able to coordinate and develop strategies for the effective separation of industrial waste effluents from domestic sewage. This is also desirable for farming groups and low-income households who may rely on the cultivation of land vegetables and crops using wastewater as their main, and often only, source of water and nutrients. It also makes sense in terms of protecting the environment.

There are examples from Hanoi and Ho Chi Minh City, Vietnam and Kolkata, India where industries have been relocated to industrial parks and zones, allowing for more effective treatment and monitoring of effluents. Smaller provincial cities and towns may be better placed to incorporate aquatic food production in their development plans, but further research will be required to confirm this.

Innovating urban aquaculture production and marketing systems

To enhance the sustainability of aquaculture production and marketing systems, more support is needed for improving and developing new systems and techniques for aquatic production, specifically environmentally sustainable production and development of new product lines. Ornamental fish and plant production are among the viable and financially attractive production systems to be considered. In Bangkok and Ho Chi Minh City, certain fish farmers have gone into the production of ornamental fish species. As well, some hatchery producers have started cultivating and selling ornamental house plants. Other livelihood diversification strategies were observed in Hanoi where adopting a rotation of aquatic plant species, e.g. morning glory, mimosa, watercress and water dropwort, provided farmers with significantly overall higher incomes and some protection from seasonal price fluctuations.

Innovative urban aquaculture operations being developed in North America and elsewhere are also increasingly regarded as multifunctional, producing food, while also contributing to education and environmental protection. In Hanoi, the municipal authorities have retained large wetlands and lakes within the city boundaries for aesthetic and flood control reasons, while remain accessible for aquatic food producers.

Improved information and education on cleaner and more sustainable production techniques could also lead to better development of aquatic production systems that rely on organic forms of pest control as opposed to agrochemicals. Governments, research and training institutes should promote ecological farming practices through training and local experimentation, and provision of licenses and incentives to micro-enterprises that produce and supply ecological friendly inputs such as biological pesticides.

Access to grants and subsidies

Indoor aquaculture produces the highest quality fish because the growing environment is maintained under optimized conditions. This maintenance entails numerous expenses including electricity, heat, equipment and real estate. Governments can help the aquaculture industry by assisting with access to low-cost electricity, heat for water (for instance waste heat from co-generation or manufacturing facilities), and equipment and real estate (e.g., help in using abandoned or underutilized buildings, or brownfield sites).

3.1.7 - Small-scale specialized production system

Introduction

Next to horticulture production, livestock keeping, and aquaculture, we find in many cities a variety of small-scale specialist production systems, varying from mushroom production, house plants and flower production and tree nurseries to medicinal and aromatic plant production and honey production. All these products are geared toward a niche market or specific consumer demand. Specialist-production systems can be small scale and managed by individuals and families or large-scale corporate production.

Products and degree of commercialization

The destination for specialist products is urban niche markets. These include among others mushrooms, beverages (wine, beer), potted plants, flowers, herbs, medicinal and aromatic plants, and tree seedlings. Cultural traditions and festivals have a very strong influence on consumer demand for niche products. In many countries, the main demand for flowers occurs on Mother's Day, Valentine's Day, and during the Christmas period. In Vietnam, the Tet celebration is an opportunity to offer two ornamental trees: kumquats bearing mature orange fruits and peach trees in blossom. In urban and peri-urban areas in Hanoi, ornamental fruit-tree specialists have set up production to meet this demand, which means that they nurture young trees for a period of one year to prepare them for sale. Another example of consumer demand is for wine produced in the Netherlands. Since demand is increasing for locally grown wine production in the Netherlands, this could become a new specialist urban and peri-urban product. Urban Green Train case study De Haagse Stadswijngaard in The Hague shows the potential for this industry (www.urbangreentrain.eu). Other niche markets include the marriage and/or funeral industry (for flowers); exclusive restaurants selling locally sourced food, and specialist shops (e.g., mushrooms or herbs).

Type of people involved and their main motives

A recent study from Manitoba ([Advancing the small scale, local food sector in Manitoba](#)), Canada explored the small-scale local food sector. A survey asked the question what attributes best characterize the sector. The key finding characterizes niche producers in many regions of the world:

“Perhaps the single most striking characteristic is the passion these stakeholders feel for their chosen enterprise. They are committed to producing food of the highest quality in a safe and healthy environment. They are also dedicated to preserving customer confidence and ensuring their practices are transparent.”

Global South

Specialist producers generally come from the lower-middle class. They have some capital of their own and are in a position to access and benefit from development projects. They tend to be innovative producers, are willing to take some risks and often have a higher level of education.

Production is geared towards the market, thus generating a source of income (main or secondary) for producers. Mushroom, aromatic plant production and extraction of essential oils can be profitable production systems, and specifically suited for female producers.

Ornamental plant and/or flower production can be another profitable urban agriculture activity. Competition is fierce and many flower factories are now run by multinationals or large domestic companies. Research shows that wages for workers are very low. For example, in Kenya wages range from US\$ 59 to US\$ 74, while the living wage is estimated to be US\$ 220 a month ([Women Working Worldwide](#)).

Yet the niche market is starting to attract businesses that would normally not be considered likely candidates to be niche producers. At Novotel in Bangkok, a small experiment growing the edible freshwater alga spirulina continues to expand.

Global North

Primary producers in urban agriculture understand the importance of diversification for their business. As a result, fruits and vegetables are frequently used as the base for value-added products. Examples are plentiful such as making pesto from basil, and jams and marmalades from fruits to making hot sauces from peppers. To diversify income sources, it is not unusual to see vegetable growers also growing ornamental flowers. These fetch a high price and can in effect subsidise the growing of vegetables. Specialist production systems, especially in urban areas are taking off to meet the demand of consumers who want special products for their cooking. Restaurants are also a major driver of this trend.

Social and environmental reasons can also drive the people behind these businesses. Urban Green Train case study Rotterzwam, in the Netherlands, shows a commitment to the environment by recycling most of the materials that are used in their production of mushrooms. The production of high quality and nutritious food locally is one of their value propositions. Socially, their mushroom growing kits allow everyone interested in this form of agriculture to participate.



Rotterzwam mushroom Growkit

Scale and locations

Specialist production is practised on a variety of locations and scales. It can be found in both urban and peri-urban areas, on small private lots, in space-confined areas, or in buildings and barns (e.g., mushroom production). It also takes place along roadsides (e.g., ornamental plant production), on public, vacant land areas (e.g., tree nurseries or flower production in public parks) and on larger private/public plots in peri-urban areas.

Technologies applied and resource needs

Small-scale specialist production is normally semi-intensive, with a strong tendency to further intensification and the use of more technology. In the case of flowers, research focuses on improved flower varieties, growing in more sophisticated controlled environments and growing for the export market. Products are sold as primary produce (fresh herbs, cut flowers) or processed (dried herbs or mushrooms, condiments, flower bouquets).

Investments are needed for various inputs for small-scale specialist production: growing media for mushrooms, hives and protective clothing for bee production, pots for flowers and ornamental plants, etc. Mushroom growing media can consist of manure (horse manure is specifically recommended), organic waste (materials like rice or cotton husks, straw or wood), but also exhausted coffee powder as for the case of Rotterzwam. Inoculation material is also required and should be of good quality.

Ornamental plant or seedling production also requires availability of compost or other potting and growing materials. Ghanaian flower producers obtain their seeds and cuttings locally from gardeners, seed vendors, and shops. Some material is also imported from neighbouring countries such as Togo and Nigeria. Fifty percent of farmers construct the pots themselves whereas 33% relied on hired labour to construct the pots for the flowers. Cow dung is the main soil ameliorant used by these farmers. About 63% of farmers had permanent labour to assist with the flower production thus providing employment for others (IWMI, Ghana, 2006).

Main potentials and support needs

Small-scale specialized production systems offer many excellent products to consumers. Support is needed in some areas for the sector to reach its full potential. [The EU funded TRADEIT](#) project supports traditional food producing SMEs in the Dairy, Meat and Bakery businesses in nine regional TRADIT Hubs across Europe. They commissioned a survey to discover what the barriers were to innovation. The chief barriers that emerged were:

- Lack of time for adequate innovation;
- Difficulties of access to finance for innovation;
- The unsuitable size and cost of new processing equipment for delivering product innovations;
- Problems in creating adequate distribution networks;
- The problem of innovation awareness.

Enhancing the development of small-scale specialist production systems is multi-faceted and may include:

- Assistance to farm management, quality control and certification, processing/packaging, transportation and marketing;
- Technical assistance to solve existing production problems and promote farmer innovation through farmer study groups, and providing access to new technologies and market information;
- Enhancing access to credit and financing.

Small-scale specialist agricultural production is an important contributor to local economic development. In and around St. Petersburg, Russia over 23 million cut flowers are produced for the market each year. Flower production is also traditionally an important activity in Vietnam. Flowers are mostly cultivated in urban areas of Haiphong, Hanoi, Ho Chi Minh, Dalat and provincial towns, involving thousands of farmers. Roses, orchids, chrysanthemums, lilies and others are being grown for commercial production. Demand for flowers is only expected to increase with the economic growth of the country and raised living standards of the people. It is also expected that the production area will increase substantially if Vietnamese cut flower producers enter the export market.

In Cuba, specific support programmes have been set up for flower, medicinal and aromatic plant production. Support is provided to producers in form of technical assistance, processing and marketing (for example the drying of herbs and preparation of condiments; the preparation of bouquets for funerals) and local seed production.

The Ministry of Food and Agriculture in Ghana provides specific extension support and technical advice to mushroom farmers. Most mushroom farmers also belong to the National Association of Mushroom Growers and Exporters. The association assists its members to market their products and organizes seminars and workshops to train members. The purpose of the association is to educate the membership on good practices in mushroom cultivation and facilitate access to inputs and credit. It also tries to open up new markets for the producers.

Selling to a niche market requires high quality produce, products, and the ability of producers to negotiate when selling to distributors and directly to consumers. Not all producers meet these requirements. They especially may lack business management skills and the capacity to organize to attain better marketing results. In many cities, there are no extension services available for urban farmers. A need exists for new learning methodologies to be developed. Rural methodologies, such as farmer-field schools or farmer-to-

farmer exchange are slowly being adapted for use in urban environments. These “urban producer field schools” are being developed in different stages, depending on local circumstances and subjects covered. Beyond the need for technical assistance and capacity building, small-scale specialist producers need access to credit and capital for starting up or expanding their enterprises. The global RUA-From Seed to Table programme (2009-2010) supported urban producer groups in 18 cities around the world in improving their production systems and strengthening market-chain development of urban agriculture. Possibilities of designing a guarantee fund needs to be investigated, such a fund serving as a guarantee for local banks and credit cooperatives to financially support local urban agriculture enterprises.

In Brazil for example a central government guarantee fund was provided to a state development bank. The bank provides loans to urban agriculture enterprises and the borrowers repay later in a conventional way. One question that arises with this model is what would happen if the government stop guaranteeing credit. One answer might be given. This financial set-up has offered, in most cases for the first time ever, urban farmers the opportunity to access formal credit. If they pay their first loans back and thus gain credibility, they will be in a better position to apply for future loans from the bank, beyond the specific, credit line. In this sense, the programmes acts as a bridge between informal producers and the formal banking system, and this makes it especially attractive.

3.1.8 - Large-scale agro-enterprises

Introduction

Large-scale farms and agro-enterprises contribute to local economic development and urban food security at the city level. The main limiting factors for developing such enterprises may be the lack of technical expertise, high initial capital cost, and marketing risks. Main support needs include assistance in farm planning and management, access to information on advanced and sustainable technologies, and access to market information and sources of financing.

Opportunities offered by the city in terms of market potential and access to inputs and infrastructure (roads, airports, harbours) may also trigger the development of large-scale agro-enterprises. Other traditionally rural-based enterprises have gradually adapted farm strategies to a more urban environment as a result of urban expansion.

Type of people involved and their main motives

Large-scale agro-enterprises are either run by traditional farmers or by urban investors hiring a manager and labour to work the farm. This category of traditional farmers still shares many characteristics with rural farmers (they may even be called “rurban” farmers). They differ in their level of intensification, capitalization and specialization, and the extent of their relations with the city, in terms of diversity of production outlets and sources of income (agricultural and non- agricultural). Peri-urban agro-enterprises may also have to deal with threats posed by urban sprawl or by other competing interests such as recreation or nature conservation.

In the Global South, the urban entrepreneurs or investors, usually civil servants, businessmen or expatriates, invest in intensive vegetable production, poultry keeping, fish farms, or fruit growing, with the main objective to generate a high return on capital invested. They rely on a salaried labour force for doing most of the tasks. They may lack an agricultural background and the cases of losses and failures are numerous. They often control the marketing of their produce, e.g. through direct delivery to stores or with links to export companies. Some examples of this category are the producers of green beans around Dakar, Senegal, civil servants embarking on poultry production in Ouagadougou, Burkina Faso, expatriates involved in rose production in Ecuador and Kenya and the producers of greenhouse vegetables in Europe and Asia.

Products, scale and locations

Large-scale agro-enterprises consist of poultry, pigs, dairy, vegetables, mushrooms, nurseries, flowers, and aquaculture produced in large units. Production is fully geared at the local, national, or even international market. They are mainly located in peri-urban areas around cities, in areas with good transport facilities, both for input supply and for marketing produce.

Intensive production of beef, pork, poultry, and eggs occurs in many cities in the Global North and South. Often highly productive hybrid breeds are used along with concentrate feed as a source of fodder. Large-scale livestock systems, like intensive broiler production are generally found in peri-urban areas. Larger-scale systems may import feed, young stock and concentrate feedstuffs from rural areas, raise animals in improved stables and make use of foreign breeds. They mainly sell to institutional consumers.

In Europe, North America, and countries such as China and Vietnam, there is a trend toward modern greenhouse operations that are technologically advanced and produce a single crop, like tomatoes, cucumbers, lettuce, or mushrooms.

As large amounts of investment are required for this type of production, long-term land security becomes an issue for the development of large-scale agro-enterprises. Cities may protect the agricultural use of peri-

urban land through zoning or controlled urbanization. In China, urban-planning concepts like "satellite towns" and "green wedges" between "fingers" of urban growth are now being experimented.

Technologies applied and resource needs

Large-scale agro-enterprises are normally characterized by high infrastructure investments (e.g., shelters, buildings, greenhouses), use of more advanced technologies (e.g., mechanizing certain agricultural operations, like irrigation or land tillage), and more intensive use of industrial feed, medicines, and agro-chemicals.

Intensive production systems may cause environmental pollution, such as soil and groundwater contamination associated with agrochemicals and discharges from (intensive) livestock operations. Energy requirements for the mechanization and heating of large-scale enterprises are also generally high. This combined with the materials used for buildings, agro-chemicals used for plant fertilisation and pest management, and industrial feedstuffs means that large-scale enterprises generally have a much larger ecological footprint than smaller-scale production systems.

In some cases, large-scale production systems make optimal use of urban-waste streams, such as organic waste and compost for mushroom production. Waste heat from buildings and industrial operations can be captured and reused in greenhouse production. The increased levels of carbon dioxide also benefits plant growth. Heated water, discharged after cooling operations, can be used for fish production.

Labour is an important resource for large-scale agro-enterprises. This offers opportunities for many migrant labourers. However, labour conditions may not always be adequate. Large-scale enterprises are under pressure to better protect the welfare of their workers and the environment. The fair trade movement has been instrumental in ensuring that farmers and workers are treated fairly. Certification gives assurance to consumers that workers have not been exploited in the production of a given product.

At the same time, agriculture like many industries can be very high-tech with robots being used for some jobs previously done by workers.



Main potentials

Large-scale agro-enterprises could produce a large part of the city's food needs, significantly reducing transportation requirements for produce to be shipped or flown in.

In Shanghai, China 60% of all vegetables consumed are produced in intensive vegetable production in and around the city. In Hanoi, Vietnam 50% of poultry consumed is raised around the city. In 2007, Canadian greenhouse operators reported total sales of CAD\$ 2.3 billion. The area of vegetables planted in greenhouses was 10.7 million m², exceeded plant and flower area, which was 10.3 million m² in 2007. Greenhouse growers sold CAD\$ 806 million of vegetables, with tomatoes comprising 43% of sales.

The economic value of the contributions of urban agriculture to the urban food system however has rarely been estimated. It would be very interesting to calculate what the costs would be of maintaining a city's urban food supply and distribution at the same level without urban agriculture. Large-scale flower production units or greenhouses could also constitute an interesting land use in its own right and if designed properly can add visual interest to an urban landscape and attract recreation and tourists, as is for example the case with flower bulb production (especially tulips) in the Netherlands.

Large-scale agro-enterprises can generate significant revenues if properly managed. They are an important contributor to local economic development, as demonstrated in Beijing, China. Linked to large-scale agro-enterprise development, there is also high potential for the development of related service delivery

enterprises, for example special labour services such as milking or harvesting, agricultural training or advisory services, animal health assistance, quality control accounting, bookkeeping and others.

One could try to calculate the estimated impacts on the city's or a region's income and employment figures, if more consumers start buying more urban agriculture produce from local (both large-scale as well as small-scale commercial) producers and processors. In Oakland, USA consumer expenditures for basic food items for a standard population unit (10'000 people) has been calculated. Per capita annual expenditure for 20 basic food items amounted to somewhere in the range of US\$ 900 to US\$ 1'300. For the 285'000 people living in the low-income neighbourhoods of Oakland, that expenditure taken together amounts to about US\$ 359 million. A large number of both small and large-scale enterprises could produce this food and most importantly, capture the farm gate share of the income. Promoting local production could be part of a specific policy to support the city's and region's local economy.

Main support needs

Main support needs to enhance the development of larger-scale agro-enterprises include:

- Assistance in farm planning and management;
- Access to information on advanced technologies and technical assistance to enhance sustainability and improve profitability (e.g. veterinary services; feed composition and quality, organic production);
- Access to market information;
- Sources of financing.

At times, peri-urban producers are lacking formal or non-formal extension, training and technology transfer. Aquaculture, livestock and agriculture training and extension institutions should pro-actively include and develop the concept of peri-urban agro-enterprise development within their curricula and programmes. Particular emphasis should be made on developing innovative methods and protocols for environmentally, socially and economically sustainable production systems, that make optimum use of urban waste streams and services.

Finally, access to market information (both local, national and for export markets) and sources of financing are crucial for development of large-scale agro-enterprises.

3.1.9 - Multifunctional farms

Introduction

In this section, we will discuss examples of multifunctional urban agriculture, which combines different functions within an area, such as a farm. Innovative small-scale and large-scale farmers in and around cities have started to come up with creative ways to better integrate themselves into the urban fabric of cities. They are doing this by offering fresh food, training, recreational services, educational services, and health services as well as integrating water and landscape management with productive functions.

Type of people involved and their main motives

Multifunctional agriculture is practiced by many different categories of farmers. They can range from small-scale to large-scale farmers, along with urban investors seeking more income. The future of farming can be solidified by introducing functions and values beyond food production. Functions refer to aesthetic and recreation activities, nature conservation and environmental services such as watershed management (Zasada, 2011). When any of these added activities occur, the farm business is in effect diversifying, and creating new income streams or cost reductions. They are also responding to an urban demand, as inhabitants there want to spend leisure time in areas that can be termed the “agricultural countryside” (Zasada, 2011).

Though normally farmers with more resources are involved in multifunctional land use, allowing them to invest in complementary services and infrastructure next to farming, they need not to be highly specialised or to apply advanced technology. One such example of a small-scale multifunctional farm is the case of a Lebanese farmer owning a 0.5 hectare orange orchard in Dbayeh, Beirut. The farmer transformed his orchard into a small zoo that can be visited by schools and children with their parents. The farmer now raises small animals in big cages, in the empty space between the trees, such as rabbits, small birds, pheasants and monkeys. This ensures him additional revenue from the entrance fees, but also a direct market for his oranges to the visitors at higher prices. The area is used throughout the year for events such as birthdays and as a picnic area where people enjoy the shade and the countryside atmosphere in the suburbs of the capital. This ensures a regular income from the entrance fee the farmer charges.

Apart from farmers and urban investors, institutions and cooperatives can be involved in multifunctional agriculture. In China, many examples of urban investors supporting larger-scale multifunctional agro-enterprises may be found. These enterprises offer a variety of educational and recreational services as playgrounds, walking paths, picnic areas and grow or pick-your-own fruits and vegetables. Often specific festivals are organised on these multifunctional farms, like the grape or cherry festival. Promotion of multifunctional agriculture is supported by Chinese municipalities, like Beijing, Shanghai and Nanjing in their attempt to develop more recreational services for urban citizens, maintain an attractive peri-urban landscape, while protecting the environment, and assist farmers in diversifying their agriculture and creating new business opportunities.

In the Netherlands, there are institutions and groups of allotment gardeners involved in fighting for the preservation of multifunctional urban garden parks. The urban garden parks managed by the association of urban gardeners in Amsterdam provide the urban population leisure space for recreation and contact with nature. In addition, the gardens provide a space where different cultural groups in an ever more diversely composed urban society can meet and learn from and about each other. The gardens are supported by health institutes, schools and groups of artists, all using the gardens for their own purposes.

Products and services

Multifunctional urban agriculture (or the multiple functions of urban agriculture) refers to the importance of diversification and pluriactivity (Fleury and Ba, 2005).

Recreational and leisure services

Recreation and leisure is a focus area of multifunctional urban agriculture. Pick-your-own farms are a good example of this and are quite popular on European, North American and Chinese farms. Often these farms revolve around a crop that is grown at abundance and have limited seasons. Strawberry and pumpkins are good examples. Urban Green Train case studies Hof Mertin, in Germany, and Jardin de l'avenir, in France, offer this amenity for visitors.

Farm restaurants and farm shops are also extremely popular for visitors and can contribute to the experience that the farms want to give. It also is an important way for farms to add value and diversify their income sources. Uit je Eigen Stad in Rotterdam (NL) offers both of these amenities.

Maintaining a landscape and farm structures that are attractive for tourists is another way multifunctional agriculture may occur. For city-dwellers, agriculture is regarded as part of cultural landscape of an area. Stronger linkages with the cultural heritage of farms can be made by the production and sale of regional products and protection of cultural heritage landscapes. For example, the agricultural park in the South of Milan, Italy has an important function in preserving traditional landscape structure and historical farm buildings in the area.

Urban agro-tourism is also an opportunity, examples found in China and in Bangkok, Thailand, where aquaculture in urban or peri-urban lakes and ponds is combined with other recreational activities like angling, boating, and a fish restaurant. In peri-urban areas that have wineries, overnight accommodation occurs providing a special multidimensional experience for patrons.

Social, health services and the environment

Social farming or care farming describes multifunctional farms that integrate social and health care services with agricultural activity (Zasada, 2011). Farms may also offer training and educational services. Examples include children's education programmes and training for community residents, youth, women and other groups. Urban Green Train case studies Eta Beta in Bologna, Italy and Food for Good in Utrecht, The Netherlands, are examples that receive subsidies for providing work-based training and rehabilitation for disadvantaged individuals in marginal positions.

Health services provided on multifunctional farms may consist of on-farm care and remedial activities for people with psychological or physical problems. In Camilo Aldao, a small town in Argentina, children mentally challenged with Down syndrome and personality disorders are offered the opportunity to work in a garden and manufacture candies with produced fruits. They enjoy stimulating activities, without having to travel now 50 km to the nearest larger city offering similar services.

In other cities, health institutes and governmental health departments financially support urban farmers providing leisure opportunities for the elderly, mentally and physically handicapped people or psychiatric patients. In the Netherlands, farmers can benefit from government subsidies when offering such services. Yet the benefits go well beyond the direct beneficiaries. Programmes such as this support inclusion and integration and can also generate positive economic effects (Pölling et al., 2015).



Multifunctional farms may also contribute to providing environmental services. These include:

- Keeping certain urban spaces green and free from construction by providing a popular amenity for people to enjoy;

- Keeping land green provides the possibility of water infiltration that is useful for aquifer management;
- Areas with forestry can cool the area and create a microclimate;
- Keeping the area green can help prevent floods.

In Zurich, Switzerland, multifunctional land use goals are linked to how urban agriculture is being developed. The city has developed environmental goals for agriculture that include preserving and promoting diversity, and fostering green knowledge for school children (Jahrl and Schmid, 2015). Currently 50% of land where agriculture is practiced has implemented the biodiversity measures.

In Rosario, Argentina, the idea of promoting multifunctional urban garden parks was first born when the only space available for one community interested in gardening was the nearby natural reserve, *Bosque de los Constituyentes*. The community approached the municipal Parks and Walkways department for permission to farm in a field within the reserve's limits. The department accepted, on condition that the gardens were attractive. Currently five garden parks have been developed.

Main potentials and support needs

Multifunctional farms offering pick-your-own services or on-farm meals often shift to other (organic, environment-friendly, etc.) production methods. Farmers may need advice and information on how to do so. Investments in infrastructure may be needed to receive customers and provide services they may require. While offering recreational services to urban citizens, producers should be aware of the fact that they are performing an amenity function. This means that in the process of designing and maintaining their farms, they should take care of the landscape-related aspects of their investments: greenhouses, barns, and sheds.

Multi-functional agriculture is important for local economic development and sustaining the income of farmers in peri-urban areas. The 180 households in Beizhai village near Beijing participating in agro-tourism generate about 65% of their annual income (US\$ 3'000-4'400 per household) here with. Such an income is much higher than in other (pure agricultural) villages nearby. By 2006, there are over 8'700 families in the whole city of Beijing involved in such family-based agro-tourism, attracting over 9.8 million visitors and generating nearly US\$ 54 million, an increase of about 30%, compared to the year before. Additionally, the overall number of visitors to Beijing's large-scale agro-parks amounted to 12 million in 2006 generating an income of US\$ 154 million (RUAFA, 2009).

Multifunctional urban agriculture plays an important role in maintaining an attractive and green peri-urban environment and offering various services to urban dwellers. In the 1990s, Mexico's *chinampas* (floating islands where agriculture has been conducted since ancient times) were threatened by urbanization and landfill, until their value for recreation and leisure were recognized. Many leisure facilities were set up (restaurants, tourist boat tours) that now attract thousands of visitors each year. Similarly, rapid urbanization led to a sharp decrease in farmland in Beijing's peri-urban area. In order to protect the peri-urban area, Beijing municipality applied two main strategic policies, the modernization and diversification of agricultural production, and the promotion of multifunctional agriculture (in China often referred to as recreational agriculture).

The recreational, health, educational and environmental outputs of agricultural production may be valued as public goods, or as inputs to the production of a tourism product, and would not be available without some joint agricultural production. Public support to a local multifunctional agriculture is increasingly rationalized not by the needs of the farming population but rather by the public (or semi-public) goods delivered to the society. The appreciation of local or regional agriculture for the food security, landscape amenities, cultural heritage and environmental effects is recognized as legitimate reasons for public financial support (European Commission, 2000). Promoting the multiple functions of urban agriculture however requires:

- Integrating multifunctional green zones in development planning;
- Enhancing direct producer-consumer linkages (markets, community-based agriculture);

- Creating markets and remunerations for public goods and services (for example payments for water, soil or landscape management);
- Assistance in creating local farmer groups and in networking between farmers and their customers (public relation campaigns, planning recreational routes, setting up websites, etc.);
- Assistance in farm planning and management;
- Access to information on urban demand for services and sources of subsidy and financing.

Integrating multifunctional green zones in development planning

Municipal authorities have to come to understand the role urban and peri-urban agriculture can play in maintaining green zones in the city. These lands help in the management of areas that hold important natural resources and provide new recreational and leisure services to urban residents. Such multifunctional land uses have to be planned and protected in both urban and peri-urban development planning, as done with the urban garden parks in Rosario, Argentina, and in Beijing, China.

The promotion of multi-functional agriculture stands out in the Beijing policy since it combines the production of food with the provision of recreational services and ecological functions for the city. In certain areas, the recreational and ecological functions may even become more important than the agricultural production itself. Multi-functional agriculture becomes part of a harmonious integrated urban-rural development, in which economic development, social equity and ecological friendliness go hand in hand. To promote multi-functional agriculture, Beijing municipal government is providing various types of support, including:

- Setting up guidelines and regulations for agro-parks;
- Permitting a certain amount of farmland to be used for recreational facilities;
- Providing tax subsidies for agro-tourism activities;
- Establishing the Beijing Agro-tourism Association;

To integrate agricultural development in the urban planning system, a zoning plan for the peri-urban area was developed. The land use in the various zones has been differentiated based on the distance from the city and the natural conditions of each area. In the suburban areas close to the city sightseeing, agro-parks, “edible landscapes” and eco-education receives preference, while in the mountainous areas, farm and village based recreational agriculture is prioritized with an emphasis on maintaining cultural heritage and ecological protection of the natural resources.

Networking between farmers and their customers

The various examples provided show that while specialized crop production might be economically unviable in a specific location, the agricultural activity can still be fundamental for a rich tourism excursion generating local activity and income. Regional networks often help this kind of development.

The [Apple Hill Growers Association](#) in California, USA, is an example of a self-driven process of agri-tourism development. Farm hikes, apple pies, museums and picnic areas are among the products offered that yearly attract day trip visitors from as far as the San Francisco Bay area (2-3 hour drive). Fifty years after the original 16 ranchers formed the association; the now 55 ranches receive more than 30'000 visitors a year. Through cooperation that started in the early 1960s, ranchers whose survival was threatened have made their area a major attraction for day tourists. New products and services are added in line with feedback from visitors. Over time, these local fruit producers have developed a rich variety of products, services and entertainment.

Sources of subsidy and financing

Policy mechanisms that can pay farmers for recreational, educational or health services need to be further developed. One of the problems is to quantify the value of agricultural services in different local contexts. New and innovative models for financing and favouring multifunctional agricultural land use are needed. These may include subsidies for landscape maintenance or wastewater treatment, tax relief and revenue from consumers (direct payments by consumers for recreational services, higher priced organic and regional products, schools paying for on farm classes). Non-profit organisations such as land trusts in the USA attempt to preserve farmland by compensating farmers for some of the potential development value of their land. In

other countries, health insurance companies may pay for social care services delivered by farmers to their clients. Farmers should be made aware of the possibilities of such support.

3.1.10 - Urban forestry

Introduction

This sub-chapter explores urban forestry – the purposeful growing of trees in urban and peri-urban areas. It can be practiced on a small scale (for individual trees or groups of trees) or large scale (urban orchards, woodlots, forests), and occurs on private, institutional, and public lands.

Type of people involved and their main motives

Urban forestry is practiced by people in many different ways. We can generalize and say that two distinct types exist:

- The growing of trees for urban greening, environmental management and recreation;
- The growing of trees for fodder and food production, fuel wood and timber for home consumption or sale.

Examples of the first system include individual households planting trees for beautification and shade, as well as environmental groups and municipalities planting and protecting urban and peri-urban forests for their environmental, social and economic benefits. Urban green spaces and specifically urban forests absorb CO₂, release oxygen and help control temperature extremes. Urban forests can provide a social space for recreation, contact with friends and neighbours, education and training. It also contributes to economic (energy) savings, having a significant cooling effect due to direct shading and increases in evapotranspiration, and reducing building energy consumption. Storm water flows are reduced, as more water is able to infiltrate the soil, resulting in better water management.

Promotion of urban forestry as part of the urban green infrastructure has for a long time been practised by cities in the Global North, as part of more ecological city planning. Gradually we see more and more cities in the South following this example. A comprehensive green infrastructure approach to planning and managing city green and urban forestry is however needed to optimize its various social, economic and environmental benefits.

The second system, productive urban forestry, involves urban poor to middle income families as well as commercial enterprises. Trees provide wood and non-wood forest products such as mushrooms, berries, fruits and nuts, (medicinal) herbs, rattan, seeds, leaves, etc. Production of fruits, nuts and seeds contribute to household food security and nutrition. Perennial fruit trees include coconut, mango, apple, pear, avocado, papaya, banana, citrus, jackfruit, tamarind, cherry and others. Trees grown for their nuts include chestnut, walnut and almond.

Timber and other wood products can also be very important in urban areas. Large parts of urban Africa are still heavily dependent upon fuel wood. In times of war and conflict, city dwellers have often turned to nearby woodland for illegal cutting of fuel wood, as in the case of Sarajevo in Bosnia and Herzegovina during the 1990s Balkans war. Tree species grown for their timber production include pine, neem and eucalyptus, amongst others.

In the Global South selling food and non-food products from urban forests contributes to income generation. Sometimes twigs, leaves and branches have additional market potential and are used for making brooms, roofing material, mats or handicrafts. Examples include *Pandanus* cultivars, the leaves of which are treated and used to make mats, baskets and hats; paper mulberry, whose treated bast fibre is used for bark cloth; and Java cedar, a source of dye. Finally, we can find species whose flowers, fruits or leaves are used in body oil (coconut), soaps (oil palm) and perfumes, offering opportunities for a rapidly expanding export market.

A specific form of productive urban forestry is agroforestry, which refers to the keeping of trees in combination with agricultural crops or livestock. Agroforestry helps diversify production, conserves soil, provides for fire wood and supplies fodder for urban livestock keeping or forage needed for honey production. In urban areas in Kenya, Uganda and Gambia, fodder shrubs are planted on farm boundaries, in

hedges around homesteads and on contour lines. Species include *Calliandra calothyrsus*, *Leucaena trichandra*, *Morus alba* (mulberry), *Camaecytisus palmensis* (tree lucerne) and *Moringa oleifera*. Farmers in Kenya reported to earn an additional US\$ 98-124 per year from their dairy enterprises by growing protein-rich *Calliandra* shrubs. These benefits resulted from either increased milk production or in savings from reducing their purchase of dairy feed.

In Europe, partly resulting from a growing recognition of permaculture design principles, in recent years there has been a growing interest in establishing food forests or edible forests in the context of wider urban food strategies. Examples are the Food forest Ketelbroek in the Netherlands, that was established by private initiative and recently the provincial government of Flevoland initiated an experiment with Food Forests in RoggebotState. Moreover, in Spain there are initiatives for urban edible forests, for example in the city of Vitoria-Gasteiz in the Basque Country and in the city of Malaga where local authorities are involved in establishing an Urban Forest Park.

Scale, location and technologies applied

Trees and forests are grown in both urban and peri-urban areas, along streets and roadsides, derelict corners, private yards, parks, and cemeteries. Woodlots occur in the form of orchards (on private or public land), forests, and natural plantations.

Trees and forests may be particularly suited for growing on contaminated land areas (as is the case with some specialist production systems like flowers or ornamental plants), on steep slopes, and in areas with poor soil and water shortages, since they generally require less water and lower soil fertility than short-term ground crops.

Form, design, and function as well as some technical and managerial aspects vary with the type of tree and location. For instance, in more hilly or mountainous areas, forests can be integrated into watershed management, justified by the need to avoid erosion and landslides, whereas in low-lying cities, particularly in arid and semi-arid areas, they help provide forage for animals, save energy by cooling the environment, and contribute to adapting to and mitigating climate change.

Specific technological and managerial challenges for urban forestry include:

- Appropriate selection of tree species;
- Proper tree care in a period of climate change;
- Site inventory;
- Policy and legal strengthening of urban forestry.

The urban environment often presents challenges for trees, such as limited root and canopy space, poor soil quality, pollution, heat, water and light deficiencies. In selecting appropriate tree species, the following characteristics are important:

- The eco-physiological properties of the trees. When planting street trees, for example, one has to make sure their root systems and crown types do not easily damage underground or overhead infrastructure; one must also avoid trees with brittle branches or large, heavy fruits that can cause problems because of fruit fall.
- Their form and function. Trees in parks are often selected based on aesthetics: form, ornamental features (blossoms, leaf colour), and capacity to provide shade.
- A mixture of tree species is needed to control diseases and insects harmful to the trees. For diversity, different tree species should be distributed throughout the city. It is important to emphasise native trees, which are well adapted to the local climate and support native wildlife and biodiversity.

Management challenges vary with the type of urban forestry and include ensuring the proper care of the trees, doing planting site inventories, quantifying and maximizing the benefits of the trees, minimizing costs, maintaining public support and funding, and establishing regulations and policies for protecting trees.

Commercial fruit production in backyards or orchards requires the management of soil fertility, pest and disease management, and pruning. Storage and processing facilities (drying, jam and juice production) may need to be set up for maximum production. Large-scale peri-urban forests are either professionally managed for timber production or left for natural and recreational services.

Tree and planting inventories may require the use of a geographic information system (GIS) to support their identification, planning, and management. GIS tools can help reduce management costs associated with urban forestry and present a more accurate picture when other attributes such as water runoff, irrigation and building heights surrounding forests are layered into the analysis.

Main potentials

As previously mentioned, urban forestry has a number of social, economic and environmental benefits. Let us now look in more detail at each of these benefits in the following section.

Social benefits

Urban forestry, if well planned, results in many social benefits. Salbitano et al. (2015) identify three functions that forests perform: prevention, therapy and recovery, and restorative. The recreational value of forests, parks, gardens, and other urban green areas are especially well documented in the Western world. The level of biodiversity of urban green areas and forests is often surprisingly high, representing nature and the “wild” close to where people live. Urban woodland in Europe attracts thousands of recreational visits per hectare, per year. The large majority of all recreational uses of forests take place in areas not more far than 1 to 2 km from where people live. Both the visual experience and active use of green spaces (through walking, cycling, playing, and gardening) have been shown to reduce stress and mental fatigue. Through the effective use of green spaces, health care agencies can indirectly reduce the costs associated with obesity, physical inactivity, and poor dietary and exercise patterns (Konijnendijk and Gauthier, 2006; Salbitano et al., 2015).

Cities in both the Global South and North are promoting productive forestry as part of an integrated strategy for food security, economic development, and urban environmental management. Thies, in Senegal, and Port au Prince, Haiti, are two among many cities that use neem trees along street sides for medicine and handicraft production as well as for beautification and greening.

Porto Alegre, Brazil, is implementing an urban forestry policy that promotes the roadside planting of native tree species and fruit trees. Additionally, the planting of tree corridors to provide a refuge and food for birds and insects are promoted. Vancouver, Canada, has issued guidelines on urban agriculture on private lands that furthers the idea of edible landscaping.

Cities like Stockholm, Sweden; Prague, Czech Republic; and Bangalore, India, grow up to 25% of fruit trees in their urban parks. Other cities in India and Africa promote the establishment of woodlots in villages close to urban centres to help relieve the pressure on natural forests for fuel wood and fodder.

Environmental benefits

The environmental benefits of urban forests are related to air quality and microclimate improvement, both of which help to reduce the urban heat island (UHI) effect. An UHI is a metropolitan area that is significantly warmer than its surroundings. Research from Bobo-Dioulasso, Burkina Faso shows that the promotion of intra-urban greenways showed a reduced land surface temperature as compared to areas where no greening had occurred (Lwasa and Dubbeling, 2015). In Perth, Australia, the importance that a tree canopy has on street temperatures is significant, as the following graphic shows:



Source: City of Perth

A reduction in vegetation cover leads to an increase of solar radiation absorption and contributes to the UHI effect. On the other hand, increased vegetation and, specifically, forestry cover will help alleviate the urban heat island effect and improve the physical climate of cities by increasing humidity, lowering temperatures, introducing more pleasant odours to the city, creating wind barriers, intercepting solar radiation, and creating shade.

Of particular importance in both the Global North and South is the role that forest resources play in water management. Many of the world's largest cities rely on fully or partially protected forests in nearby or more remote catchment areas for much of their drinking water. Additional protective measures are often needed to ensure high-quality drinking water from these watersheds. Quito, Ecuador, is one of several Latin American cities that have taken active steps to protect its watershed forests; this endeavour is financially supported by the creation of a water-consumption fee that contributes to a local water fund to support sustainable land-use.

Trees reduce storm water runoff and can assist with the processing of wastewater. Moreover, forests and trees in cities act as carbon sinks (which is relevant for global warming), release oxygen, and trap dust and gasses from polluted air, thus improving city air quality.

In arid regions, forest shelter belts around cities help combat desertification, while trees may also be planted on steep slopes and mountain sides to avoid soil erosion.

Economic benefits

Apart from direct economic benefits (food and non-food production), the indirect economic benefits from urban forestry are closely related to the environmental benefits. Calculated benefits include energy savings, improved air quality, reduced storm water runoff, and increased property values.

Active management of an urban forest entails the costs of planting, maintenance, materials, and disposal. These investment costs are accounted for in budgets of municipal agencies or user groups. Returns on investment are less easily calculated. Many products that come from urban forests are public goods. Municipal authorities invest in a city's natural capital, generating products in the form of various intangible functions and benefits for each resident, visitor, and user.

Two North American cities have attempted to estimate the value of the tree cover to the city.

An analysis of trees in Chicago reveals that this city has about 157 millions of trees, with canopies that cover 21% of the area. Chicago's urban forest currently stores about 16.9 million tons of carbon (61.9 million tons CO₂), which is valued at US\$ 349 million. In addition, these trees remove about 677'000 tons of carbon per year (US\$ 14 million per year) and about 18'080 tons of air pollution per year (US\$ 137 million per year). Trees in Chicago are estimated to reduce annual residential energy costs by US\$ 44 million per year. The compensatory value of the trees is estimated at US\$ 51.2 billion (Nowak et al., 2013).

In 2014, the TD Bank did a study on the value of urban forestry to Toronto. They found that over CAD\$ 80 million or about CAD\$ 8 per tree in environmental benefits and cost savings are provided each year.

Benefit	Description	Tangible benefit	\$ value (millions)	\$/tree
Wet-weather flow	Reduced strain on water transportation and processing infrastructure from rain and wet-weather flow intercepted.	25,112,500 cubic metres	\$53.95	\$5.28
Air quality	Air pollutants absorbed removed and avoided by street trees.	1,905 tonnes	\$19.09	\$1.87
Energy savings	Energy saved through shading and climate moderation.	749,900 MBTU of natural gas 41,200 MWh of electricity	\$6.42	\$0.63
Carbon sequestration	Carbon sequestered from the atmosphere and emissions avoided through energy savings.*	36,500 tonnes	\$1.24	\$0.12
Energy emission abatement	Carbon emissions from fossil fuel power generation avoided through climate moderation.	17,000 tonnes	\$0.58	\$0.06
Total benefit	Sum of economic benefits provided by urban forests.	-	\$81.29	\$7.95
Cost benefit ratio	Benefits to citizens for every \$ spent on maintenance.	-	-	\$1.35 - \$3.20

* Carbon avoided and sequestered is net of the emissions from the decomposition and maintenance of trees.
Source: Toronto Parks, Forestry & Recreation, TD Economics.

Source: TD Economics (2014)

Main support needs

Enhancing the development of urban forestry systems requires long term land security and integration of urban forestry into city land use and green infrastructure plans. Furthermore, institutional capacities need to be strengthened and relevant policies developed. New technologies and knowledge generation for optimizing management and the provision of urban forestry goods and services also need to be developed. Let us look at some examples of how this is done in various cities around the world.

Integrating urban forestry into land use urban greening plans

Long term security of access and use of land is a primary condition for promoting tree planting and conservation in a sustainable manner. Land use legislation and protection of urban forest resources is especially problematic in developing countries, where uncontrolled migration towards cities, poverty and lack of control lead to drastic and illegal changes in land use and overexploitation of green resources.

Too often, parks, urban forests and other city green areas are managed on an *ad hoc* basis. A comprehensive approach would consider the potential system of urban green elements and its implementation across an entire city and within sub-districts. Amsterdam, the Netherlands promotes urban agriculture and forestry as part of its green, ecological structure, alongside sport facilities, parks and waterways. Accessibility and promoting multiple functions are two pillars of this policy.

Beijing, China defines four types of urban forestry in terms of spatial planning and functions:

- Forests in the outer mountainous areas of the city owned by either the municipality of central government;
- Forests located in the peri-urban plain areas, consists of netted woods with the functions of protecting local farm fields from wind and sand storms;
- Green belts established immediately adjacent to newly built-up areas for growth management and environmental improvement;
- Green space in residential areas.

The resulting mosaic of forestry systems, street trees, gardens, forests and recreational parks, is one of the main strategies for Chinese cities to respond to the environmental and health needs of their inhabitants.

Melbourne, Australia has launched an urban forest strategy in response to climate change induced reduction of the tree canopy.



Institutional strengthening and coordination

Development of urban forestry requires long-term and cross-sectorial planning. Even at the city level, green space responsibilities are often still poorly defined and fragmented. In Europe, for example, the planning and management of city parks, street trees and peri-urban woodland has traditionally been the domain of different professionals and sometimes different departments.

A higher level of service in green space management is evident in Johannesburg, South Africa, where a City Park Office was created along the principles of new public management. Johannesburg City Parks is now run by a managing director and a board of directors who report to the city manager. Previously, parks services were fragmented across Greater Johannesburg's five councils. This led to confusion about who was responsible for what and resulted in different standards being applied across the Johannesburg region. Building more parks is now part of the City Park office's budget (for more information: [Johannesburg City Parks and Zoo](#)).

Develop appropriate legal frameworks

At national and municipal levels, a clear need still exists to further develop or improve existing legal frameworks. In the rare cases that urban forests are mentioned in legislation, it is mostly through certain explicit provisions as part of forestry acts. Some links to urban forests are found in environmental legislation and in land use planning acts.

In most countries and cities, municipal bylaws safeguard the city's tree resources. In Vienna, Austria an environmental protection law covers trees on both public and private land. In Zimbabwe, trees in urban areas can only be planted or cut, after obtaining prior authorisation from the Director of Works. Much can be learned from cities like Curitiba, Brazil and countries like Cuba and the United Kingdom that have succeeded in developing advanced greening and forestry policies.

Urban forestry in Curitiba, Brazil

Curitiba is known beyond Brazil's national borders for its policies in favour of well-ordered urban development, a sophisticated public transport system and environmental conservation, and a model city in Latin America. For the last 30 years, Curitiba has focused on urban planning. A master plan for orderly urban development was implemented in early 1971. The master plan development was supported by the IPPUC ("Research and Urban Planning Institute of Curitiba") with ongoing discussions throughout society ("Tomorrow's Curitiba" seminars). Today, the city is extending its solutions to the whole metropolitan area through, for example, "zoning and land use", with time lines for execution. A significant part of the population is involved in Curitiba's environmental programmes, with most success achieved in the communal planting project *Plantios Comunitários*. In this project, people in a given locality plant native (fruit) trees with the support of the Environmental Education Department. When suitable areas are found, the department contacts local representatives and involves them in the planning process. The areas designated for planting are always public areas, usually steep slopes or riparian zones threatened by erosion or inundation. The people are also provided with information about the tree or shrub species to be planted (Konijnendijk and Gauthier, 2006).

New technologies and knowledge generation

New technologies and knowledge for optimizing management and the provision of urban (agro) forestry goods and services need to be developed. In the USA, the Forest Service, through special urban forestry research centres, has generated extensive knowledge on urban forests, trees and their benefits. However, the development of knowledge and technologies also needs to be developed at the grassroots level.

A few examples of this can be mentioned. The World Agroforestry Centre (ICRAF) has been working with tree growers in Kisumu, Kenya, training them in better nursery practices, marketing and entrepreneurial skills. The project is also helping to facilitate the development of private seed producers and dealers and helps linking them to urban and peri-urban dairy farmers to scale up the adoption of fodder shrubs and trees.

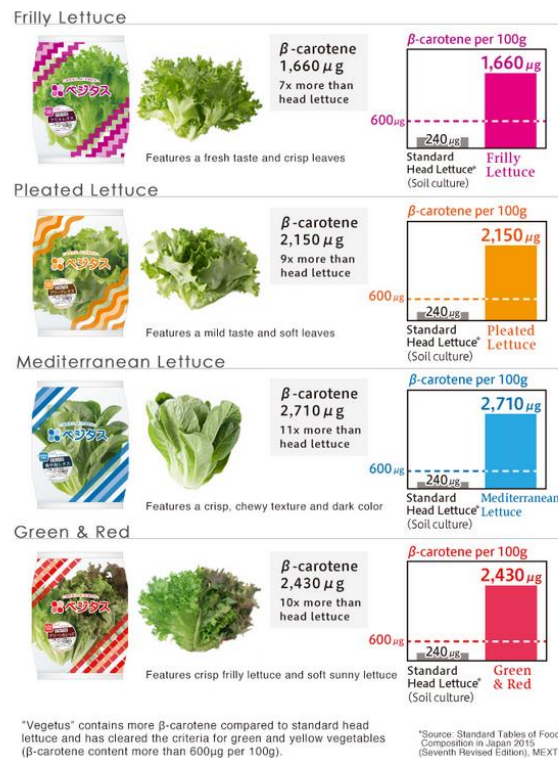
The City of Bogota, Colombia, is training urban citizens to protect and take care of the trees in their neighbourhood. They receive simple handouts with information on watering in the dry season, keeping trees free of waste and reporting to the city's Botanical Service the evidence of possible pest and diseases.

3.1.11 - Vertical farming (wall, in building, soilless or not)

Introduction

In this final subchapter, we will discuss developments in vertical farming techniques, for example on walls or in buildings. For this sub-chapter we will use a broad definition for the term vertical farming. Vertical gardens refers to any kind of construction and support structure for growing plants in an upwards direction, thereby efficiently using existing space for plant production.

In this sub-chapter, we will explore the types of people involved and their motivations. We will follow this with looking at the products, location and scale that is employed. We will finish by examining the potentials and issues associated with vertical farming.



Spread Farm, Japan (<http://spread.co.jp/en/product/>)

Types of people involved and their motives

Vertical farming is a quickly growing and controversial type of urban agriculture. It is practiced mostly in the Global North. Low tech versions exist as well in the Global South, which will be discussed later in this sub-chapter. As a whole, the industry is seeing explosive growth. A recent study predicts the market will reach US\$ 3.88 billion by 2020, with a compound annual growth rate of over 30%. The industry refers not only to farms but also to all the related businesses that provide services and equipment such as lighting, hydroponic component manufacturers, climate control and sensing devices. At the industrial level, major corporations are involved such as Koninklijke Philips N.V. (Netherlands) and Everlight Electronics (Taiwan).



Low-tech innovations in vertical farming in Nairobi, Kenya. By Can Ya Love

The 2008 book “*The Vertical Farm: Feeding the World in the 21st Century*” by Dickson Despommier, proposed vertical farming as an elegant solution to feed the world.

 Watch the video [The Vertical Farm](#)



Assignment 3.1.11.

After watching the video above, do you think he has proven to be correct?

Proponents of the technique and representatives from industry feel that vertical farming is part of the solution to feeding a world population that will rise sharply. Over 50% of the world’s population lives in cities and the numbers are growing. Producing food in cities will help augment the food supply to feed growing numbers of people.

Environmental management is another motivating factor for people involved in vertical farming. Arguments can be made that producing food in cities will contribute to a reduction in GHGs. As well in industrial-scale farms, water usage may be greatly reduced in comparison to conventional greenhouse techniques, so it is claimed. As this is likely to become the scarcest commodity in the decades ahead, perhaps vertical farming makes sense.

Aside from altruistic motives such as improving food security and environmental stewardship, most businesses are in the field for economic gain – to maximize their profits. This new breed of farmer/entrepreneur sees an economic opportunity and they are responding to it.

Countries like Singapore import over 90% of their food. Vertical growing is able to provide consumers with fresh, local products that are in demand. As an affluent country, the price premium associated with vertical farming is manageable for consumers.

However, vertical farming is much more than mega-food factories that grow vegetables within buildings. Vertical gardening follows some of the same principles as the big farms in that plants are stacked. It is also practiced on a much smaller scale and the motivations of those involved are different. For Urban Green Train

case study Le Vivant et la Ville in France, growing on vertical structures, often on land that needs upgrading or where space is a premium that makes an environmental contribution to the city. Case study Poliflor in Italy installs wall gardens to increase the aesthetics of buildings, capturing pollutants and organic compounds and adds thermal insulation for the structure.

In the Global South, vertical farming (gardening) usually is not (yet?) a high-capital, high-technology enterprise. Sack gardening as occurs in Kenya is a form of low-space vertical farming, as plants grow on top of each other within the sack.

Products, scale and location

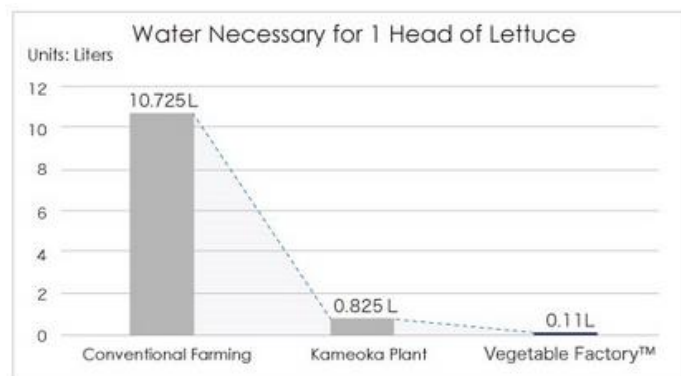
Theoretically, any kind of vegetable could be grown but at this early stage in industry, leafy greens and herbs dominate the productions. These plants are the most economically efficient to produce as they are fast growing and therefore will incur less costs, especially for energy as they grow to maturity. There is also a ready market that is willing to absorb the added costs of the produce by paying premium prices. Locations vary for these farms. Some are newly built while in other places, former industrial buildings are being repurposed. An example of this is the Aizu-Wakamatsu factory in Fujitsu, Japan. Part of this semi-conductor factory has been converted to a vertical farm, serving a niche market. There are various other examples of such “plant factories” in Japan, partly as a response to the economic crisis in the semi-conductor industry.



For smaller and lower tech installations, the focus may be different. Growing vertically on walls is such an example. Urban Green Train case study Poliflor offers two lines of installation: using the climbing capacity of plants to produce a green curtain and creating a vertical garden with plants that are rooted in substrate. Very basic but effective vertical growing is sack gardens. As these do not take up much place, they are frequently found around the household.

Technologies employed

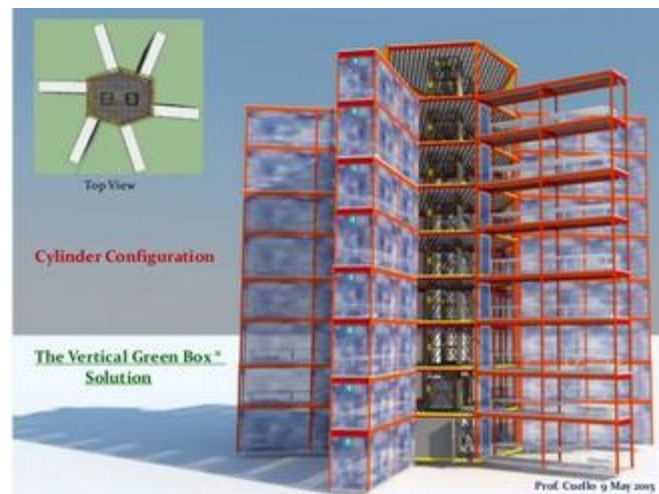
Like vertical farming itself, there is a very wide range of technologies employed. The largest factory farms practice controlled environment agriculture (CEA). This approach employs a combination of engineering, plant size and computer managed climate control to optimize plant growth and resource use. Water recycling is a central feature in these farms. Spread Co. Ltd in Japan is one of the more technologically advanced farms in the world. They are able to recycle 98% of the water they use in the production process. The following graphic from the company shows water used to produce a head of lettuce for various production systems:



Source: <http://spread.co.jp/en/environment/>

Obviously, this kind of vertical farming is heavily capital intensive and beyond the reach of many businesses. However, more reasonably priced alternatives are beginning to be developed. The Minimally Structured & Modular Vertical Farm (MSM-VF) is an example of this (Cuello and Liu, 2014). This design uses a scaffold like

structure that supports vertical growing. Full or partial environmental control could accompany this structure but it's not mandatory as the structure is designed to be located in a variety of buildings and spaces.



An example of MSM-VF design (Joel Cuello)

For green walls, continuous research is required to see how the walls are performing. Areas of interest to the green wall industry includes plant selection, installation, growing, maintenance, and monitoring performance. Remote monitoring is a new trend in the industry.

Technology employed in sack gardens is low-cost and effective. Sack with a volume of 0.1 to 0.5 m³ is ideal for growing leafy vegetables. A stone spine is used to facilitate the infiltration of water. Soil and compost are used to fill the sack. Reliable soil is an issue for some sack gardeners, as is a reliable water supply (Pascal and Mwende, 2009).



Vertical production methods, Le Vivant et la Ville (www.levivantetlaville.com)

Main potentials and issues

Vertical farming in many respects is a new type of urban agriculture that is evolving quickly as it tries to live up to its potential, establish business initiatives and open markets, while simultaneously responding to people that are uncritical of the practice. On a small scale, vertical farming utilizes space in a practical way that will allow more plants (food) to be grown. An excellent example of this is sack gardening, which is a low-cost way to grow a maximum of food in a small place. This form of agriculture can make a positive impact on food security at a household level. There could even be surplus that could be sold at market.

Intermediate scaled approaches to vertical farming such as the Minimally Structured & Modular Vertical Farm are likely to become more plentiful. This space saving technology affords people the chance to grow a significant amount of food in small spaces, allowing them the opportunity to earn more income. Food security is also enhanced.

Large-scale vertical farms have a number of proponents and detractors. For a new and in many ways revolutionary industry, this is a normal development. No doubt, vertical farming will look very different 10 years from now. Loessl (2014) identified some of the advantages of vertical farming that include:

- Increased production per square meter;
- Decreased water use because of recycling;
- Decreased pesticide use;
- Elimination of agriculture runoff;
- Elimination of seasonal, regional and climatic restrictions.

These are valid benefits that justify the practice. Climate change is already making conventional agriculture more difficult as weather patterns are changing rapidly and unpredictably. Being able to eliminate this, as a risk will likely evolve into one of the major benefits of this form of agriculture. Linked to this is the fact that water will likely become an extremely scarce resource in many parts of the world. Using water in a very economic manner should give impetus to vertical farming.

Detractors point to many issues concerning large-scale vertical farming. Perhaps the largest point of contention is its impact on the environment. Though many resources such as water are used efficiently, the same can not be said about energy use. These factories use a great deal of energy to light the crops. Using the sun is a global public good with no price attached. LED lighting, climate control, computers and mechanization of the facility all use energy. There are many competing claims about how energy intensive the practice is, but as of now, it is a cause for concern.

Social issues also need to be raised. This technology is expensive and as a result, the food that is produced has a significant price premium. This excludes low-income people from being able to purchase the food. It also excludes many farmers and business people from getting into the field. This becomes an issue when public funds are used to support and subsidize these operations.

Perhaps further technological development will be able to respond to the critics. More research and experimentation is needed to make this happen.

3.2 - Urban Agriculture integration in agri-business

3.2.1 - Urban Agriculture and Agribusiness

Introduction

For defining and understanding possible positions and roles of UA within the framework of general agriculture and modern societies, we have to face some long term developments - they are like "macroeconomic laws of nature".

Along the historical development from an agricultural to a manufacturing and later to an industrial and service oriented society, some „inconvenient observations“ – from the viewpoint of agriculture were made by scientists.



Assignment 3.2.1: Please research and fill in missing figures for your home country or a country of your special interest.

Macroeconomic importance of agriculture in your country

Country:	People working in agriculture (in %)	Share of agriculture of Gross Domestic Product (GDP; in %)
1950		
2000		
Today - Year:		

Average of EU (28) in 2014 was 5.0 % of all working people and 1.6 % of GDP.

Structural change in agriculture

Country:	Number of farms	Average size of a farm (in ha)
1950		
2000		
Today - Year:		

In 2013 in EU (28) there had been 10.8 million active farms with an average size of 16.1 ha.

After completing the assignment, follow the slideshow below:





The picture above illustrates the so called agriculture and food value chain with agriculture at its heart - however, the size of the gearwheels is just symbolic!

You may be not familiar with all economic terms used in Slideshow - here are some explanations:

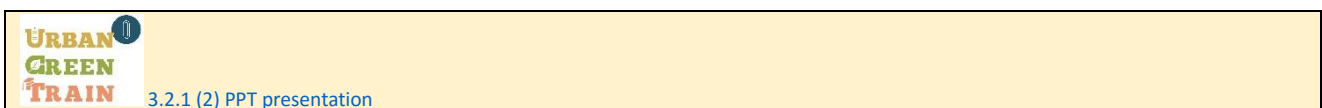
Economies of scale: a term which describes how unit costs of production develop, when production is increased. For example, if unit costs fall with expanding production, we speak of increasing economies of scale. Many modern - industrial - production processes follow this logic, modern large scale agriculture as well.

Specialization advantages: economic advantages, mainly in terms of quality and unit costs of production by focusing an enterprise or a farm on a small number or a single kind of product or service.

Clustering advantages: popularized by Michael E. Porter, so called industrial clusters (agglomerations of competing, linked supplying, marketing and supporting industries) offer comparative economic advantages for the participating enterprises by contact advantages, short distances, low transaction costs, knowledge exchange and competition among themselves as well, which strengthens their positions against outside competitors. Regional clusters offering such benefits exist for example in horticulture, viticulture and intensive livestock production regions.

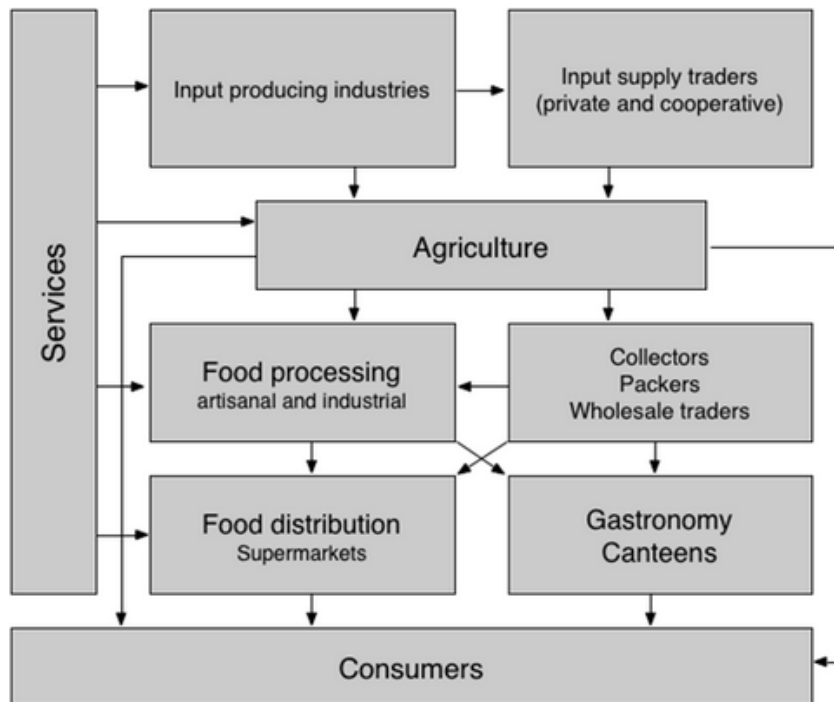
Agriculture of today has performed as a consequence of the above explained long term trends. If farms want to keep pace with other sectors of the economy and society in terms of income, workload and human welfare, labour productivity is playing an important role. This term describes how much labour you need to reach a certain result (e.g., a certain quantity of production or a certain level of income). A certain level of labor productivity is of crucial importance to pay adequate wages to workers and to create adequate incomes for farm entrepreneurs.

The following slideshow gives you an idea, how modern agriculture is developing itself for increasing its labor productivity:



Today, most (rural) farms are integrated in the so called food value chain (or food supply chain). The food value chain or food supply chain covers all steps of production of food, starting from the agricultural inputs, covering the farming sector and including the sectors for processing, marketing and distribution (see picture). In some countries, the whole system is called "agribusiness", but sometimes this term is understood synonymous for large scale industrialized farming business.

Agribusiness - or the food value chain - covers all production steps "from farm to fork" (and prior):



Source: Strecker et al., 2010; Rieping 2004; Federal ministry of food and agriculture, 2000

Let's now look at different sectors of the food value chain, first on Subchapter 3.2.2 "Input supply systems".

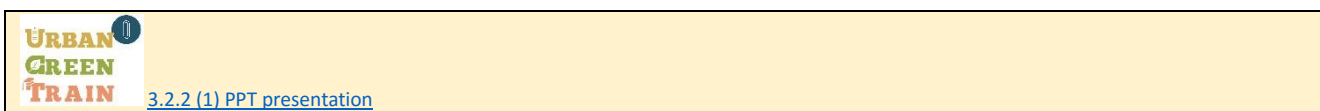
3.2.2 - The input supply part of the food value chain

Introduction

Looking first to a typical rural farm, you will observe that it has a quite complex and much differentiated input supplying system („upstream industries“). To get an overview, we may distinguish following main actors:

- Machinery, chemical and construction industries from industrial sector;
- Specialized enterprises inside the agricultural sector like animal feed producers, animal and plant breeding enterprises and so called multiplying enterprises (for plant varieties and breeding animals);
- Input trading enterprises, often in the form of agricultural cooperatives dedicated to bundle input purchases, processing and marketing activities for their farm members;
- Electric energy, heat, water, fuel and lubricants providing enterprises;
- Institutions and enterprises providing services and knowledge.

Next slides will illustrate input supply streams to typical farms.



So far, we have only considered direct inputs to farms, but not (all) material flows and recycling processes. Here we give a simplified overview to these systems:



What are the ideas behind? - Closing cycles means:

- improving carbon prints / limiting greenhouse gas emissions;
- improving eco-balances;
- improving generally resource efficiency on enterprise and on societal level!

Please elaborate an own sketch showing potential material and energy flows of an exemplary urban farm
Assignment 3.2.2 (1).



Assignment 3.2.2 (1). Please elaborate an own sketch showing potential material and energy flows of an exemplary urban farm

Do you have some (innovative) ideas for intelligent, resource efficient solutions?
Please draw the sketch, scan it and add some written explanations in a file.

Please, complete the following Assignment:



Assignment 3.2.2 (2).

1. Which input supplies do you need for an urban farm? Define in short an exemplary urban farm and its specific needs and think about potential supplying enterprises/institutions. Order them following their economic importance.

Table: Input supply for an urban farm (example)

Type of exemplary urban farm:

Type	Specific needs	Potential provider/source

2. Which *supporting services* do you need for an urban farm? Define in short its specific needs for and think about potential supplying enterprises/institutions! Order them following their economic importance!

Table: Supporting services for an urban farm (example)

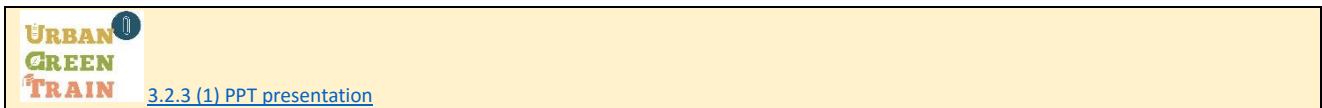
Type	Specific needs	Potential provider/source

Now it is time to have a look to the "downstream" sectors of farming - look at Subchapter 3.2.3 "Processing and marketing".

3.2.3 - Processing and marketing

The following slideshow introduces the complexity of the “downstream industries” of agriculture and its food products – the “long” food value chain. Beyond food production, some more value chains – recently called “Bioeconomy” - and the “short” value chains as alternative processing and marketing model exist, especially for urban farms!

Follow the slideshow below:



The following table provides a comprehensive overview of the most important food value chains, differentiating four stages:

- Collecting and Packaging/Bundling of primary production for marketing;
- First processing (starting from farm product);
- Finalizing (second stage and further industrial processing, incl. artisanal food production);
- Consumer distribution.

Traditional and modern "long" food value chain - stages after agriculture ("downstream industries")

	Collecting and Packaging / Bundling of primary production for marketing	First processing (Starting from farm product)	Finalizing (Second stage and further industrial processing, incl. artisanal food production)	Consumer distribution
Cereal line	private and cooperative collectors/traders	mills, feed industry, starch production, malting plants, distilleries	production of bread, pasta, biscuits, cookies, frozen pizza, bakeries, confectioners, breweries	Traditional artisanal food production shops (butcheries, bakeries, confectioners....), market traders, supermarkets, wholesalers, gastronomy, catering....
Sugar line	producer associations for joint sugar beet deliveries	sugar industry	sweet & biscuit production, delicacies, confectioners	
Oil line	private and cooperative collectors/traders	oil mills, feed industry, fat industry		
Potato line	private and cooperative collectors/traders	starch industry, alcohol production, potato products (pommes frites...)	convenience food / ready-to-eat meals, chilled and canned food, frozen meals	
Fruits & Vegetables line	private and cooperative collectors/traders, auctions	frozen food & vegetable products, juices, canned products, jams	convenience food / ready-to-eat meals, chilled, canned and frozen meals	
Wine line	(producer associations for joint grape marketing)	private and cooperative cellars, distilleries		
Milk line	producer associations for joint milk marketing	dairies: milk, butter, cream, cheese...	dairies: higher elaborated milk products	
Meat line	animal traders (private and cooperative), producer associations for joint marketing of slaughter animals	slaughterhouses	sausage and meat products industry, butchers, convenience food / ready-to-eat meals, chilled, canned and frozen food	
Egg line	producer associations for joint marketing, private traders	liquid egg production		
Fish line	fish marketing cooperatives, private traders, auctions	chilled and frozen fish	elaborated fish products	

Remarks: Not included here special input industries like producers of flavours (aromas), spices.....

Some systematics differentiate "finalizing" in 2nd and 3rd level processing

However, product flows are not strictly following the horizontal line, but lead also to other value chain partners of other product lines.


3.2.3 (2) PPT presentation

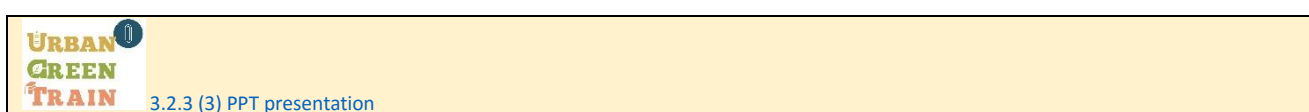
Please, now perform Assignment 3.2.3



Assignment 3.2.3.

Search websites of five direct marketing farms (in English or your native language). Please, briefly summarize the key selling strategies (on-farm shop, farmers' markets, delivery of boxes, booths, online shop, etc.) offered and how they attract the customers, e. g. emotions (nice pictures), stories, farm videos, etc.!

Follow the slideshow below:



The following table provides a brief overview of direct marketing methods and channels, which are summarized in the previous slideshow.

List of direct marketing methods and channels

	Short explanation
Sales booth with "cash box on trust"	Sales booth on farms, at streets or busy places without personnel/cashier, but a cash box on trust. These cash box on trust sales booths do often have a simple design. This is a promising start into direct marketing.
Sales automat	Fully automated sale of farm products; no personnel/cashier. Sales automats are mostly situated on-farm for easier surveillance.
Farm shop	Sale of farm products directly on the farm in a shop. Easy shops use bells, while more elaborated farm shops have opening hours like other shops. Farm shops require certain investments (place, cooling, shelves, parking lots, etc.) and personnel.
Self-picking fields	Products, mainly berries, but to some extent also vegetables, legumes, potatoes, and fruits, are harvested by the consumers. In return, the consumers pay less compared to products already harvested by the farm.
Mobile booths	Sales booths for direct marketing moving to places for marketing, like streets, squares, and market places. Mobile booths offer flexibility in terms of the location.
Farmers' markets	A group of mobile booths/stands/tables at frequently used centrally located places (in-/outdoors). Participating farmers offer products regularly (daily, weekly, twice a week, etc.) at the same place.
Web shop	Direct marketing farms are progressively using the internet for marketing. Via web shops, consumers are able to order products on the farm website. Two common ways exist for the exchange of products and money: Either the consumers pick up the goods on the farm or the farm offers delivery service.

Delivery services	Farmers deliver products directly to the consumers. Different contracts and channels between producer and consumer exist; most often are subscribed vegetable boxes. The delivery of subscribed boxes runs on periodic terms (weekly, every 14 days, monthly, etc.), while other delivery offers are as required and occasional. Occasional delivery is connected to web shop, email or phone orders.
Rent-a-field systems	Farmers rent already prepared and sown parcels to clients seasonally. A variety of vegetables and sometimes also other products (potatoes, legumes, fruits, berries) is cultivated by the clients; water, tools, and know-how is offered by the farmer.
Food assembly	A food assembly connects consumers and producers; organized by hosts. The hosts offer online platforms, where consumer orders products from farmers, who offer their products online in the food assembly. Additionally, the hosts organize the pick-up market, where several producers and consumers meet to transfer the goods.
Community Supported Agriculture	Community Supported Agriculture (CSA) is a community based farm financing / marketing form: The farmer sets up a comprehensive production plan, estimates the physical output and calculates the production costs. A group of persons pays a fixed sum per month / year and in return receives the whole harvest. All participating consumers cover together with their fixed payments the total production costs of the farm.
Farm gastronomy	A farm gastronomy offers farmers the possibility to process (cook/bake) some of the products and offer it in to guests, like cakes, full meals, breakfast, juices, soups, etc. Farm gastronomy services are often combined with on-farm shops.
Catering service	Catering service of processed food, e. g. to private clients - often elderly people -, to schools, kindergartens, public canteens, party services, etc.
Product sponsorship	People sponsor fruit trees, shares of fields, e.g. potato fields, pigs, milk cows or other farming activities. Some receive the harvest, while some also donate it to support the farmer.

Here you get more and state-of-the-art information including basic and general information, good-practice examples and recommendations for setting-up and strengthening short value chains in Europe:

<https://ec.europa.eu/eip/agriculture/en/content/innovative-short-food-supply-chain-management>

3.3 - Innovation in Urban Agriculture



Illustration of a Farmery. By Ben Greene

This chapter highlights innovations in urban agriculture. The various forms of innovations are particularly important because urban agriculture is adapted to specific urban challenges and opportunities. Innovation is taking place continuously, exploring the multiple functions of urban agriculture, including food security, income generation and environmental management.

Moreover, the required trajectories of innovation are highly differentiated between different urban agriculture types, their specific location in the (peri-) urban space and the societal needs to which initiatives aim to contribute.

The following article, presentation and questions give an overview of relevant aspects of innovation in urban agriculture, different types of innovation and the role of different actors and stakeholders in success innovation processes in urban agriculture.



Assignment 3.3

Please read the following article: [Innovations in Urban Agriculture](#) (By Van der Schans, Renting and Van Veenhuizen) and follow the slideshow below:



[3.3 PPT presentation](#)

After reading the article and going through the slideshow respond to the following questions:

1. Can you think of an urban agriculture innovation in your city?
2. Who are the users of this innovation? What are their specific needs?
3. What is their path from idea to acquire or use the innovation (product or service) to the end of life or discontinuation of use?
4. What are the constraints encountered?