URBAN AGRICULTURE AND SUSTAINABLE CITIES

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1. Introduction

At the end of the 20th century, humanity is involved in an unprecedented experiment: we are turning ourselves into an urban species. Large cities, not villages and towns, are becoming our main habitat. Urban growth is changing the face of the earth and the condition of humanity. In one century, global urban populations have expanded from 15 to 50% of the total, which itself has gone up from 1.5 to nearly 6 billion. The size of modern cities in terms of numbers as well as physical scale is unprecedented. In 1800, there was only one city with a million people, London. By 1990, the world's 100 largest cities accommodated 540 million people and 220 million people lived in the 20 largest cities, mega-cities of over 10 million people, some extending to hundreds of thousands of hectares.

Urban agglomerations and their resource uses are becoming the dominant feature of the human presence on earth, profoundly changing humanity's relationship to its host planet and its ecosystems. The cities of the 21st century are where human destiny will be played out, and where the future of the biosphere will be determined. It is unlikely that the planet will be able to accommodate an urbanised humanity that continues to draw upon resources from ever more distant hinterlands, or which uses the biosphere, the oceans and the atmosphere as a sink for its wastes at the current accelerating rates. The challenge faced is whether cities can transform themselves into self-regulating, sustainable systems - not only in their internal functioning, but also in their relationships to the outside world. Is it possible to make a world of cities viable in the long term – socially, economically, as well as environmentally? The answer to this question is critical to the future well-being of the planet, as well as of humanity. There can be no sustainable world without sustainable cities.

1.1 Cities and the environment

Many of today's cities function very differently from those we have inherited from history, and relationships with the environment are changing. Low transport costs, based on the ubiquitous use of fossil fuels and facilitated by

substantial government subsidies for transport infrastructure, often make distances irrelevant – plugging cities into an increasingly global hinterland. The actual location of settlements is also becoming less important as global trade treaties come to determine the fate of national and local economies. Today, urban dwellers don't really live in a *civilisation*, but in a *mobilisation* - of natural resources, people and products.

The concept of an urban ecological footprint can be used to help illustrate how surrounding rural and natural areas are being affected by cities. Ecological footprint analysis assumes that every category of energy and material consumption and waste discharge requires the productive or absorptive capacity of a finite area of land or water (Wackernagel & Rees 1996). The sum of all land and water required to meet material consumption and waste discharge of a defined population is that populations' ecological footprint on the earth. This does not have to coincide (and often does not) with the populations' home region. Ecological footprint analysis reveals the growing competing demands on natural capital, and it also raises the issues both of equity and the long-term sustainability of production. By establishing the ecological footprint of different life styles, infrastructure, consumption patterns and certain densities separately, it is possible to develop strategies to reduce environmental impacts and the depletion of natural resources. Local Agenda 21 cities are required to list activities to reduce the ecological footprint, while at the same time increasing the quality of life for the inhabitants. Food supplies to cities are an important component of the footprint of cities and a key issue in this context.

1.2 Cities and food

Cities require vast areas of land for their sustenance and have come to depend on large amounts of food being brought in from outside the land area they actually occupy. London, for instance, has a surface area of some 160,000 ha. With only 12% of Britain's population, London requires the equivalent of 40% of Britain's entire productive land for its food. In reality, these land surfaces, of course, stretch to far-flung places such as the wheat prairies of Kansas and Iowa, the soybean fields of Mato Grosso, the orchards of France and Spain, and the tea gardens of Assam or Mount Kenya. But this global dependence of Londoners has never been a big issue. Food is there to be bought and enjoyed – the environmental impact of food supplies, including the energy required for food production, processing and transport, is rarely discussed.

However, today's retailing and food distribution systems, relying on motorised transport and, increasingly, airfreight exact a heavy environmental toll in terms of fossil-fuel use, air pollution and damage to wildlife habitats through road building (SAFE Alliance 1994). The largest land surfaces required for feeding cities in developed countries are for producing grains, and animal feed such as maize and soybeans to meet the demand for meat. As countries with huge population, such as China and India, urbanise, worldwide demand for land to feed cities will continue to grow. Sooner or later, cities that have come to take large-scale food imports for granted may need to consider reviving agricultural production in urban areas or the urban fringe to reduce the demand for land surfaces elsewhere.

1.3 Urban sustainability

In a world increasingly dominated by cities, the international community is starting to address the issue of *urban sustainability*. The process began in Rio with Agenda 21 and continued at the 1996 UN City Summit in Istanbul. The 100-page Habitat Agenda, signed in Istanbul by 180 nations, states: "Human settlements shall be planned, developed and improved in a manner that takes full account of sustainable development principles and all their components, as set out in Agenda 21. ... We need to respect the carrying capacity of ecosystems and preservation of opportunities for future generations. … Science and technology have a crucial role in shaping sustainable human settlements and sustaining the ecosystems they depend upon."

It is recognised that cities nowadays use too many natural resources and produce too much waste. The ecological footprints of cities are stamping out the habitat of many species. The city's impact stretches far beyond its physical boundaries. Moreover cities are confronted with an increasing number of people and, therefore, an increasing number of mouths to feed. Along with other initiatives and activities, urban agriculture therefore has an important role in contributing to the future sustainability of cities.

2. Urban agriculture

2.1 Farming in cities today

Despite their inherent density, cities do have enormous potential for food growing. Smit et al. (1995) reported that:

The 1980 US census found that urban metropolitan areas produced 30% of the dollar value of US agricultural production. By 1990, this figure had increased to 40%. There are 80,000 community gardeners on municipal land in Berlin with a waiting list of 16,000. Singapore is fully self-reliant in meat and produces 25% of its vegetable needs. Bamako, Mali, is self-sufficient in vegetables and produces half or more of the chickens it consumes. Dar-es-Salaam, one of the world's fastest growing large cities, now has 67% of families engaged in farming compared with 18% in 1967. Presently, 65% of Moscow families are involved in food production compared with 20% in 1970.

These are remarkable figures given the neglect of agriculture in urban planning policy. Planners tend to think that urban food growing is a messy business, and have little understanding of peoples' need to grow food in cities. But for hundreds of millions of urban people, it is a vital component of their livelihoods and during hard times it is an important survival strategy, and city dwellers are increasingly trying to persuade planners to give them space for growing crops. This is true not only in developing countries, but also increasingly in the developed countries, particularly in cities where unemployment is endemic. In addition, many people like to spend part of their time growing things as a leisure pursuit.

In times of crisis, like war or recession, growing food in cities has always been essential to urban people. *Schrebergaerten* were started In Germany after the First World War, when city people had the choice to go hungry or to grow some of their own food. In the Second World War in Britain, the Dig for Victory campaign brought much urban land into cultivation. Today we face a new kind of crisis: chronically high levels of unemployment are a growing concern in some cities, forcing many people to adapt or adopt new survival strategies, including spending some of their time on growing food.

Urban agriculture therefore contributes to the sustainability of cities in various ways – socially, economically and environmentally.

2.2 Farming in cities and ecology: constraints and opportunities

In this section, we concentrate on the major environmental constraints associated with urban agriculture and its potential role to help improve the ecological performance of cities. One of the major constraints is obvious: the lack of space in cities for growing food. However, there are several advantages and opportunities to improve the environment and ecology of cities. Urban farming can help to create an improved microclimate and to conserve soils, to minimise waste in cities and to improve nutrient recycling, and to improve water management, biodiversity, the O_2 - CO_2 balance, and the environmental awareness of city inhabitants.

2.2.i Space for growing food

In the western world since the Second World War, few provisions have been made for space for urban food production. The economic boom of the last 40 years has led to the assumption that city people will *buy* food, not *grow* it themselves. But at a time when work sharing is widely seen as essential for assuring a dignified existence for large numbers of people, additional opportunities for people to create livelihoods for themselves are essential. Urban food growing is certainly one of the options.

In cities that have experienced industrial decline, provision of derelict land for food growing is certainly a planning policy option. In American cities such as Detroit and New York, thousands of acres of land have been given over to unemployed workers for food growing. In Britain, city-farm projects have been established on areas of derelict land in some 20 cities. In Germany, land in former coal-mining areas in cities such as Essen is being set aside for urban agriculture projects.

There has been concern about the suitability of contaminated urban land for food growing, and it has been suggested that it is prudent not to grow crops less than ten metres from busy roads, particularly in countries where lead fuel is still in use. Generally, land polluted by heavy metals, such as cadmium and lead, requires special precautions. However, research in the USA and the UK has shown that these problems can be tackled in a number of ways: firstly, maintaining a high pH with additions of plenty of lime, and high organic matter levels through additions of compost or manure helps to immobilise heavy metals in the soil.

The Chinese are famous for their highly intensive urban cropping systems and, to this day, many of their large cities are largely self-sufficient in food produced on *adjacent* land areas administered by them. Beijing, now a city of over 10 million people, still administers its own adjacent farmland extending to an area the size of Belgium. In Shanghai, only 20% of the land administered by the city authorities is actually built on; 80% of the land, mainly in the urban perimeter, is used for crop growing, making the city region self-sufficient in vegetables and producing much of the rice, pork, chicken, duck and carp. With their unique system of governance, Chinese cities administer vast adjacent areas of farmland and aim to be self-sufficient in food from this. Is this model of urban-rural linkages relevant to cities elsewhere in the world?

In many cities there are areas which are less suitable for housing, and often offer excellent positions to produce food. Dar es Salaam in Tanzania provides a good example. The city has a spacious urban pattern and many areas near the rivers are not suitable for housing, because of regular flooding in the rainy season. These areas are well suited, and well used, for growing food.

2.2.ii Microclimate improvement

If appropriately planned and integrated into urban design, urban agriculture can contribute to the comfort of citizens. Green spaces around apartment blocks and houses, as well as neglected spaces in the city, help to improve the physical climate because vegetation can:

help increase humidity, lower temperatures and introduce more pleasant odours to the city;

capture dust and gases from polluted air through deposition and capture by the foliage of plants and trees, and soils; and

help break wind and intercept solar radiation, creating shadow and protected places.

One good example is the city of Cairo, where air pollution has risen to dangerous levels. For this reason, urban green areas now have a high political priority. The Tree Lovers' Association aims to expand the green areas in Maeâdi. The Association takes charge of planting and caring for the trees in the location of the old canal in this district of Cairo. Another example is Sofia, the capital of Bulgaria, where growing of food around housing compounds, along riverbanks and in other vacant spaces where public green spaces have been neglected by the municipality has led to an increase in vegetation and an improved microclimate.

2.2.iii Conservation of urban soils

Creating fertile soil is not usually a problem in cities because, by definition, they are places where fertility accumulates in great abundance. There is little need to use chemical fertilisers, although in some cities like London, urban agriculture can also be highly chemical intensive. A great variety of materials are available that can be composted and incorporated into garden soil – crop residues, kitchen wastes, old newspapers, the leaves of city trees and even human faeces. The Chinese have long used a system of meticulously recycling and composting human and animal wastes, thus maintaining the fertility of their farmland by the most appropriate means. Whilst this system has been weakened in recent years, the Chinese are reluctant to abandon it altogether. Instead, they are exploring ways of upgrading sewage-recycling technology.

Urban farmers have always utilised the great variety of fertile materials they have found in cities. The best-known example is the vegetable growers in Paris who, until the end of the First World War, were famous for the abundance of their crops. They used to heap up to 0.3 m of horse manure on top of their vegetable beds every year, and used many different methods to control soil and air temperature. They were able to grow between three and six crops of fruit and vegetables a year, making a good living on no more than 0.75 ha. In Paris of a century ago, 100,000 tonnes of high-value out-of-season crops were grown on 1400 ha, around one-sixth of the surface area of the city, using about one million tonnes of horse manure. The crops were so abundant that they were even exported as far away as London. However, the introduction of motor-powered transport ended the supply of horse manure to the *marais*. In addition, more and more crops were brought in by train from the south of France.

Provided that organic amendments are not contaminated, the use of abundant fertile materials and the growing of trees, crops and other greenery in cities will help keep urban soils fertile. Natural soils are rich in life; there are numerous "recycling" systems at work in the top layers of the earth. Through urban agriculture, soil systems can be kept in balance. Examples of good practice can be found in Accra (Ghana) and Dakar (Senegal) where urban agricultural activities have shown a positive effect on stabilising the soil against water and wind erosion "Filao" plantation both hinders quick movement of sand through wind erosion and produces compost.

2.2.iv Waste and nutrient recycling

A key factor in urban ecology is the process of waste management and nutrient recycling. The *metabolism* of many traditional cities was *circular*, whereas that of most "modern" cities is *linear*: Resources are funnelled through the urban system without much concern about their origin and about the destination of wastes; inputs and outputs are treated as largely unrelated. Contemporary urban sewage systems are a case in point. They have the function of separating people from their wastes. Sewage, treated or not treated, is usually discharged into rivers and coastal waters downstream from population centres, and its inherent fertility is lost to the world's farmland. Today, coastal waters everywhere are polluted both by sewage and by toxic effluents, as well as the contaminated runoff arising from use of fertilisers and pesticides applied to farmland growing food for the cities.

Justus Liebig, a pioneer of modern chemistry in the 19th century, took a close interest in the history of urban food production and studied the environmental history of ancient Rome. For two centuries, much of Rome's grain supply was imported from North Africa, with a dramatic impact on the area's soil fertility. The minerals contained in the grain – nitrogen, potash, phosphate, magnesium and calcium – were removed from the farmland and, via Rome's Cloaca Maxima, flushed into the Mediterranean, never to be returned to the land of North Africa. Despite having studied Rome's mistakes, most modern cities have repeated this pattern. In a letter to Sir Robert Peel, Prime Minister of the UK in 1840, Justus Liebig wrote:

The cause of the exhaustion of the soil is sought in the customs and habits of the towns people, i.e., in the construction of water closets, which do not admit of a collection and preservation of the liquid and solid excrement. They do not return in Britain to the fields, but are carried by the rivers into the sea. The equilibrium in the fertility of the soil is destroyed by this incessant removal of phosphates and can only be restored by an equivalent supply. ... If it was possible to bring back to the fields of Scotland and England all those phosphates which have been carried to the sea in the last 50 years, the crops would increase to double the quantity of former years.

When London's authorities decided to construct a sewage disposal rather than a recycling system, Liebig decided that it was necessary to find ways to replace the fertility removed by cities from farmland by artificial means. He set about developing artificial fertilisers to keep the land feeding cities productive. Today, the use of artificial fertilisers is the norm all over the world. The systemic

problems inherent in this are well documented. For instance, coastal waters everywhere now contain both urban sewage as well as the runoff of mineral fertiliser applied to the farmland feeding cities. This is both a massive waste of nutrients as well as a major cause of eutrophication of coastal waters.

The linear metabolic system of most contemporary cities is unsustainable. It is profoundly different from the metabolism of nature's own ecosystems, which could be likened to a large circle: every output by an organism is also an input, which renews and sustains the whole living environment. Urban planners and educators should make a point of studying the ecology of natural systems. On a predominantly urban planet, cities need to adopt circular metabolic systems to assure their own sustainability and the long-term viability of the environments on which they depend. Urban *outputs* will need to be regarded as crucial *inputs* into urban production systems, with routine recycling and composting of organic materials for re-use on local farmland. Very up-to-date methods for recycling urban wastes into nutrients for urban and urban-fringe farming and gardening are now available to us.

Efforts for waste reduction require three different approaches: reducing the amount of waste, re-using what can be re-used, and recycling the remainder. Urban agriculture can play an important role in all three approaches. It can help to reduce the need for food packaging. Much of the packaging of food is cosmetic or its purpose is to get it safe and undamaged across long distances to its destination. Food-growing sites can be the repositories of much re-usable household waste. Old carpets, bits of polythene, wood, glass, rubber tyres and clothing may be used in production activities. Food growing also makes use of recycled materials. Organic waste accounts for 20% of household waste and, when composted, it can produce an excellent fertiliser.

The relation between urban agriculture and waste management is most pronounced in the use of organic wastes. Food production by livestock eating food remainders is a tradition in many Asian and African countries, but also in northwestern Europe. Observation of daily life in Hubli-Dharwad, India shows that keeping livestock in urban centres has some advantages, because there are sources of fodder, such as waste materials from hotels, markets and homes, and easily accessible markets for produce, particularly for fresh milk from urban dairies. The cycle of nutrients through the use of urban waste within Hubli-Dharwad (and in many other regions of India) is also a good example of urban-rural linkages. Such linkages include the sale of dung from cows, and the sale of

market waste to rural farmers. There are a number of advantages for the Municipal Corporation arising from these informal waste markets. These include the removal of much wet organic waste from the streets and bins, the revenue from selling waste, creation of more space at the dumpsites, and the use of dung as a cooking fuel reducing the demand for fuelwood and liquid petroleum gas (LPG). Although keeping animals in an urban area does have disadvantages, it can serve a useful role in solid-waste management.

Farmers in Accra (Ghana) are also well engaged in solid-waste recycling (see case study). The waste generated from crop farming (dried vegetables) is recycled and used as mulch and compost to enrich the soil. Waste generated from livestock farming, such as cow dung and chicken droppings, is the main source of fertiliser for vegetable farming. Livestock is fed on leftover food from restaurants or "chop bars". The skeleton waste from livestock is collected, cremated and processed into powder for feed and paints. In this way, re-use of wastes helps contribute to a well-functioning agricultural system.

2.2.v Water management

Agricultural activities in cities can indirectly improve urban water management, because green spaces with permeable land surfaces allow rainwater and runoff to drain through the soil. This is important because the growing areas of hard-covered surfaces in cities (e.g. streets, roofs and car parks) leads to increased volumes of runoff during storms, with risks of floods and landslides. The need for costly storm water sewers and drainage can be minimised when enough green space is available. To invest in urban agriculture, therefore, is just as necessary as developing a network of channels and drains.

The direct use of recovered wastewater for food production in cities can also improve the efficiency of water use – especially important in countries with limited water resources. Given the existing nature of most sewage systems, which combine wastewater with numerous pollutants, wastewater re-use requires significant investment in separation or treatment, and improved organisational capacity. Unfortunately, investments in water infrastructure and conservation measures are often not made because of unclear land rights. The case of Dakar, Senegal, however, demonstrates how a wastewater recycling system can be set up. There are two stations for the filtering of used water, combining collection points of solid waste to make compost. The recovered water is used to irrigate land. Recycling of wastewater is not without its problems though. In Cairo, environmental contamination of soils arising from use of untreated sewage water for irrigation is a serious problem.

Lack of water is a major problem to many, if not all, developing countries. For example, Hubli-Dharwad struggles as a result of a declining number of lakes and water tanks over the last 20 years, as the urban settlement has grown and tanks have been filled in and built over. Farmers in horticulture have responded to the shortage of water through the use of sewage water for the irrigation of vegetable crops. Wealthier farmers also often sink bore-wells to establish more secure water supplies, though this is inevitably affecting the water table of the area and the availability of water resources for other purposes.

Urban agriculture can also pose serious risks to water resources, for example, by leading to increased pesticide levels in groundwater. To reduce risks of pollution, in Cagayan de Oro in the Philippines (see case study), farmers have begun to use organic fertilisers. The local government launched an Integrated Pest Management (IPM) programme aimed at training and educating farmers. Thus far, however, only 27% of the participants have decreased the level of pesticide application.

2.2.vi Biodiversity

Urban agriculture can have a positive effect on increasing biodiversity. The urban environment is often already richer in flora and fauna than rural farmland; beehives in cities in some developed countries like the United Kingdom or Germany actually produce more honey than those in the countryside. This is because cities are often home to more trees and flowers than intensively-farmed agricultural land with large fields, limited crop diversity and little uncultivated area. In Cagayan de Oro (Philippines), a "Greening" project that constitutes part of the City Agricultural Office's (CAO) urban agriculture programme aims to increase the production of fruit and forest tree seedlings, specifically to improve the biodiversity in the city.

2.2.vii Global warming and atmospheric pollution

Urban agriculture can help contribute to reducing the net discharge of CO_2, one of the gases contributing to global warming, from activities in cities. If more cities were to produce food within their boundaries, bringing places of production and markets closer to each other, the transport of products can be reduced; this would contribute to reducing emissions of CO_2 and other polluting gases. Urban agriculture is also a means for reducing the net discharge of CO_2, because plants and trees capture CO_2. The captive capacity is at its highest in the growth phase of vegetation. Through agricultural activities in cities, urban ecosystems are kept continuously in their "primary production phase"; which

means that much more CO_2 per surface area is captured than in natural systems like tropical forests. In cities, however, much of the carbon stored in vegetation is likely to be quickly released through decomposition of organic matter and there may be little lasting benefit.

2.2.viii Environmental awareness

Urban agriculture can also change the perception of people in cities regarding food. The direct experience of growing food is largely absent in urban life in the "developed" countries; people harvest at the supermarket and most people have come to expect food to be packaged and even pre-cooked. As city people, they are hardly aware of the impacts of food consumption on the fertility of farmland supplying them, often from distant places. Too many people eat unhealthy "junk" food.

The recognition of urban agriculture among citizens is related to the size of production activities in this sector within the city (Barrs 1997). People will often have more interest in the food-growing process and the biophysical processes involved when crops are locally cultivated. Their knowledge can be expanded through agricultural and environmental training and education. This could increase the influence citizens have over the way food is produced. People will understand what sort of inputs are used in the farming process and they can quickly respond to any harmful environmental practices. Urban agriculture can re-educate us about the ecological base of food, and the links of food production to natural food chains, as well.

Skills associated with urban food growing and related enterprises are not necessarily simple or primitive. Organic growing techniques, for example, can make use of the results of innovative scientific research. If any of the produce is sold – processed or not – then the people involved will develop a whole range of sales and marketing skills of varying degrees of sophistication. And food growing is adaptable to nearly everybody's circumstances; from a window box to several acres, from conventional gardening to full-scale organic, from a few herbs and a tomato plant to bees, chickens and goats.

A good example of growing environmental awareness among citizens can be found in London, where local councils promote urban food growing through Local Agenda 21 strategies in almost all boroughs. There are various community projects aiming to improve the environmental performance of urban agriculture (see Box 1).

BOX 1: Becontree Organic Growers, London

This is a co-partnership of local people formed to revitalise an overgrown site in East London (see case study). The site is located next to allotments, many of which have fallen into disuse. Permaculture techniques will be used and the group hopes to keep much of the wildlife which has established itself on the derelict site by not removing all the nettles and weeds. It also hopes to boost honey production by doubling the three hives they already have. They will re-use and recycle resources, save energy by recycling water and using solar heating, monitor the local environment, conserve nature, use "green" buildings, work with students and local schoolchildren, and develop the local economy, particularly by using Local Employment Trading System (LETS) schemes. LETS is a scheme whereby people exchange goods or services instead of using money.

2.3 Prospects for urban farming: policies and approaches for the 21st Century

Urban farming is clearly alive and well in many countries. New marketing initiatives and approaches to promote participation in urban environmental management auger well for the future of the sector.

2.3.i Marketing initiatives

New ways of marketing urban produce are helping to advance the case for urban and urban-fringe agriculture. Clever marketing, as well as the desire of consumers to know where their food comes from, has a lot to do with the surprising growth of farmers' markets in the USA. Some 2000 new farmers' markets have been set up in US cities in recent years, often run by the growers themselves on the urban fringes of cities such as New York, Chicago, Detroit, Washington and San Francisco.

Nobody would suggest that all city people will want to grow food themselves. But urban agriculture also has the potential for bringing growers and consumers closer together. Vegetable box schemes, providing customers with a selection of vegetables in-season from locals farms, enjoy growing popularity.

Another scheme to bring together growers and local customers in a mutually beneficial arrangement is *community-supported agriculture*. This is becoming popular in both Europe and the USA: in such schemes, participants purchase a share in any produce in advance. Participants acquire the right to visit a farm and to help in the cultivation and harvesting of crops, if they wish. An additional benefit is that participants may also get a say in what crops are grown. Such schemes have proved that crops produced for local consumption can be very lucrative and that mutual arrangements between growers and consumers can also be environmentally and culturally beneficial.

2.4 Promoting integration and participation: challenges to urban planners and policy- makers

Urban agriculture can reduce the "ecological footprint" of cities when environmental goals are combined into an overall urban policy (Van Delft & McDonald 1998). Such overall urban policies would include environmental awareness-raising and wide public participation in urban development. In this section, examples are given of such integrated policies which provide examples of good practice and challenges to planners and policy-makers around the world.

Local authorities and specialists in Vancouver (Canada) have promoted progressive programmes on urban agriculture utilising wastewater/sewage streams from buildings (Barrs 1997). The wastewater stream from residential buildings represents a potential resource (water and nutrients) that can be used for urban food production. The "Solar Aquatic" sewage-treatment system introduced in Vancouver duplicates the natural purifying processes of meadows and wetlands, utilising bacteria, algae, plants and aquatic animals to produce treated wastewater ready for use to irrigate crops. The process is accelerated using controlled greenhouse conditions, reducing the amount of costly urban space required. Another approach adopted in Vancouver is to reduce the production of organic waste at source. This will be achieved by providing consistent composting messages across the region, and providing training in composting techniques, educational resources and support to member municipalities for the delivery of education and promotion programmes. The aim is to create greater awareness in Vancouver about the potential of organic waste for city farming.

The town of Kolding, Denmark, provides another example. A group of apartment buildings used to surround a piece of wasteland, which was occupied by old cars

and other pieces of waste. The area was considered to be unpleasant and unsafe. To regenerate the buildings and the surrounding space, a clever system has been developed. Nowadays, the wastewater from the buildings is being collected, together with the rainwater, and filtered through a cascade system. The system culminates in a glass pyramid that has been built in the middle of the neighbourhood. At the bottom of the pyramid, the final nutrients from the wastewater are used to breed fish. Other parts of the pyramid serve as greenhouse areas for plants and vegetables. Some people have now found a green job in the pyramid, and are working in the greenhouse. The area has become a very nice place for the inhabitants to meet and relax and also for children to play, especially because of the visual and acoustic effects of the flowing water.

Other examples of urban agriculture find their origin in community spirit and existing strong social cohesion. This co-operative spirit can be found in many developing countries. An example is city farming in Albania (Chisholm 1996). The end of communist rule was accompanied by the destruction of many irrigation systems, greenhouses and other infrastructure. On account of poor living conditions, people were forced to take their own initiatives in adapting their survival strategies. Agriculture for self-consumption and trade are fundamental sources for food security. Many people live in apartment buildings and have no access to land, so they grow tomatoes in old bowls on their balconies. Several people have even managed to create a flourishing garden on rooftop spaces. Onions, garlic, tomatoes and grapes have transformed ugly buildings into nicer places. People made use of their local environment, fully exploiting their own limited devices. There are even persons who raise pigs in their houses. Despite bad odours and noise, neighbours don't complain because they understand that people need to survive. Almost every small space of land is used productively. Urban agriculture in a developing country like Albania shows that, despite the limited resources available, opportunities exist to make human settlements sustainable. This is a lesson to be learned in industrial countries.

2.5 Implications for urban policies and programmes

Traditionally, agricultural policies – whether oriented towards export production or local food production – have focused on maximising short-term profits rather than on long-term environmental management of local resources. Many urban managers and planners think of their city more in terms of housing, transport,

commercial services and industry, rather than in terms of agriculture, which generates relatively low yields (Girardet 1992).

Generally, urban agriculture suffers from a combination of political restraints, that include (Van den Berg & De Zeeuw 1998):
restrictive urban policy, laws and regulations (due to the mainly illegal status of urban agriculture);
uncertainty about property rights of land;
lack of supportive services;
unfeasible implementation of environmental technologies; and
lack of organisation and representation of urban farmers.

As a principal issue, it is proposed that urban farmers and consumers should receive more information and training on environmental risks (e.g. wastewater treatment and composting techniques) because more urban people will be engaged in growing food and more cities are beginning to try to use their agricultural waste to curb pollution and optimise freshwater usage (Reijntjes et al. 1992).

There is a need to stimulate dissemination of good practices in urban agriculture to farmers and consumers. In this respect, Barrs (1997) envisions an important role of policy-makers. They are, or should be, able to support farmers and consumers to build up knowledge about the opportunities of urban agriculture to protect city ecology. The key issue is how opportunities of urban agriculture can be translated into sustainable initiatives. National governments need to reduce the environmental risks of (urban) agriculture by adopting pesticide reduction targets, and promoting biological pesticides and fertilisers. Finally, governments must also provide funds for information and grant-aid schemes to assist conversion to less chemically-intensive systems. At first sight, small-scale farmers in developing countries need appropriate strategies and production techniques that lead to higher yields. However, many farmers recognise that they cannot continue to increase yields, because more resource-intensive production methods inevitably lead to the depletion of available natural resources.

To support farmers in making their production systems more productive and sustainable, development workers – in their turn – need suitable instruments for co-operation with these farmers. The question is how development workers can support farmers in urban agriculture to protect or improve city ecology. Reinforcing farmers' capacity to develop and manage technology is of vital

importance for the actual creation of environmentally-friendly ways of farming. There may be many steps required to reach that objective.

A fundamental step in order to set the right conditions for city farming is to develop an urban agriculture plan and policy, recognising the interrelated nature of food, agriculture, health and ecology by forming a municipal working group that can deal with food issues from a total system perspective. This could involve, among others: the health department, planning department, engineering, local economic development, water management and waste management. Following this, the urban agriculture plan should be incorporated into the land-use planning system. This implies that urban agricultural activities are recognised as major components of green zoning systems, for which a dedicated policy must be formulated, developed and implemented.

It is hard to regulate good practice, but labelling food to show how and where it is produced at least allows people to make informed food choices and to support sustainable approaches to production. Programmes such as the provincial "BUY BC" campaign in British Columbia, Canada, encourage people to purchase locally-grown food and other products. In British Columbia, there are strict guidelines for production, operation and farm management. Only those farms certified by an approved certification agency (in this region, British Columbia Association of Regenerative Agriculture, BCARA) are allowed to market and label their products as "organic" and attach the "BC Certified Organic" label.
As urban agriculture becomes more sophisticated, lending institutions will become aware of the financial possibilities involved. However, this is not yet generally recognised. Difficulties in obtaining sufficient capital and credit to start an urban food-production business hamper all sorts of initiatives. However, government bodies can offer favourable conditions to city farmers in less developed countries regarding urban agriculture, through for instance the following policy interventions (Barrs 1997):
start-up grants/loans for small urban agricultural businesses;
subsidisation of inputs such as municipal compost for a limited time to stimulate projects.

If the potential of urban agriculture is going to be realised, much more has to be done than what is happening in many cities at present. What is needed is a policy for the city that focuses on encouraging the productivity of open urban space, integrating the various components necessary to make urban agriculture healthy and sustainable, and combating bad practices where necessary. Urban agriculture

can have a positive effect on the availability of healthy, nutritionally balanced and culturally appropriate food, in particular for low-income groups of the urban population. Since food is a basic requirement for a healthy life, this should be seen as an absolute priority in urban policies. Local food production may never replace the need of a decent level of income, but it can substantially contribute to adequate and culturally appropriate sources of human nutrition.

3. Conclusion

All in all, prospects for urban farming are good in many parts of the world. However, it is crucial that planners start recognising the importance of urban farming in the rich mix of activities that characterise modern cities. As the world urbanises, greater local food self-reliance, using nutrients accumulating in our cities, must be regarded as an important aspect of sustainable urban development. Together with initiatives on energy efficiency, high resource productivity and policies for containing sprawl, urban agriculture has an important contribution to make towards shaping the cities of the future.

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